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FACILITIES CRITERIA (FC)

NAVY OPERATIONAL SUPPORT CENTER



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FACILITIES CRITERIA (FC)

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NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**

FOREWORD

Facilities Criteria (FC) provide functional requirements (i.e., defined by users and operational needs of a particular facility type) for specific DoD Component(s), and are intended for use with unified technical requirements published in DoD Unified Facilities Criteria (UFC). FC are applicable only to the DoD Component(s) indicated in the title, and do not represent unified DoD requirements. Differences in functional requirements between DoD Components may exist due to differences in policies and operational needs.

All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC (replace w/ FC), the SOFA, the HNFA, and the BIA, as applicable.

Because FC are coordinated with unified DoD technical requirements, they form an element of the DoD UFC system applicable to specific facility types. The UFC system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applicable to the Military Departments, Defense Agencies, and the DoD Field Activities. The UFC System also includes technical requirements and functional requirements for specific facility types, both published as UFC documents and FC documents.

FC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet site listed below.

FC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Refer to UFC 1-200-01, *General Building Requirements*, for implementation of new issuances on projects.

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FACILITIES CRITERIA (FC)

NEW SUMMARY SHEET

Document: FC 4-171-06N, Navy Operational Support Center

Superseding: None.

Description: This FC provides design criteria for Navy Operational Support Centers in support of the Navy mission. It outlines all of the required functional spaces and optional spaces in the facility, and it provides guidance on key dedicated Navy spaces for Armed Forces Reserve Centers.

Reasons for Document: This FC was developed to provide design requirements for Navy Operational Support Centers to accomplish the following:

- Assist planners to understand the facility requirements to ensure accurate space programs and budgets
- Provide architects, engineers, and construction surveillance personnel with the essential, minimum requirements for the design and construction of Navy Operational Support Centers.
- Assist Navy and Marine Corps Reserve personnel to understand the operational intent of the facility design.

Impact: This FC identifies the basic requirements for Navy Operational Support Centers. This FC will reduce the initial cost of design and reduce costs associated with redesign of facilities that do not meet minimum standards. The design should also streamline facility operations.

Unification Issues: None.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE

This FC provides requirements for evaluating, planning, programming, and designing Navy Operational Support Centers (NOSC). The information in this FC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental Unites States (CONUS) and outside the continental US (OCONUS). It also applies to the procurement of design-build services for the above noted projects. This FC is not intended as a substitution for thorough review during design by individual Program Managers and Operations Staff.

1-2 APPLICABILITY.

This FC applies to all military service elements and contractors involved in the design, and construction of NOSC.

1-3 USERS OF FACILITY.

Users will include both able-bodied and disabled individuals. Design facility in accordance with ABA accessibility guidelines included in UFC 1-200-01, *General Building Requirements*. The following are the typical facility users:

- Commanding officer,
- Executive officer,
- Senior enlisted personnel,
- Full-time support,
- Reserve unit commanders and reservists
- Recruiter, and
- Civilians

1-4 GENERAL BUILDING REQUIREMENTS

Comply with UFC 1-200-01, *General Building Requirements*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this FC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-5 PHYSICAL SECURITY

That part of security concerned with physical measures designed to safeguard personnel; to prevent or delay unauthorized access to equipment, installations, material, and documents; and to safeguard them against espionage, sabotage, damage, and theft.

1-5.1 Physical Security System.

A physical security system is comprised of people, equipment, and operational procedures that control access to critical facilities or assets. Electronic Security Systems and security lighting are two of the elements that comprise the equipment component of a physical security system.

1-5.2 Physical Security Requirements.

NOSC may contain assets that must be protected against damage or theft. The requirement to protect assets such as classified materials or arms are defined in SECNAV and OPNAV Instructions.

1-5.2.1 Defining Requirements.

For assets not defined in policy, the requirements are determined by evaluating the value of the assets and the threats to those assets. Defining the requirements of a physical security system and its components involves an interdisciplinary team. The team should consider all interests relating to a project to determine how security fits into the total project design. The specific membership of the team will be based on local considerations, but in general, the following functions should be represented; facility user, antiterrorism officer, operations, security, logistics, architecture, engineering, life safety, and others as required. This team identifies the design criteria, which includes the assets to be protected, policy based requirements, threats to the identified assets (the Design Basis Threat), and the level of protection to be provided to protect the assets. In addition, the team must identify user constraints such as appearance, operational considerations, manpower requirements or limitations, energy conservation and sustainment costs when establishing the physical security system requirements. For information on Security Engineering Planning, refer to UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*.

When required, integrate physical measures into the site, building, room(s), or area(s) as applicable. Refer to specific design criteria and functional data sheets (FDS) for specific area requirements.

1-6 REFERENCES.

Appendix A contains a list of references used in this document. The publication date of the code or standard is not included in the reference. In general, the latest available issuance of the reference is used.

1-7 GLOSSARY

Appendix C contains acronyms.

CHAPTER 2 TECHNICAL REQUIREMENTS

2-1 SCOPE OF FACILITY

The NOSC size is determined by the number of units, the number of reservists, the number of full-time staff, and other exclusive spaces as determined by a detailed planning analysis, which, in turn, will define the authorized facility spaces and functions reflected on the 1391 project documentation. In general, administrative, medical and support spaces are either fixed sizes or increase in relatively small increments based on unit size. The primary increase in facility size occurs in the unit areas.

2-2 PROGRAM AREAS

The Program Area headings shown in Table 2-1 are described in the following sections. The individual functional program spaces are listed and described in Table 2-1, and addressed in greater detail in Chapters 2 and 4.

2-2.1 Administrative Support.

These areas accommodate the day-to-day functions of the facility and are occupied during normal facility operating hours by full-time staff.

2-2.2 Medical Suite.

These spaces are provided when a medical unit is assigned. The suite of spaces will vary in scope depending on where the NOSC is located and the availability of other nearby medical facilities. If medical spaces are not included because of an agreement to allow use of medical facilities on base, the agreement must be well documented.

2-2.3 Fitness Spaces.

Before fitness spaces are included, determine if they are allowed by CNIC Instruction 1710.1. If allowed, they must conform to this instruction and the DD1391.

2-2.4 Unit Areas.

The unit areas provide the training, administrative, and storage requirements for the specific reserve units assigned to the NOSC. An individual unit can vary in size from around 15 reservists to over 100 reservists. These spaces are typically only used during drill weekends, and each unit drills once a month. Up to two drill weekends per month can be conducted, so these spaces are typically shared by units drilling on different weekends. The space is designed to accommodate the largest weekend drilling population, not the entire unit population.

2-2.5 Drill Hall.

This area provides a room to accommodate large groups, typically more than one unit at a time, for various activities such as testing, muster, training, drill assessment, team

building, basketball, other physical fitness, messing, and ceremonies. It includes storage, support, and toilet spaces, the latter designed to facilitate urinalysis testing.

Table 2-1. NOSC FUNCTIONAL PROGRAM AREAS

Functional Program Area	Description/Service Exceptions
Administrative Support	
ID Check	Area immediately off the main entry vestibule with a transaction counter to the full-time staff area and an entrance to the recruiting office.
Recruiting office	Small suite for recruiting officer(s) to meet with prospective reservists. Includes administrative, meeting/interview, and display spaces. Provide separate room to accommodate a table and chair for knowledge testing adjacent to the recruiting office.
Quarterdeck	The Quarterdeck is near the main entry and serves multiple functions: Central circulation node, formal gathering area for small staff ceremonies, and display area for flags and unit memorabilia.
Full-time staff spaces	The following full-time staff areas work as a suite of spaces.
Commanding Officer office	Private office adjacent to the open office area with an entrance from a separate, dedicated vestibule that serves the CO office and the family services office. Office includes a private toilet and shower.
Executive Officer office	Private office (optional, only for larger commands).
Senior Enlisted office	Private office.
Open office area	Space for workstations, secure personnel files, other files, printers, and general work space.
Service counter/waiting area	The service counter provides access between the waiting area and the open office area. The waiting area is a vestibule between the service counter and the main entry corridor, typically with a glass storefront/door to the corridor.
ID service area (if required)	Sub-space of the open office area and directly adjacent to the service counter. Includes a digital camera and equipment for creating and issuing ID cards.
Navy family services office	Private office with desk and small three- to four-person conference area off the entry vestibule serving the CO office.
Copier/mail nook	Area off a main corridor and with easy access from the full-time staff spaces with copiers and secure individual mail boxes for units and command staff.
Mail distribution	Sub-space of the open office area located directly adjacent to the copier/mail nook and with a mail sorting table.

Table 2-1. NOSC FUNCTIONAL PROGRAM AREAS

Functional Program Area	Description/Service Exceptions
Mail receiving	In a NOSC located off-base, an additional room must be provided that meets antiterrorism requirements per UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*.
Conference room	VTC-capable conference room adjacent to the CO's office and full-time staff area.
Funeral honors office	Space for staff workstations and coffin storage near/adjacent to Drill Hall
Distance learning center	Classroom configured to accommodate remote instruction with computers, microphones and cameras. Can be two equally sized rooms if desired.
Mess	Warming/staging kitchen for catered events with a direct adjacency to the drill hall, and, if possible, an exterior door.
SIPRNET	Secure private office with SIPRNET capability.
Supply storage	Space to store and fit new uniforms and store administrative supplies. Includes a private dressing room, workstation for the supply personnel, and storage shelving.
Fitness room (when allowed)	Space for several cardio and weight machines. If fitness spaces are included in the enacted DD1391, confirm that they are authorized by CNIC Instruction 1710.1.
Public toilets	Male and female toilets with associated janitor's closet(s) sized per code. Located near the distance learning center, service counter and waiting area, and medical suite, if included.
Shower/locker room	Male and female facilities for use by full-time staff and reservists. Includes toilet facilities.
Break room	Space for vending machines, counter with sink, microwave, refrigerator and a small seating area.
Recycling area	Space for the collection and storage of trash and recyclable materials adjacent to the service entrance with an exterior exit. Locate near Mess.
Telecommunications closet	LAN and telecom space per the paragraph in Chapter 3, "Electrical Design".
NMCI closet	NMCI equipment.
Medical Suite	
Medical office/reception	Includes a reception counter with a small waiting area and staff administrative areas.
Check-in/admitting/vision	Private area off of reception where information such as blood pressure, temperature, etc. can be obtained. Also includes vision testing.
Medical exam room	Private exam space. Typically, at least one exam room is provided in the NOSC even if other medical facilities are available.

Table 2-1. NOSC FUNCTIONAL PROGRAM AREAS

Functional Program Area	Description/Service Exceptions
Dental exam room	Similar to medical exam room but with dentist chair and equipment. Dental cleaning is not performed. Typically not included if other medical facilities are available.
Doctor library and transcription room	Open office area for doctor/dentists with medical resource library.
Dental x-ray	Divided space with controls on one-side of a protective screen and the x-ray machine/chair on the other side. Typically not included if other medical facilities are available.
Audio room	Sized for one to two reservists to undergo hearing tests. Enclosed area includes the sound booth with adjacent control area. Typically not included if other medical facilities are available.
Immunization room	Includes area for storing and administering shots. Typically not included if other medical facilities are available.
Blood draw	Area for drawing, initial processing, and storing blood. It is also directly adjacent to the medical toilet to accommodate processing of urine samples. Typically not included if other medical facilities are available. Electrically monitored refrigerator needed.
Medical toilet	Single-use toilet with a carousel to the blood draw room. Typically not included if other medical facilities are available.
Medical file room	Securable room with secure medical and dental file storage.
Medical supply room	Includes shelving for medical supplies. Typically not included if other medical facilities are available.
Medical equipment storage	Storage for larger items such as CPR dummies, back boards and other deployable medical supplies.
Unit Areas	
Unit classrooms	Classroom(s) sized for between 25 and 100 reservists.
Unit administrative area	Mix of private offices and open office area. Each unit gets two private offices (CO and senior enlisted) and three workstations.
Unit storage	One storage area per unit for miscellaneous unit supplies with access from the unit administrative area.
Drill Hall	
Drill hall	Large room for various activities such as testing, muster, messing, and ceremonies. Includes either a permanent or portable stage. Locate with direct access to the mess and urinalysis area.

Table 2-1. NOSC FUNCTIONAL PROGRAM AREAS

Functional Program Area	Description/Service Exceptions
Storage	Storage behind stage for tables, chairs, and AV equipment.
Urinalysis area	Separate male and female toilets directly off of drill hall. Includes enough space for observation for testing.
Support	Dedicated mechanical room.

2-3 SIZE DETERMINANTS.

2-3.1 Navy Operational Support Centers.

The NOSC space program is determined by a detailed planning analysis to be conducted according to UFC 2-000-05N (P-80), *Facility Planning Criteria for Navy/Marine Corps Shore Installations.* Information regarding the use of the interactive Space Planning Spreadsheet for establishing authorized space allowances in NOSC projects can be found in Appendix B to this document. The paragraph entitled, "Layout and Adjacencies" in Chapter 2, provides additional information for how the spaces are broken down and configured and must be reviewed during the planning and design process.

Support spaces identified on Table 2-1 and elsewhere in this FC may not be specifically identified in the final space program if their space allowance is included in the net-to-gross multiplier. However, they are included here to identify required adjacencies or design elements. Note that the shower/locker room is programmed space, but space for the public and unit toilets will come out of the net-to-gross multiplier.

2-4 LOCATION DETERMINANTS.

Determine the most appropriate and cost-effective location for a NOSC based on the following factors. Ensure the availability and capacity of required utilities and the compatibility of the mass/scale of the facility relative to adjacent structures.

2-4.1 Access.

Locate the NOSC to be easily accessible to the users, including potential recruits and active reservists. If the NOSC is located on an Installation, locate it as near the main Installation entrance as possible. Provide adequate parking as close to the facility as possible within antiterrorism (AT) requirements.

2-4.2 Complementary Facilities.

Locate the NOSC near other potentially complementary functions, such as a fitness facility, large parking areas, medical facilities, and a dining facility. Any adjacent parking

facilities that are intended to be shared must be available on weekends when the NOSC parking demand is highest.

2-4.3 Sustainable Design.

The location of a facility can have a significant impact on achieving sustainable design rating points. Consider issues such as brownfield redevelopment, access to public transportation, building orientation, and reuse of existing paving and hardscape when selecting a site.

2-4.4 Cost.

These facilities must be designed with the objective of achieving the lowest life cycle cost over a 40-year period. To do so, the project's design program must adequately define the scope and performance requirements and match those needs against a budget. Conversely, the budget must adequately support an appropriate and high-quality program and the performance requirements outlined and identified in this FC.

Note that additional Navy mission funds may be required for the computers and data outlets in the Distance Learning Center. This additional funding must be budgeted separately and should include IT installation, servers, and terminal connections. Confirm requirements with Region Resfor N6 for each project. Regardless of whether or not the computers and data connections are funded, the Distance Learning Center will be designed and outfitted with the VTC capabilities as indicated in Chapter 4.

2-5 LAYOUT AND ADJACENCIES.

The appropriate layout and adjacencies of the NOSC and key subareas are illustrated in Figures 2.1 through 2.3. These diagrams do not convey a building shape. Required adjacencies may be accommodated vertically. If a multi-story facility is required, unit areas will work most efficiently on the upper levels.

Figure 2-1. NOSC Adjacencies

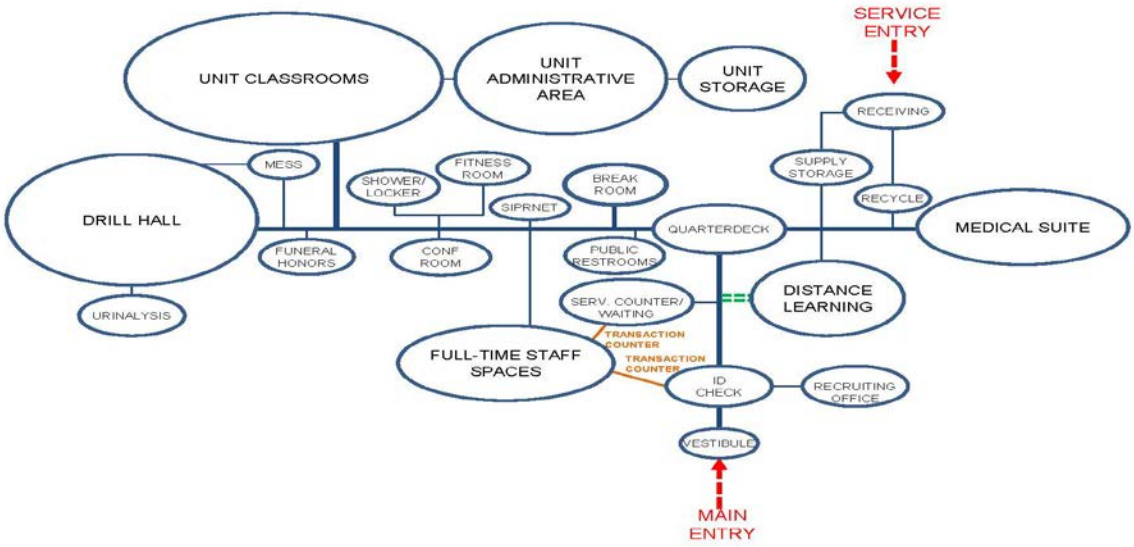


Figure 2-2. Full-Time Staff Spaces Adjacencies

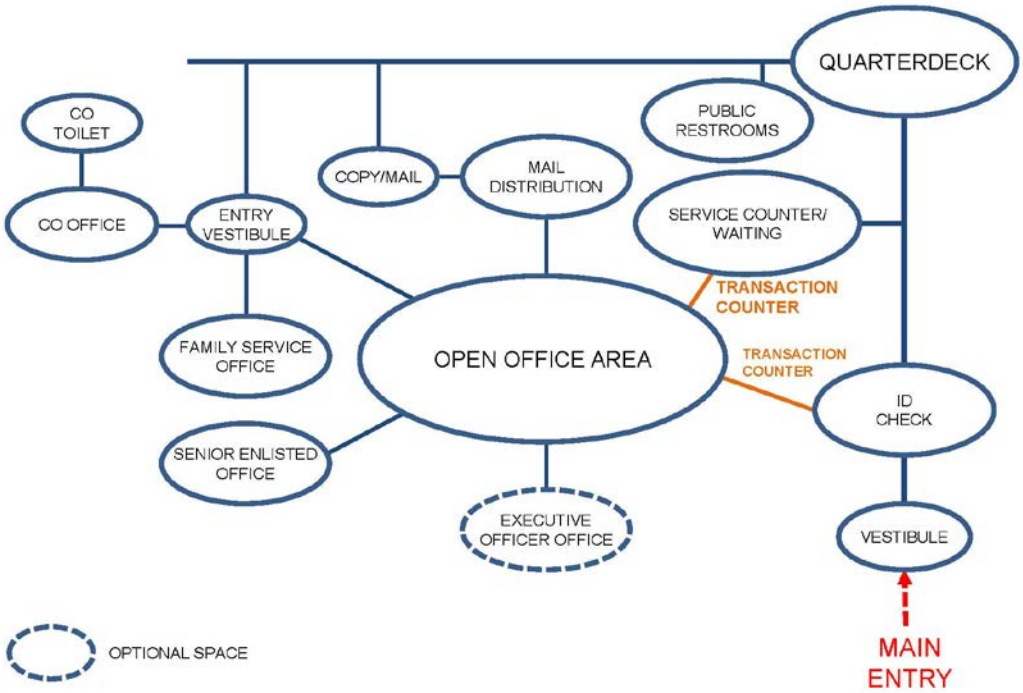
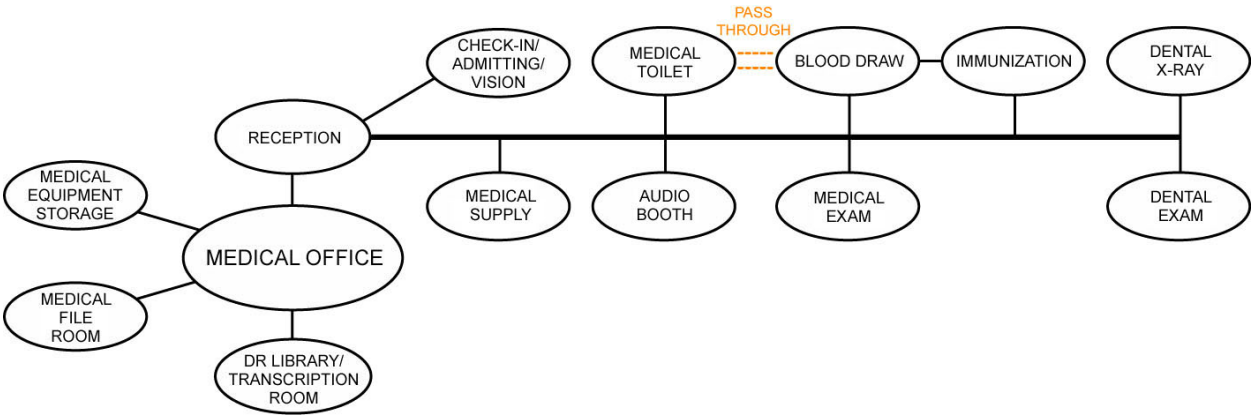


Figure 2-3. Medical Suite Adjacencies



2-5.1 NOSC in an Armed Forces Reserve Center.

When a NOSC is located within an Armed Forces Reserve Center (AFRC), the spaces identified in Table 2-1 must be dedicated Navy spaces, not shared. These spaces have been broken down by those that are required in all AFRCs and those that are optional. Desired adjacencies are also identified. See Table 2-2.

Table 2-2. Dedicated NOSC Spaces In An Armed Forces Reserve Center

NOSC Functional Program Area	Desired Adjacency/Proximity	Required/Optional
ID Check	To main entry and open office area	Only optional if building layout precludes a separate Navy entrance
Recruiting office	To main entry	Required
Quarterdeck	To full-time staff areas and distance learning center	Only optional if building layout precludes a separate Navy entrance
Public restroom	To quarterdeck and break room	Required
CO office	To open office area and quarterdeck (if provided)	Required
Executive Officer office	To CO office and open office area	Based on number of Navy reservists
Senior enlisted office	To CO office and open office area and quarterdeck (if provided)	Required
Navy family service office	To CO office and open office area	Optional based on Navy mission
Open office area (incl. service area, copier/mail nook and mail distribution)	To CO office and quarterdeck (if provided)	Required
Conference room	To CO office and open office area	Required
Funeral honors office	To drill hall	Required
Distance learning center	To quarterdeck (if provided)	Required
Dedicated IT room and SIPRNET	SIPRNET to CO office	Required
Supply storage	None required	Required
Shower/locker room	To full-time staff areas	Space for Navy personnel is required, but dedicated Navy space is optional
Medical Spaces	To other medical spaces	The scope of the medical spaces will depend upon both facility and program factors
Unit administrative areas (incl. private offices and workstations)	To unit classrooms	Required
Unit storage	To unit administrative areas	Required

2-5.2 Unit Classrooms.

Unit classrooms are designed to flexibly accommodate the variable unit sizes as noted in the paragraph in Chapter 2 entitled, “Functional Space Relationships”. Total classroom area is based on the number of reservists in the largest weekend drill population as described in Appendix B, but this area must be configured into rooms as follows:

2-5.2.1 Quantity of Rooms.

Round the weekend drilling population up to the closest multiple of 100 and provide one room for every 100 reservists as follows:

- Provide one room for up to 100 reservists.
- Provide two rooms for 101 to 200 reservists.
- Provide three rooms for 201 to 300 reservists.
- Continue as such to accommodate the largest weekend drill population.

2-5.2.2 Sizing of Rooms.

The final sizing of the individual classrooms must conform to the following criteria: Each room is sized to accommodate multiples of 25 reservists, is never larger than needed to accommodate 100 reservists, and is never smaller than needed to accommodate 25 reservists. If only one room is provided, it must accommodate 100 reservists. Any room larger than for 25 reservists must be partitionable into sections sized for 25. Within these parameters, the Activity must select the room size options that result from these criteria. Note the following examples:

- For up to 100 reservists in a weekend drill population, provide one classroom sized for 100 reservists. This classroom must have three operable walls to create four sections, each to accommodate 25 reservists.
- For 101 to 125 reservists, provide two separate classrooms with a total area sized for 125 reservists. Room sizes could be for 75 (with two operable walls) and 50 (one operable wall) or for 100 (three operable walls) and 25 (no operable walls).
- For 125 to 150 reservists, provide two separate classrooms sized for 75 and 75 or for 100 and 50, with the appropriate operable walls.
- For 150 to 175 reservists, provide two separate classrooms sized at 100 and 75, with the appropriate operable walls.
- For 175 to 200 reservists, provide two separate classrooms, each sized for 100 reservists and each with three operable walls.
- Beyond 200 reservists, a third room is added and the same criteria are applied to the individual room sizing.

2-6 FUNCTIONAL SPACE RELATIONSHIPS.

See the Functional Data Sheets in Chapter 4 for additional information on the space types and their relationships to each other.

2-7 ALTERATIONS TO EXISTING FACILITIES.

2-7.1 Navy Regulatory Authorities.

Authorities are contained in OPNAVINST 11010.20G, *Facilities Projects Manuals* and NAVFACINST 11010.45, *Comprehensive Regional Planning Instruction.* Prior to planning alterations to an existing facility to convert it to a NOSC, the activity should consult the following: Military Construction Navy Reserve (MCNR) Program Manager at Commander, Navy Reserve Force Command N5.

2-7.2 Other Considerations.

If other facilities are being considered for conversion to a NOSC, ensure that the structure can accommodate the required functions, such as the Drill Hall and/or unit areas. Also ensure adequate site space for parking. Whether planning a conversion, alteration, addition, or new construction, all the criteria in this FC must be met by the resulting facility.

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CHAPTER 3 DESIGN

3-1 GENERAL.

Use UFC 1-200-01, *General Building Requirements* for Applicability of model building codes and referenced government criteria. UFC 1-200-01 identifies through references key unified facility criteria and requirements including accessibility, antiterrorism, security, sustainability, safety, discipline-specific, and building systems. The design requirements in this FC are to be used in addition to UFC 1-200-01 and referenced UFC's and government criteria.

3-1.1 Medical Facility Requirements.

Design and construct the medical portions of the facility to comply with applicable portions of UFC 4-510-01, *Design: Medical Military Facilities,* particularly in the paragraph in Chapter 4 entitled, "Architectural". UFC 4-510-01 is a multidiscipline UFC; therefore, all architectural/engineering disciplines need to be aware of the requirements.

The medical spaces in a NOSC are not classified as clinical spaces, and treatment and ambulatory services are not provided. The NOSC clinic performs non-therapeutic activities related to the health of the personnel served, such as physical examinations, immunizations, medical administration, preventive medicine services, and health promotion activities to support the military mission. The Navy Bureau of Medicine and Surgery (BUMED) approval is not required for medical spaces in a NOSC.

3-2 STRUCTURE.

The NOSC must comply with UFC 3-301-01, *Structural Engineering*.

Provide clear spans for the drill hall, classrooms and Distance Learning Center.

3-3 ARCHITECTURE.

In addition to UFC 3-101-01, *Architecture*, the following requirements are specific to NOSC.

3-3.1 Stories.

Single-story structures are preferred for NOSCs. Site constraints may drive the need for multi-story structures. If a multi-story structure is required, ensure the appropriate adjacencies are maintained. See the paragraph in Chapter 2 entitled, "Layout and Adjacencies", for more information on the required adjacencies.

3-3.2 Exterior Design.

The building design must comply with Command and Installation architectural standards and incorporate the local geographical and cultural environment.

3-3.2.1 Entrance.

The main entrance serves as the architectural focal point of the exterior design for a standalone NOSC. Provide a vestibule at the main entrance. Provide flooring features for cleaning of footware. In climate appropriate areas, the vestibule must incorporate an airlock to act as a buffer from the exterior weather.

Provide a canopy (or a recess) at required egress doors to ensure that doors can open completely without obstruction.

3-3.2.2 Exterior Finishes.

Exterior finishes must be durable and low-maintenance. Coordinate exterior finishes with the interior design standards noted in the paragraph in Chapter 3 entitled, “Interior Design”.

3-3.2.3 Windows/Natural Light.

Provide for the admission of natural light in the design of the facility window systems and in the design of the overall footprint and floor depth. Select furniture systems that maximize the admission of natural light into the facility. The goal should be to achieve the LEED® “Daylight & Views” points.

In designing for natural light admission, coordinate with the paragraph in Chapter 3 entitled, “Electrical Design”.

3-3.3 Interior Design.

In addition to UFC 3-120-10, *Interior Design*, the following requirements are specific to NOSC.

3-3.3.1 Countertop and Casework Design.

Counters, casework, and cabinets must be of high-quality and durable construction. Specify Architectural Woodwork Institute (AWI) Premium or Custom for finishes per *AWI Quality Standards Illustrated, Current Edition.* Casework, cabinet doors, and drawer faces must be veneer panel core. Doors, drawers, and casework faces must be plastic laminate at a minimum. Where no water source is present, countertops must be plastic laminate as a minimum with self-edging. Where a water source is present, countertops must be solid surface/solid composite plastics only. Specify .75-in. (20-mm) minimum thickness for plywood, plywood backing, and solid wood panels.

3-3.3.2 Finishes.

Finishes should take into account the intended uses and be highly durable and require low maintenance. They must meet the requirements listed in NFPA 101, *Life Safety Code* and UFC 3-120-10, *Interior Design.*

3-3.3.2.1 Moist Climate Considerations

In moist climates, do not cover the inside of exterior walls with impervious materials such as mirrors or vinyl wall coverings to help preclude mold development in the wall.

3-3.3.2.2 Finish Criteria

For finish criteria in specific areas, see the Functional Data Sheets in Chapter 4.

3-3.3.2.3 Vinyl Composition Tile

Vinyl composition tile (VCT) is not permitted in a NOSC.

3-3.4 Acoustics.

Provide acoustical design to prevent sound from noisy spaces such as corridors, toilets, elevator machine rooms, and mechanical rooms from having negative impact on the adjacent spaces.

At a minimum, provide the required sound transmission coefficient (STC) ratings identified in Chapter 4 Functional Data Sheets, for individual spaces. Use the "Suggested Design Values" STC ratings in UFC 3-450-01, *Noise and Vibration Control* as the basis for the sound design of partition, door and window assemblies. Utilize gypsum board wall "improvements" to increase the STC of gypsum board "Stud Type" partitions to achieve the project sound requirements. Unless noted otherwise extend the room partitions and seal to the structure above for rooms that have a noise source such as, but not limited to, corridors, toilets, classrooms, training rooms, maintenance rooms, and mechanical rooms. Unless indicated in Chapter 4 STC ratings do not need to be field verified.

3-4 PLUMBING.

Design domestic hot and cold water, sanitary and storm drainage, propane, fuel oil, or natural gas systems to meet the requirements of local Installation standards, and UFC 3-420-01, *Plumbing Systems.*

To calculate fixture counts, use a population split of 70% male and 30% female. While the shower/locker room is programmed space and does not come out of the net-to-gross multiplier, include the shower/locker room fixtures in the overall facility fixture count when performing code calculations.

3-5 HEATING, VENTILATING, AND AIR CONDITIONING (HVAC).

Design the HVAC system to meet the requirements of UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems.*

Zone the system to allow for separate operation of the administrative support (including medical) areas, the unit areas, and the drill hall. Only the administrative support areas are occupied during a normal work week.

3-6 FIRE PROTECTION.

Design fire protection and life safety to comply with UFC 3-600-01, *Fire Protection Engineering for Facilities*.

3-7 ELECTRICAL DESIGN.

In addition to UFC 3-501-01, *Electrical Engineering*, comply with the following NOSC-specific requirements:

3-7.1 Lighting.

See Chapter 4, Functional Data Sheets, for light level and control requirements that are exceptions or in addition to the requirements referenced above.

3-7.2 Power.

Provide a minimum of six outlets (one quad and one duplex receptacle) at each workstation throughout the facility.

3-7.3 Electronic Security System (ESS).

ESS is the integrated electronic system that encompasses one or more of the following subsystems; access control system (ACS), intrusion detection system (IDS), and closed circuit television (CCTV) systems for assessment of alarm conditions.

ESS must meet the policy based requirements for assets being protected and designed in accordance with UFC 4-021-02NF, *Security Engineering: Electronic Security Systems*. See Chapter 4, Functional Data Sheets, for locations.

3-7.3.1 Intrusion Detection System (IDS).

Provide an Intrusion Detection System (IDS) unless there is a documented exception. IDS must include:

- Point sensors on perimeter doors and other "accessible" openings.
- Line supervision on transmission lines. If line supervision is unavailable, two independent means of alarm signal transmission is required.
- Reporting to a central monitoring station where alarms will sound and from which a response force can be dispatched. An alarm bell located only at the protected location is not acceptable.

3-7.3.1.1 Motion Detection Sensors.

Must be UL 639 listed.

3-7.3.1.2 Point Sensors.

Must be UL 634 high security switches (HSS) level 1 or 2. HSS Level 2 is preferred. Balanced Magnetic Switches meet HSS Level 2. Level 2 rated switches include only Balanced Magnetic Switches that pass additional performance testing.

3-7.3.1.3 IDS Local Processor or Intrusion Panel.

Provide an IDS local processor or intrusion panel within the protected area. System must be configured to only allow cleared personnel located within the protected area to initiate changes in access modes or alarm conditions.

3-7.3.1.4 Sensor Cabling.

Cabling between all sensors and the IDS local processor or intrusion panel must be dedicated to the system and contained within the protected area. If the wiring cannot be contained within the protected area, provide tamper protection in accordance with UFC 4-021-02NF.

3-7.3.1.5 Backup power.

Provide eight hours of uninterruptible backup power. This may be provided by internal batteries, uninterruptible power supply (UPS), generators, or any combination. Emergency backup power for IDS must not generate the requirement for a UPS or generator. If a generator or UPS is not available for backup, provide backup with internal batteries.

In the event of primary power failure, the IDS must:

- Automatically transfer to the emergency electrical power source without causing alarm activation.
- Initiate an audible or visual indicator at the IDS local processor or intrusion panel to provide an indication of the primary or backup electrical power source in use.
- Initiate an audible or visual indicator at the monitoring station indicating a failure in a power source or a change in power source.

3-7.3.2 Access Control System (ACS).

Provide card reader with keypads at entry to building to ensure only authorized personnel are permitted ingress. The ACS must log and archive all transactions and alert authorities of unauthorized entry attempts. When provided, the ACS may be interfaced with the CCTV system to initiate event activated recording of unauthorized access attempts. Unless otherwise directed, the default ACS identifier credential must be the Common Access Card (CAC).

3-7.3.3 CCTV.

Provide the infrastructure for a CCTV system when the need for a CCTV system has been established.. Currently, there is no policy based requirement for a complete and useable CCTV system. Therefore, the decision to provide a CCTV system must be determined based on the value of the asset being protected, designs basis threat, and the desired capability to record events for evidentiary archiving. The program manager will determine if design and construction funds will be provided. See the paragraph below entitled, “Camera Locations” and Chapter 4, Functional Data Sheets for workstation and camera locations.

3-7.3.3.1 CCTV Workstation

Provide a minimum of one workstation for the CCTV system if provided by local command. Multiple workstations may be required for a large distributed system. Video management software must be compatible with all cameras, encoders, and recording devices.

3-7.3.3.2 Video Recording

System must have the capability to digitally record and store all cameras images for a minimum of seven days.

- Event activated recording and on-demand recording must be 30 frames per second (fps).
- Routine recording must be not less than 5 fps.
- Resolution must be no less than 720 X 480 pixels.

3-7.3.3.3 Camera Locations

In addition to the locations indicated in Chapter 4, a camera outlet should be provided at each emergency exit and the building entrance.

3-7.4 Telecommunication Systems.

See Chapter 4, Functional Data Sheets, for outlet locations.

3-7.5 Television Systems.

See Chapter 4, Functional Data Sheets, for outlet locations.

3-7.6 Intercommunication Systems.

See Chapter 4, Functional Data Sheets, for locations.

3-8 FURNISHINGS.

All windows and other glazed openings to the exterior of the building must be provided with horizontal blinds or solar shading systems and are considered part of the

construction project. Soft window treatments such as draperies are considered collateral equipment and must be included in the FF&E package as required.

Additional furnishing and equipment criteria for specific spaces within a NOSC are provided in Chapter 4.

3-9 SITE WORK.

Comply with UFC 3-201-01, *Civil Engineering.* Organize the site to be compatible with the site planning and style of adjacent existing structures. Locate the building to reflect local climatic conditions. For example, provide protection from prevailing winds and glare and orient operable windows to take advantage of summer breezes. Orient the building, to the maximum extent possible, to take advantage of passive solar heating and day lighting.

3-9.1 Landscaping.

Comply with UFC 3-201-02, *Landscape Architecture.*

3-9.1.1 Plants

The plant selection must be easy to maintain and enhance the visual quality of the facility in all seasons. Indigenous species are preferred. Comply with local Installation landscape standards.

Address sustainable design issues when designing the landscape. Select plants that require little to no additional water beyond normal rainfall. Avoid plants that require an irrigation system or consider a gray water or storm water irrigation system.

3-9.1.2 Site Furnishings and Amenities

Site furnishings and related amenities must address issues of vandal resistance, durability, and handicapped accessibility, and should be coordinated in a manner that reflects the architecture and context in which the facility is situated. While not all-inclusive, the following site components may be considered to complement landscaping when designing outdoor spaces: facility signage, flagpoles, tables and chairs for outdoor dining, benches, trash receptacles, ash urns, bike rakes, bollards, fencing, trash dumpster enclosures, and specialty paving surfaces for accent and focus. Consider the need in the landscaping plan for a large flat area for physical training (PT).

The following are required:

- Provide a facility sign for all NOSC. Match the style of other signs on the base or the Installation Appearance Plan of the base.

- Provide a screen wall around three sides of the trash dumpster pad with an exterior surface that matches the exterior walls of the facility. Provide a gate on the open side for access to the dumpster.

- Provide a flagpole for NOSC that are located off-base.

- Provide hard surfaces with covered roof at the building entry, adjacent to Drill Hall, and adjacent to Mess.

3-9.2 Site Circulation and Parking.

Comply with UFC 3-201-01, *Civil Engineering*. Locate parking areas so they do not dominate the main entrance and public image of the facility. Provide the following:

- Government vehicle parking. Provide two large, van-sized, paved parking spaces. If climate dictates and budget allows, provide enclosed or covered spaces. Accommodate any additional vehicle requirements associated with exclusive spaces, as required.
- Staff and reservist privately-owned vehicle (POV) parking. For a NOSC located on an Installation, provide paved parking spaces for 80% of reservist and full-time-staff population. If site space and budget permits, provide unpaved spaces for the remaining 20% of the population. For a NOSC located off Installation, provide paved parking spaces for 100% of reservist and full-time staff population. For both on- and off-Installation NOSCs, reservist population must be calculated based on the largest single drill weekend, not on total NOSC capacity.

CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-1 INTRODUCTION.

This chapter identifies the specific design needs for each functional area outlined in this FC. Tables 4-1 through 4-40 provide this data in a standard Functional Data Sheet format.

- The interior construction specialties, equipment and furnishings criteria provided in these tables are broken down as follows:
- Casework/Built-in Equipment. This includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window treatments, laundry machines, and retractable overhead screens.
- Furnishings, Fixtures, and Equipment (FF&E). This includes contractor-furnished, contractor-installed loose items such as desks, tables, chairs, and bookshelves.
- User-provided FF&E. This includes all government-furnished, government-installed items, which are typically limited to office equipment such as computers, printers, copiers, projectors and flat screen monitors (if mounted, the projector and/or flat screen monitors mount is part of construction).

Table 4-1. ID Check

Description/ Usage	The ID check is a small space directly off the main entry that provides a transaction window to the security desk and access points to the NOSC and the recruiting office.
Ceiling Ht.	10 ft. (3.0 m).
Finishes	**Walls.** Provide a durable, impact resistant wainscot such as split-faced/ground-faced CMU, acrylic molded wainscot, etc. **Floor.** Provide a low-maintenance, durable finish suitable for this high-traffic area such as stone, terrazzo, or quarry tile. Provide a recessed walk-off mat/area at the entrance door. Provide a base that matches the flooring. **Ceiling.** Acoustical ceiling panel (ACP).
Plumbing	None required.
HVAC	Provide a system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** Provide one outlet for monitor location, if required. **CATV/Internal Video.** Provide a CATV outlet. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. If a security gate is provided for NOSC located off-base, provide telephone at exterior gate for communication with ID Check. **Data.** None required. **Security.** Provide an electronically locked door from the ID check to the NOSC with controls at the security desk. Provide door buzzer at main entrance door. For NOSC located off-base, provide electronically locked gate at the site perimeter that can be unlocked from ID Check.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide a secure transaction counter to the full-time staff area security desk that serves as a security check-in point.
Furnishings Fixtures & Equipment (FF&E)	
User-provided FF&E	CCTV cameras at all building perimeter doors, at entry gates on site, and monitor and computer in ID Check room, if required.
Special Requirements	Where climate conditions dictate, provide an airlock at the exterior doors, and provide double doors leading into the NOSC. Provide door buzzer at main entrance door.

Table 4-2. Recruiting Office

Description/ Usage	This small suite is directly off the ID check/main entry and provides an environment for a recruiting officer to meet with prospective reservists. It includes a display area with brochure racks, table, two workstations with facing chairs for prospects, and storage. Provide a separate room to accommodate a table and chair for knowledge testing adjacent to the recruiting office. For larger NOSC with three recruiters or more, a small conference or meeting area for briefings must be provided. A small waiting area may be desired.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Carpet tile with rubber base. **Ceiling.** Acoustical ceiling panels (ACP).
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and for all dedicated equipment. Provide at least one quad outlet per workstation.
Lighting	Provide system per the paragraph in Chapter 3, entitled “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication at each workstation. **Data.** Provide data outlets to support each workstation and other required equipment. **Security.** None required.
Acoustics	Provide wall and door construction with a factory STC rating of 40. Rating does not need to be field verified.
Casework/Built-in Equipment	Provide marker board and bulletin board.
Furnishings Fixtures & Equipment (FF&E)	2 ft. (.61 m) diameter round table for display material, brochure racks, and display space. Workstations—systems furniture for 48 $ft.^2$ (4.5 m^2) workstation: desk chair and side chair. Workstation systems furniture must provide adequate space for filing and overhead storage.
User-provided FF&E	Computers and printer.
Special Requirements	Ensure this suite is well marked with signage and clearly visible from the facility entrance. Provide lockable door.

Table 4-3. Quarterdeck

Description/ Usage	The quarterdeck is directly off a corridor from the main entry and acts as an internal "lobby" of the facility. It provides for the main facility signage, the display of the flag, and display of Navy or unit memorabilia. It will also be used for staff gatherings of up to 15 people and as a ceremonial space.
Ceiling Ht.	10 ft. (3.0 m).
Finishes	**Walls.** Architectural Feature Wall Panel System using material such as acrylic, wood, metal or polished ground faced block. **Floor.** Provide a low-maintenance, durable finish such as stone, terrazzo, or quarry tile. Provide a base that matches the flooring. Provide recessed walk-off mat at entrance as an extension of the entrance vestibule. **Ceiling.** Provide a decorative acoustical ceiling.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, "HVAC".
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, "Fire Protection".
Power	Provide outlets per the paragraph in Chapter 3 entitled, "Electrical Design".
Lighting	Provide system per the paragraph in Chapter 3 entitled, Electrical Design". Provide decorative and task lighting.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide one outlet. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Main facility signage
Furnishings Fixtures & Equipment (FF&E)	Cases to display Navy/unit memorabilia (display cases can be built-in). Provide chain of command board, with high quality finish, to include four 8 by 10 inch frames that can be easily changed.
User-provided FF&E	
Special Requirements	Consider a skylight or clerestory.

Table 4-4. Commanding Officer Office

Description/ Usage	This private office includes typical office accommodations and an adjacent private toilet.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board in office and reception areas. In toilet, provide moisture and mildew resistant gypsum wall board with ceramic tile wainscot, and semi-gloss or better industrial latex-based paint. **Floor.** Carpet tile with rubber base in office and reception areas. Provide porcelain tile with flush cove base in toilet. **Ceiling.** Provide ACP in office and reception areas. Provide moisture resistant gypsum board ceiling in the toilet.
Plumbing	Provide water closet, shower, and lavatory.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”. Provide independent thermostat.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”. Ensure an adequate number of circuits to power all equipment. Provide a minimum of one quad outlet in office area on at least three walls. Gang outlets with data and telephone. Provide outlets per code in the toilet.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet. **PA/Audio.** None required. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide data outlets to support required equipment. **Security.** None required.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified.
Casework/Built-in Equipment	Provide vanity cabinet with lavatory and solid surface top in toilet.
Furnishings Fixtures & Equipment (FF&E)	Office desk, office chair, file cabinet, bookshelf, desk lamp, and two side chairs. Small conference table and four chairs, or sofa, two lounge chairs and two end tables.
User-provided FF&E	Computer and printer.
Special Requirements	Provide lockable door.

Table 4-5. Executive Officer and Senior Enlisted Offices.

Description/ Usage	These are one or two private offices adjacent to the CO office/command suite. Every NOSC has a Senior Enlisted office. NOSCs that accommodate over 500 reservists add the XO office.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”. Ensure an adequate number of circuits to power all equipment. Provide a minimum of one quad outlet on at least three walls. Gang outlets with data and telephone.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical”.
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet in the XO office. **PA/Audio.** None required. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide data outlets to support required equipment. **Security.** None required.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified.
Casework/Built-in Equipment	Provide markerboards.
Furnishings Fixtures & Equipment (FF&E)	Office desk, office chair,file cabinet, bookshelf, desk lamp, and two side chairs.
User-provided FF&E	Computers.
Special Requirements	Provide lockable doors.

Table 4-6. Open Office Area

Description/ Usage	The office area for the full-time staff includes workstations arranged in an open office plan with systems furniture. The offices should be free from frequent distraction, have a professional appearance, and provide a sense of work place. The square footage of this space may be divided into at least six different areas; Personnel Management, Mobilization, Career Counseling, Operations, Supply, and Command Services.
Ceiling Ht.	9 ft. (2.74 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, "HVAC".
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, "Fire Protection".
Power	Provide outlets per the paragraph in Chapter 3 entitled, "Electrical Design". Ensure an adequate number of circuits to power all equipment. Provide at least one quad outlet per workstation. Provide additional outlets as necessary to operate shared equipment such as printers, fax, etc.
Lighting	Provide system per the paragraph in Chapter 3 entitled, "Electrical Design".
Communication	**CCTV.** None required. **CATV/Internal Video:** None required. **PA/Audio:** Provide speaker and PA controls. **Telephone.** Provide one line per staff plus additional lines for fax and copier. **Data.** Provide one outlet per staff plus outlets for each printer, copier, scanner, etc. **Security.** None required.
Acoustics	Partition and floor materials must have a high Noise Reduction Coefficient (NRC) and be manufactured specifically for open office environments. Provide ceiling materials that have a high Articulation Class (AC) rating.
Casework/Built-in Equipment	Provide built-in cabinets under the transaction counters. Workcounter with under-counter storage in printer area. All countertops to be solid surface material.
Furnishings Fixtures & Equipment (FF&E)	Workstations—systems furniture for 64 $ft.^2$ (5.9 m^2) workstation: desk chair and side chair for open offices. Workstation systems furniture must provide adequate space for filing and overhead storage. Counters for work surfaces and equipment such as printers and cabinets for storage of administrative supplies. Provide lockable lateral file cabinets for secure personnel files.
User-provided FF&E	Computers, printers, and other office equipment as needed.
Special Requirements	**Mail Handling.** Provide a direct entrance into the mail distribution area. If the NOSC is located off Installation, provide a separate mail room that meets the requirements in UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*. **Telecom Closet.** Near or adjacent to the administrative offices, provide a telecommunications room in compliance with the paragraph in Chapter 3 entitled, "Electrical Design".

Table 4-7. Service Counter/Waiting Area

Description/ Usage	This area provides space for reservists or other customers to interact with the full-time staff through the service/transaction counter. It includes a small waiting area and accommodates ID photography.
Ceiling Ht.	8 ft. (2.44 m) minimum.
Finishes	**Walls.** Painted gypsum wall board with durable acrylic wall system. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”. Coordinate lighting with ID photography area.
Communication	**CCTV.** None required. **CATV/Internal Video:** Provide one outlet. **PA/Audio:** Provide speaker and PA controls. **Telephone.** Provide one line. **Data.** Provide one line. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide work desk/service/transaction counter with ABA section. Include file and pencil drawer storage. Provide bulletin boards and/or tack surfaces for display of facility information.
Furnishings Fixtures & Equipment (FF&E)	Provide comfortable seating in waiting area. Provide child-sized tables and chairs for children waiting. Provide magazine and brochure racks.
User-provided FF&E	
Special Requirements	The entrance to this area should be directly off the corridor that runs from the main entrance to the quarterdeck and be easily visible to anyone who has entered the facility. Provide glass storefront walls between the waiting area and the corridor with glass entrance doors. A person standing in the corridor should be able to see the service counter and the staff administrative area behind it when looking through the storefront. Provide a lockable door from the waiting area into the open office area. Provide a photographic backdrop opposite the side of the service/transaction counter that includes the digital camera for ID issue.

Table 4-8. Navy Family Services Office

Description/ Usage	Family services offer a variety of private counseling functions such a financial planning or clinical counseling. Between sessions, staff will work on files and research cases.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** Provide one outlet. **CATV/Internal Video.** None required **PA/Audio.** Provide a speaker. **Telephone.** Provide one line **Data.** Provide one outlet for each piece of equipment.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified.
Casework/Built-in Equipment	Provide marker board and bulletin board.
Furnishings Fixtures & Equipment (FF&E)	Modular office furniture consisting of a desk or workstation, credenza with overhead storage, secure file cabinet, and desk chair. Provide an upholstered love seat, an upholstered arm chair, and a side table (see layout). As an option, the room can be utilized as a small conference room as needed.
User-provided FF&E	Computer and printer.
Special Requirements	Lockable door with a vision panel.
Special Requirements	The furniture configuration allows the staff member to meet with customers in a more intimate, less threatening setting. The desk should not divide the staff member from the customer. See illustration below.

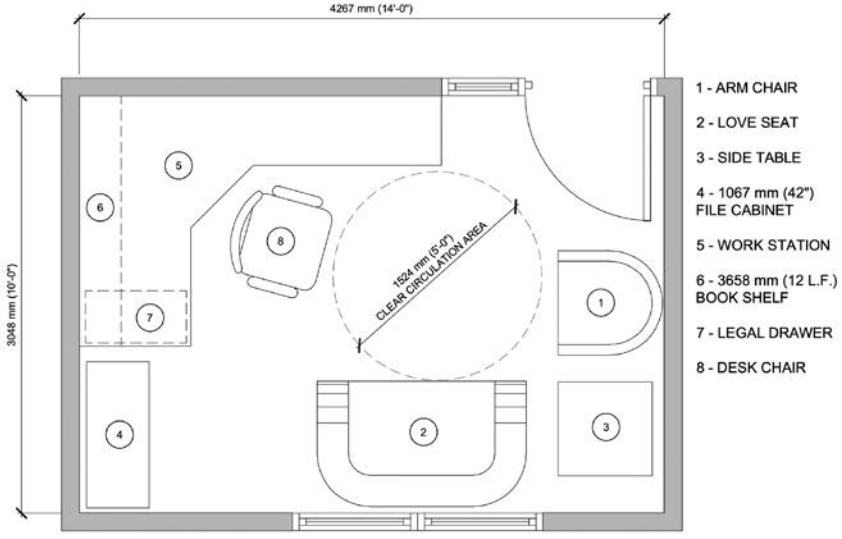


Table 4-9. Copier/Mail Nook and Mail Distribution

Description/ Usage	The copier/mail nook is directly off a main corridor and directly adjacent to the mail distribution area. It includes one or more copiers and office equipment for staff and reservists use and double-sided, lockable mailboxes for staff and reserve units. It should be easily accessible by both the full-time staff and the reservists. The mail distribution area is directly off the full-time staff open office area and includes a mail sorting table and access to the back of the mail boxes in the copier/mail nook.
Ceiling Ht.	8 ft. (2.44 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient flooring with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** Provide one outlet. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line for a facsimile machine. **Data.** Provide outlets for each piece of equipment. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide base and wall cabinets. Provide 4-in. x 10-in. (100-mm x 255-mm) double-sided, lockable mailboxes for each reserve unit plus 13 additional for full-time staff and operational divisions.
Furnishings Fixtures & Equipment (FF&E)	Provide sorting table and chairs in distribution area. Provide mail sorter and counter for large mail machine, if required by the size of the facility.
User-provided FF&E	Copiers and office equipment.
Special Requirements	If the NOSC is located off-base, provide a separate mail room in addition to the mail distribution area. This mail room must comply with the requirements in UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*.

Table 4-10. Conference Room.

Description/ Usage	This conference room serves the CO and his/her staff and the Unit COs and senior enlisted personnel. It includes video teleconference (VTC) capability and is near the CO office and full-time staff area. (Note: NMCI does not support VTCs in NOSCs.)
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. Provide durable wainscot with chair rail. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3, entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”. Ensure an adequate number of circuits to power all equipment. Provide a minimum of one quad outlet at table and on at least three walls. Gang outlets with data and telephone. Provide outlet above ceiling for projector.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”. Provide dimmable lighting.
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet. **PA/Audio.** None required. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide data outlets to support required equipment. **Security.** None required.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified.
Casework/Built-in Equipment	A retractable overhead screen and ceiling mounted projector mount can be provided as an option to a 50 inch (1.27 m) video monitor/TV if desired. Provide two large marker boards and a bulletin board.
Furnishings Fixtures & Equipment (FF&E)	Conference table and chairs. Lectern.
User-provided FF&E	VTC equipment, including 50 inch (1.27 m) minimum video monitor/TV. (Note: NMCI does not support VTCs in NOSCs.)
Special Requirements	Consider the viewing angle when planning the location of the conference table, VTC camera, screen, and microphone.

Table 4-11. Funeral Honors Office

Description/ Usage	This office accommodates staff administrative functions for the oversight of military funeral honors and storage of coffins and other ceremonial equipment.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** Provide one outlet. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide two lines. **Data.** Provide one outlet for each piece of equipment. **Security.** None required.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified.
Casework/Built-in Equipment	Provide a storage closet with shelving for items such as uniform accessories, bugles, and other ceremonial equipment.
Furnishings Fixtures & Equipment (FF&E)	Two workstations—systems furniture for 64 $ft.^2$ (5.9 m^2) workstation: desk chair and side chair for open offices. Workstation systems furniture must provide adequate space for filing and overhead storage. Coffin dolly.
User-provided FF&E	
Special Requirements	

Table 4-12. Distance Learning Center

Description/ Usage	The distance learning center is an advanced classroom environment that supports synchronous or asynchronous learning where the student and the instructor may be in physically separate locations. It is designed to accommodate a minimum of 20 students. Space can be divided into two equally spaced separate rooms if desired.
Ceiling Ht.	10ft. (3.0 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Match ID Check area flooring. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”. Ensure adequate number of circuits to power all equipment. Provide utility AC outlets on separate circuits from the media equipment inside the room for portable media equipment and laptop computers. Provide at least one duplex outlet every 10 ft. (3.05 m) along the front wall of the classroom, on the underside of any teaching tables and on any fixed lecterns. Provide power outlet in ceiling for projector.
Lighting	Provide a minimum of three lighting zones: 1. One zone should control the classroom's general-use fluorescent lights that provide full brightness for general activities up to 50 ft. candles (540 Lux). 2. One zone should control low level, fully dimmable lights for note taking that provide 2 ft. candles (20 Lux) at the desktops. These lights must not shine on the screens and the eyes of the audience. 3. One zone should control presentation area lights (either incandescent or fluorescent) that illuminate the writing/display surface at the front of the room and provide 50 ft. candles (540 Lux).
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet at the front of the room. **PA/Audio.** Provide speakers. **Telephone.** Provide one outlet at the front of the room near the lighting and media equipment controls. **Data.** Provide dual duplex data outlets at each of the following locations: the front of the classroom, the video monitor, and the media equipment rack. Provide one outlet for each student and coordinate location with selected furniture. Provide WIFI infrastructure and boosters. **Security.** None required.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified. Provide ceiling materials that have a high Articulation Class (AC) rating.
Casework/Built-in Equipment	A retractable overhead screen and ceiling mounted projector mount can be provided as an option to a 50 inch (1.27 m) video monitor/TV if desired. Provide two large marker boards and bulletin board.
Furnishings Fixtures & Equipment (FF&E)	Provide tables that have C-legs on castors and wire management baskets. Tables must be 30 in. (762 mm) deep and long enough to accommodate two computers with 3-ring-binder space between. Provide mid-back upholstered task chairs with adjustable arms for each student and instructor. Provide a combination lectern to hold computer, monitor and keyboard connected to video monitor and camera control.

Table 4-12. Distance Learning Center

User-provided FF&E	Computers and projector.
Special Requirements	Provide two 1.25-in. (32-mm) conduits from each video projector location to the podium and to the location of the media equipment rack for low voltage projector control and signal cables. The distance learning center serves as a focal point of the facility. Provide an interior window to the corridor that runs from the main entrance to the quarterdeck. This window should be easily visible to anyone who has entered the facility.

Table 4-13. Mess

Description/ Usage	This space serves as a warming kitchen/staging area for catered events in the drill hall.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Provide a low maintenance, durable finish such as an epoxy based paint. **Floor.** Resilient sheet or tile such as linoleum, rubber or solid vinyl with rubber base. Do not use VCT. **Ceiling.** Gypsum wall board, semi-gloss latex paint.
Plumbing	Provide hot and cold water supply to a double-tub, stainless steel, commercial-grade kitchen sink. Provide cold water supply for refrigerator and coffee maker.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and for all dedicated equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet. **PA/Audio.** Provide speaker. **Telephone.** Provide one line. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Double-tub, stainless steel, commercial-grade kitchen sink, solid surface countertop, base cabinets with doors and drawers, and upper cabinets with doors. Provide a 6-ft. (1.83 m) wide pass-through window to drill hall.
Furnishings Fixtures & Equipment (FF&E)	One commercial microwave, one residential-style refrigerator, and commercial coffee maker.
User-provided FF&E	Provide warming cabinet if required by the size of the facility.
Special Requirements	A covered outdoor dining area may be considered.

Table 4-14. SIPRNET Room

Description/ Usage	Secure room housing equipment for secure Internet access.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet or tile such as linoleum, rubber or solid vinyl with rubber base. Do not use VCT. **Ceiling.** ACP or none required.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”. Mechanical or other openings greater than 96 in.^{2} (0.06 m^2) must have bars in accordance with MIL HDBK 1013/1A, *Design Guidelines for Physical Security of Facilities*. Do not route other utilities through this space.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and for all dedicated equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** Provide outlet outside of room in corridor for surveillance of this room, if required. CCTV is not allowed inside the room, **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** Navy to provide/install classified equipment. Provide one outlet for Secure Telephone Equipment. **Data.** Navy to provide/install classified equipment. **Security.** Navy to provide/install classified equipment.
Acoustics	Provide acoustical attenuation that meets SIPRNET requirements.
Casework/Built-in Equipment	Equipment racks.
Furnishings Fixtures & Equipment (FF&E)	Navy to provide computer racks. Provide desk, chair and class 5 safe.
User-provided FF&E	CCTV camera, if required.
Special Requirements	Navy to provide final fit-out of room based on "Technical Guide for the Integration of Secret Internet Protocol Router Network (SIPRNET),” latest version. Provide solid core wood or hollow metal door with a GSA-approved combination lock and an Intrusion Detection System (IDS).

Table 4-15. Supply Storage

Description/ Usage	The supply storage provides space for the storage of administrative supplies and new uniforms, a uniform fitting area for taking measurements, a workstation for supply staff, and a small receiving area directly off a service entrance.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet or tile such as linoleum, rubber or solid vinyl with rubber base. Do not use VCT. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and one additional quad outlet for the workstation.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide speaker. **Telephone.** Provide one line at workstation. **Data.** Provide one outlet at the workstation. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide a department-store style dressing room with minimum 6-ft. (1830 mm) high walls and a lockable door. Provide hooks in the dressing room. Provide a minimum 10 ft. (3.05 m) length of countertop/work surface for organizing/inventory of supplies.
Furnishings Fixtures & Equipment (FF&E)	Storage shelving for boxed uniforms and administrative supplies. Measuring platform and three-panel adjustable mirror at the fitting area. Workstation systems furniture for 64 ft.^{2} (5.9 m^2) workstation, desk chair and side chair. Workstation systems furniture must provide adequate space for filing and overhead storage.
User-provided FF&E	Computer, printer and copier.
Special Requirements	Provide a transaction counter open to the corridor with a coiling door or grille at the counter to serve as a security screen. The receiving area comprises open floor space for stacking of larger boxes until they can be unpacked and distributed appropriately. Provide lockable door.

Table 4-16. Fitness Room

Description/ Usage	The Fitness Room should accommodate the latest in fitness machines, as well as more traditional equipment. Design and size the room to provide free circulation between equipment while in use. Must conform to CNIC Instruction 1710.1.
Ceiling Ht.	10 ft. (3.0 m) minimum.
Finishes	**Walls.** Provide a low-maintenance, durable finish such as epoxy-based paint with wall graphics. **Floor.** Provide low-maintenance rubber sheet athletic flooring with rubber base. **Ceiling.** Provide acoustical ACP or gypsum board ceiling with a finish such as industrial egg-shell latex paint for gypsum board ceiling.
Plumbing	None required.
HVAC	Provide a system per the paragraph in Chapter 3 entitled, "HVAC". In addition, provide 68° F (20° C) minimum, 74° F (23° C) maximum, less than 60% relative humidity, 20 CFM (0.566 CMM) / person outside air and use CO_2 sensors to control outside air. Provide multi-speed ceiling fans.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, "Fire Protection".
Power	Provide outlets per the paragraph in Chapter 3 entitled, "Electrical Design" and provide wall or floor outlets to accommodate fitness machines such as treadmills, bikes, and stair-step machines.
Lighting	Provide system per the paragraph in Chapter 3 entitled, "Electrical".
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide at least one outlet for a wall-mounted unit. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** None required. **Security.** None required.
Acoustics	Provide partition and door construction with a minimum STC rating of 52 per the paragraph in Chapter 3 entitled, "Acoustics".
Casework/Built-in Equipment	Provide full-wall-height mirrors on at least one wall.
Furnishings Fixtures & Equipment (FF&E)	Provide fitness machines, treadmill, stationary bicycle, elliptical machine, weights, and mats.
User-provided FF&E	Provide a wall mounted flat screen video monitor.
Special Requirements	Determine if space is allowable in accordance with CNIC Instruction 1710.1. Consider an outdoor flat area for physical training (PT).

Table 4-17. Public Toilets

Description/ Usage	Male and female toilets for staff, reservists, and visitor use. Provide multiple toilet rooms for staff and units dispersed throughout building.
Ceiling Ht.	8 ft. (2.44 m) minimum.
Finishes	**Walls.** Epoxy painted, moisture-resistant, gypsum wall board with accent color and with a ceramic tile wainscot. **Floor.** Porcelain tile with flush cove base. **Ceiling.** Painted, moisture-resistant gypsum board.
Plumbing	Water closets, urinals, and lavatories. Floor drain.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”. Provide power to the air hand dryers.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Solid-surface countertop supported at both ends with either underhung or integral sinks. Wall-hung lavatories are also acceptable. Water closet and urinal partitions. Toilet accessories: air hand dryers, toilet paper dispensers, robe hooks, grab bars, soap dispensers and recessed waste receptacles. Mirror.
Furnishings Fixtures & Equipment (FF&E)	
User-provided FF&E	
Special Requirements	Provide a Janitor’s closet associated with or in proximity of these toilets. This closet includes a floor mop sink with hot and cold water and a hose connection, a floor drain, and storage for pails, mops, vacuums, and related cleaning supplies and equipment. Include a lockable door (which can be opened from the inside) with a vision panel. Provide lockable cabinets for cleaning supplies. Provide exhaust ventilation directly to the outside.

Table 4-18. Showers/Locker Room

Description/ Usage	The shower/locker room includes private water closets, lavatories, shower stalls with private changing area, and lockers for temporary storage of personal items for regular use by full-time staff and periodic use by reserve units during scheduled periods on drill weekends.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Provide a low-maintenance, durable finish such as epoxy paint. Provide full-height ceramic tile in showers. **Floor.** Provide slip resistant porcelain tile with flush cove base. **Ceiling.** Provide skim-coated cementicious backerboard ceiling.
Plumbing	Water closets, urinals, lavatories, and shower stalls. Provide a floor drain.
HVAC	Provide system per the paragraph in Chapter 3 entitled, "HVAC". In addition, provide 70° F (21° C) minimum, 78° F (26° C) maximum. Provide for air flow from the dry side (locker/dressing area) to the exhaust intakes in the wet (toilet/shower) area. Provide 0.50 CFM/ft.^{2} (0.154 CMM/m^2) of outside air and a minimum of 12 air changes per hour. Provide air supply as necessary to minimize air velocities while providing negative pressure. Limit relative humidity to under 50% through the use of humidistats. Humidistats may also be used to throttle back air changes as long as temperature and humidity remain within limits.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, "Fire Protection".
Power	Provide outlets per the paragraph in Chapter 3 entitled, "Electrical Design". Provide counter-height outlets at the vanity area.
Lighting	Provide system per the paragraph in Chapter 3 entitled, "Electrical Design". Lighting fixtures should have translucent, moisture resistant, non-breakable, protective covers. Minimize shadowing at face of lockers. Provide recessed fixtures with sealed lenses that are rated for wet applications in the shower areas. Provide lighting over lavatories.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide 24 in. (610 mm) deep minimum solid surface materials for countertops and shower and toilet partitions. Provide half-sized Z-shaped lockers and full-size lockers. Provide integral benches (usually part of the locker system) or free-standing benches at least 16 in. (406 mm) wide. Solid composite plastic lockers are strongly preferred. Provide wall-to-wall mirror over lavatories, and one full-length mirror in locker area..
Furnishings Fixtures & Equipment (FF&E)	
User-provided FF&E	
Special Requirements	Lockers should be configured as two half-sized lockers per one full-sized locker. Distribute the lockers throughout the area to prevent congestion during periods of heavy use. Provide a privacy screen at the entrance to this area.

Table 4-19. Break Room

Description/ Usage	The break room accommodates vending machines for snacks and drinks and a small seating area.
Ceiling Ht.	8 ft. (2.4 m).
Finishes	**Walls.** Provide acrylic wall panel system. **Floor.** Provide low-maintenance sheet vinyl flooring material with rubber base. **Ceiling.** Provide ACP or painted gypsum ceiling.
Plumbing	Provide a stainless steel sink in the counter.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”. Provide outlets and power required by equipment and vending machines.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical”.
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet **PA/Audio.** Provide speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Counter with base and upper cabinets.
Furnishings Fixtures & Equipment (FF&E)	Refrigerator, microwave, two four-top tables, eight chairs, and trash receptacles.
User-provided FF&E	Vending machines. Anchor vending machines to floor or walls.
Special Requirements	

Table 4-20. Recycling Area

Description/ Usage	This room is used for the collection, short-term storage, and separation of recyclables. Provide a direct access to receiving/service entrance.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Provide an acrylic wall panel system. **Floor.** Resilient sheet or tile such as rubber or solid vinyl with rubber base. Do not use VCT. **Ceiling.** ACP.
Plumbing	Provide a floor drain and a hose bibb.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	Receptacles for the separation of various products: glass, plastic, paper, etc. Heavy-duty, commercial shredder.
User-provided FF&E	
Special Requirements	Consider a location near the outdoor trash dumpster enclosure, if feasible.

Table 4-21. Medical Waiting/Check-In/Reception

Description/ Usage	The medical office and reception area accommodate medical staff general administrative work and the receiving and processing of personnel receiving medical examinations. The space includes a small waiting area, a transaction/reception counter and workstations.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet such as rubber or homogeneous vinyl with rubber base. Do not use VCT. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and for all dedicated equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. Provide controls at the reception desk. **Telephone.** Provide one line with internal two-way communication at each workstation. **Data.** Provide one outlet at each workstation and additional outlets to support other required equipment. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide transaction reception counter with solid surface top and desk. Provide file and pencil drawer storage.
Furnishings Fixtures & Equipment (FF&E)	Workstations—system furniture for 64 $ft.^2$ (5.9 m^2) workstations: desk chair and side chair for open offices. Workstation systems furniture must provide adequate space for filing and overhead storage. Seating for waiting area.
User-provided FF&E	
Special Requirements	Visually separate the transaction/reception counter from the workstations and the exam rooms to enhance staff, patient, and doctor privacy. Ensure privacy of workspaces for receipt of HIPAA protected information.

Table 4-22. Admitting/Vision

Description/ Usage	This area is directly adjacent to the reception/waiting area and accommodates private rooms or workstations for patient interviews and taking of vitals such as blood pressure, temperature, etc. It also includes an area with a vision chart and the proper stand-off distances for vision exams.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet such as rubber or homogeneous vinyl with rubber base. Do not use VCT. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, and the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and for all dedicated equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** Provide one line with internal two-way communication at each workstation. **Data.** Provide one outlet at each workstation.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified.
Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	Provide partitions (or constructed walls) to accommodate privacy requirements for interviews. Provide tables and chairs. Provide lockable cabinets for supplies.
User-provided FF&E	
Special Requirements	Interview areas must accommodate Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy Rules. Finishes must comply with the requirements in the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, to meet the need for an aseptic environment.

Table 4-23. Medical Exam Room

Description/ Usage	Private room used to conduct routine medical examinations.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet such as rubber or homogeneous vinyl with rubber base. Do not use VCT. **Ceiling.** ACP.
Plumbing	Provide one hand-washing sink with hot and cold water connections and health-care-style butterfly fittings on faucet.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, and the paragraph in Chapter 3, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and for all dedicated equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide one outlet.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified.
Casework/Built-in Equipment	Provide a solid-surface counter top with under-mount sink on floor-mounted storage cabinet. Paper towel dispenser, soap dispenser, and robe hook. Provide countertop surface with knee-space for computer and note taking.
Furnishings Fixtures & Equipment (FF&E)	Examination table, wheeled chair or stool for the doctor, and trash receptacle. Provide lockable cabinets for supplies/medications.
User-provided FF&E	
Special Requirements	Accommodate Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy Rules. Finishes must comply with the requirements in the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, to meet the need for an aseptic environment.

Table 4-24. Dental Exam Room

Description/ Usage	Private room used to conduct routine dental examinations. Dental cleanings are not performed.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet such as rubber or homogeneous vinyl with rubber base. Do not use VCT. **Ceiling.** ACP.
Plumbing	Provide one hand-washing sink with hot and cold water connections and health-care-style butterfly fittings on faucet.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, and the paragraph in Chapter 3 entitled, HVAC.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and for all dedicated equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”. Provide power for X-ray light box and freestanding exam light.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide one outlet.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified.
Casework/Built-in Equipment	Provide a solid-surface counter top with under-mount sink on floor-mounted storage cabinet. Paper towel dispenser, soap dispenser, and robe hook. Provide a wall-mounted, flip-down writing table for note taking.
Furnishings Fixtures & Equipment (FF&E)	Dental exam chair and associated equipment, a wheeled chair or stool for the dentist, and trash receptacle. Wall mounted X-ray light box. Provide lockable cabinets for supplies/medications.
User-provided FF&E	
Special Requirements	Finishes must comply with the requirements in the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, to meet the need for an aseptic environment.

Table 4-25. Doctor Library and Transcription Room

Description/ Usage	This office accommodates doctor and dentist administrative functions and includes a medical resource library.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design.
Communication	**CCTV.** Provide one outlet. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line at each workstation. **Data.** Provide one outlet at each workstation. **Security.** None required.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified.
Casework/Built-in Equipment	
Furnishings Fixtures & Equipment (FF&E)	Provide workstation systems furniture for 64 $ft.^2$ (5.9 m^2) workstations: desk chair and side chair for open offices. Workstation systems furniture must provide adequate space for filing and overhead storage. Provide bookshelves for medical resources.
User-provided FF&E	
Special Requirements	Note this is an administrative work area only; medical files are not stored here and patients will not occupy this space. Accommodate Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy Rules.

Table 4-26. Dental X-Ray

Description/ Usage	Area to provide dental x-rays for all training reservists. Room is typically divided by shielding with the x-ray controls on one side and the chair for the reservist on the other side. Changes in equipment technology may alter the design of this room; coordinate the design with the planned equipment.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet such as rubber or homogeneous vinyl with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, and the paragraph in Chapter 3, “HVAC.”
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, and the paragraph in Chapter 3, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, and the paragraph in Chapter 3, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide speaker. **Telephone.** Provide one line at x-ray control station. **Data.** Provide one outlet at x-ray control station. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Counter with base and wall cabinets.
Furnishings Fixtures & Equipment (FF&E)	Dental chair.
User-provided FF&E	X-ray machine and control station and image developing equipment.
Special Requirements	Provide x-ray shielding as required in the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, for the application. Finishes must comply with the requirements in the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, to meet the need for an aseptic environment.

Table 4-27. Audio Room

Description/ Usage	Room to provide hearing tests for all training reservists. The booth may be set-up for testing of one or two reservists. If the booth is configured for two tests, the control station portion of the booth must be configured for a single technician to administer two tests simultaneously. The reservists are in a sound-proof booth with the technician at a control console with visual control of both reservists while the reservists do not have visual contact with each other.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, "Medical Facility Requirements", and the paragraph in Chapter 3 entitled, "HVAC". Provide connection to pre-fabricated audio booth.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, "Fire Protection". Provide connection to pre-fabricated audio booth.
Power	Provide outlets per the paragraph in Chapter 3 entitled, "Electrical Design" and electrical service designed specifically for the audio equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, "Electrical Design".
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide speaker. **Telephone.** Provide one line at the audio control station. **Data.** Provide one line at the audio control station. **Security.** None required.
Acoustics	Provide an acoustically-sealed environment specifically designed for audio testing. Doors, windows and partitions must all have acoustical sealing.
Casework/Built-in Equipment	Sound-proof partition with a vision panel to the control station.
Furnishings Fixtures & Equipment (FF&E)	One or two chairs for the reservists taking the exam. Workstation/control station for the technician and associated testing equipment.
User-provided FF&E	Pre-fabricated audio booth with ducted connection to building-wide HVAC, power, communications. Audio booth must conform to UFC 4-510-01, *Design: Medical Military Facilities*.
Special Requirements	Finishes must comply with the requirements in the paragraph in Chapter 3 entitled, "Medical Facility Requirements" to meet the need for an aseptic environment.

Table 4-28. Immunization Room

Description/ Usage	This area is for providing immunization shots to all training reservists. It may not be a fully-enclosed room.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet such as rubber or homogeneous vinyl with rubber base. Do not use VCT. **Ceiling.** ACP.
Plumbing	Provide one hand-washing sink with hot and cold water connections and health-care-style butterfly fittings on faucet.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, and the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and dedicated electrical outlets for all the equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide speaker. **Telephone.** None required. **Data.** Provide one outlet. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Solid-surface counter with base and wall cabinets.
Furnishings Fixtures & Equipment (FF&E)	Provide one medical grade refrigerator and freezer with lock and temperature alarm connected to remote monitor in accordance with UFC 4-510-01 for immunizations. Provide chairs designed for administering immunizations.
User-provided FF&E	
Special Requirements	Accommodate Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy Rules. Finishes must comply with the requirements in the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, to meet the need for an aseptic environment.

Table 4-29. Blood Draw

Description/ Usage	This room is for drawing, initial processing through a centrifuge, and storing blood samples. It is directly adjacent to the medical toilet to also allow processing of urine samples.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet such as rubber or homogeneous vinyl with rubber base. Do not use VCT. **Ceiling.** ACP.
Plumbing	Provide one hand-washing sink with hot and cold water connections and health-care-style butterfly fittings on faucet.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, and the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and dedicated electrical outlets for all the equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide speaker. **Telephone.** None required. **Data.** Provide one outlet. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Solid-surface counter with base and wall cabinets.
Furnishings Fixtures & Equipment (FF&E)	One refrigerator for blood samples. Refrigerator must be on alarm and kept at a constant temperature. Blood draw chairs.
User-provided FF&E	Centrifuge (counter or floor model).
Special Requirements	Provide a carousel from the medical toilet for transfer of urine samples. Locate carousel near the sink. Accommodate Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy Rules. Finishes must comply with the requirements in the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, to meet the need for an aseptic environment.

Table 4-30. Medical Toilet

Description/ Usage	Single-use, unisex toilet for patient use that is directly adjacent to the Blood Draw.
Ceiling Ht.	8 ft. (2.44 m) minimum.
Finishes	**Walls.** Epoxy painted moisture-resistant gypsum wall board with a ceramic tile wainscot with accent tiles and a flush cove base. Provide full-height ceramic tile on wet walls. **Floor.** Porcelain tile. **Ceiling.** Painted, moisture-resistant gypsum board.
Plumbing	One water closet and one wall-hung lavatory. Provide a floor drain.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, and the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”. Provide power to the air hand dryer.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** Lockable door.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Toilet accessories: air hand dryer, toilet paper dispenser, robe hook, grab bars, and soap dispenser. Mirror.
Furnishings Fixtures & Equipment (FF&E)	
User-provided FF&E	
Special Requirements	Provide a carousel to the blood draw area for transfer of urine samples. Finishes must comply with the requirements in the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, to meet the need for an aseptic environment.

Table 4-31. Medical File Room

Description/ Usage	This room provides secure medical file storage. May include space for one to three personnel.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** Provide one line with internal two-way communication per occupant. **Data.** Provide one outlet/line per occupant. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Secure, high-density automated filing system with rotary or rolling units with base/track recessed into slab construction, if required. Must accommodate separate dental and medical records for each reservist.
Furnishings Fixtures & Equipment (FF&E)	If the secure, high-density, automated medical file storage system is not required, will include filing system of free-standing file units to accommodate separate dental and medical records for each reservist. May include workspace for one to three personnel. Smaller NOSC prefer rotary high-density (X2) filing.
User-provided FF&E	
Special Requirements	Accommodate Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy Rules. Provide lockable door.

Table 4-32. Medical Supply Room

Description/ Usage	This room provides secure medical supply storage for non-perishable items such as gloves and needles.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet such as rubber or homogeneous vinyl with rubber base. Do not use VCT. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, and the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** Provide one outlet/line. **Security.** Lockable door.
Acoustics	No special provisions required.
Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	Provide 18-in (455-mm) deep, adjustable shelving in lockable cabinets for medical supplies.
User-provided FF&E	
Special Requirements	Finishes must comply with the requirements in the paragraph in Chapter 3 entitled, “Medical Facility Requirements”, to meet the need for an aseptic environment. Provide lockable door.

Table 4-33. Medical Equipment Storage

Description/ Usage	This room provides storage for larger items such as CPR dummies, back boards and other deployable medical supplies.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet such as rubber or homogeneous vinyl with rubber base. **Ceiling.** None required.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide wall-to-wall 36-in (915-mm) deep adjustable metal shelving mounted to wall and floor for safety..
Furnishings Fixtures & Equipment (FF&E)	Provide 36-in (915-mm) deep, adjustable shelving for medical equipment.
User-provided FF&E	
Special Requirements	Provide lockable door.

Table 4-34. Unit Classrooms

Description/ Usage	Unit classrooms are used for meetings, training, testing, muster, etc. Rooms are sized to accommodate from 25 to 100 students at 20 $ft.^2$ (1.86 m^2) per student, and any room larger than for 25 includes movable partitions to divide the space into 25-student sections. See the paragraph in Chapter 2 entitled, "Layout and Adjacencies" for more information on sizing of individual rooms. The classrooms are directly adjacent to the unit administrative area.
Ceiling Ht.	10 ft. (3.0 m) minimum.
Finishes	**Walls.** Painted gypsum wallboard. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, "HVAC".
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, "Fire Protection".
Power	Provide outlets per the paragraph in Chapter 3 entitled, "Electrical Design" and for all dedicated equipment. Provide power outlet above ceiling for projector, if provided.
Lighting	Provide system per the paragraph in Chapter 3 entitled, "Electrical Design".
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet per room division. **PA/Audio.** Provide a speaker in each divided space. **Telephone.** Provide one line with two-way communication in each divided space. **Data.** Provide outlets for all dedicated equipment. **Security.** None required.
Acoustics	Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified. Floors materials must have a high NRC and be manufactured specifically for open office environments. Provide ceiling materials that have a high AC rating. See Casework/built-in equipment for partition acoustics.
Casework/Built-in Equipment	A retractable overhead screen and ceiling mounted projector mount can be provided as an option to a 50 inch (1.27 m) video monitor/TV if desired. Provide heavy-duty, highly durable, operable walls with a 55 STC rating for the room dividers. To achieve the required STC, operable walls must extend above the dropped ceiling tiles and insulation provided in the ceiling around the operable wall openings. Powered operable walls are preferred, but the durability and acoustical criteria take precedence. One marker board and tack board per 25-student section.
Furnishings Fixtures & Equipment (FF&E)	Lectern; two-person, leg-powered activity tables; and stackable chairs.
User-provided FF&E	Provide 50 inch (1.27 m) minimum video monitor/TV in each room division.
Special Requirements	Permanent partitions and openings must be designed in accordance with ANSI/ASA S12.60.

Table 4-35. Unit Administrative Area

Description/ Usage	The unit administrative area groups all of the unit offices and workstations into a consolidated area. Each unit gets two private offices and three workstations that will be shared. Directly adjacent to the unit classrooms and the unit storage.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Carpet tile with rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”. Ensure an adequate number of circuits to power all equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** Provide one line with internal two-way communication for each office and one line in the open office area, plus as needed to accommodate required equipment. **Data.** Provide data outlets for each office and workstation and to support required equipment. **Security.** None required.
Acoustics	**Private offices.** Provide wall and door construction with a factory STC rating of 49. Rating does not need to be field verified. **Open offices.** Partition and floor materials must have a high Noise Reduction Coefficient (NRC) and be manufactured specifically for open office environments. Provide ceiling materials that have a high Articulation Class (AC) rating.
Casework/Built-in Equipment	Minimum 8 ft. (4.4 m) length of solid surface countertop for work surfaces and equipment such as printers and cabinets for storage of administrative supplies.
Furnishings Fixtures & Equipment (FF&E)	**Private offices.** Provide office desk, office chair, file cabinet, bookshelf, desk lamp, and one side chair. **Open offices.** Provide systems furniture for 48 $ft.^2$ (4.5 m^2) workstations: desk chair and side chair for open offices. Workstation systems furniture must provide adequate space for filing and overhead storage.
User-provided FF&E	Computers and other equipment.
Special Requirements	

Table 4-36. Unit Storage

Description/ Usage	A room for storage of equipment and unit supplies, directly off the unit administrative area.
Ceiling Ht.	12 ft. (3.7 m).
Finishes	**Walls.** CMU or painted gypsum wall board. **Floor.** Sealed concrete. **Ceiling.** None required.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	Freestanding shelving.
User-provided FF&E	
Special Requirements	Provide lockable door.

Table 4-37. Drill Hall

Description/ Usage	This is a multipurpose space that provides a large, open auditorium-like space for musters, training, drill assessment, team building scenarios, physical fitness, lectures, and ceremonies or presentations.
Ceiling Ht.	25 ft. (7.62 m).
Finishes	**Walls.** Painted CMU. **Floor.** Cushion underlayment and poured synthetic multi-purpose flooring system with rubber base. Provide game lines to include main court basketball and volleyball lines in different colors, if required by User. **Ceiling.** Exposed painted structure, except provide NRC (Average Sound Absorption Coefficient) of not less than 0.70).
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled," HVAC".
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, "Fire Protection".
Power	Provide outlets per the paragraph in Chapter 3 entitled, "Electrical Design". Provide additional outlets in the stage floor.
Lighting	Provide Lighting System per the paragraph in Chapter 3 entitled, "Electrical Design".
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide speakers and PA controls. **Telephone.** Provide four outlets. One on each wall. **Data.** Provide four outlets/lines. One on each wall. **Security.** None required.
Acoustics	Reverberation time must equal 1.0 second. Provide additional acoustical control with sound baffles, banners, and acoustical materials. Provide noise attenuation measures to mitigate acoustical problems resulting from mechanical systems, plumbing systems, and vibration transmitted through the facility structure. Design walls and openings to have an STC in accordance with ANSI/ASA S12.60.
Casework/Built-in Equipment	Provide a pass-through window to the mess room. Provide projector mount and electrical operated screen for presentations.
Furnishings Fixtures & Equipment (FF&E)	Folding chairs and tables on rolling carts for seating 200 people. Optional portable stage.
User-provided FF&E	
Special Requirements	Provide a stage (raised platform) at the end opposite the entrance from the mess. As budget and mission requirements dictate, design this space to accommodate large-audience audio-visual presentations, which may require items such as a built-in screen, built-in wiring, and additional controls. Provide a pair of 3'-6" (1.07 m) x 7'-0" (2.13 m) (7'-0" (2.13 m) clear width) hollow metal doors to exterior.

Table 4-38. Drill Hall Storage

Description/ Usage	Space behind the drill hall stage for storage of folding tables and chairs on rolling carts and other miscellaneous items such as flag poles and podiums.
Ceiling Ht.	25 ft. (7.62 m).
Finishes	**Walls.** Painted CMU. **Floor.** Sealed concrete. **Ceiling.** Exposed painted structure.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	
Furnishings Fixtures & Equipment (FF&E)	
User-provided FF&E	
Special Requirements	

Table 4-39. Mechanical Room

Description/ Usage	Space behind the drill hall stage for storage of folding tables and chairs on rolling carts and other miscellaneous items such as flag poles and podiums.
Ceiling Ht.	25 ft. (7.62 m).
Finishes	**Walls.** Painted CMU. **Floor.** Sealed concrete. **Ceiling.** Exposed painted structure.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	Provide wall and door construction with a factory STC rating of 49. STC rating does not need to be field verified.
Casework/Built-in Equipment	
Furnishings Fixtures & Equipment (FF&E)	
User-provided FF&E	
Special Requirements	

Table 4-40. Urinalysis Area

Description/ Usage	Separate male and female toilets directly off the drill hall and designed to facilitate supervision during urinalysis testing.
Ceiling Ht.	8 ft. (2.44 m).
Finishes	**Walls.** Epoxy painted, moisture-resistant gypsum wall board with a ceramic tile wainscot. Provide full-height ceramic tile on wet walls. **Floor.** Porcelain tile with flush cove base. **Ceiling.** Painted, moisture-resistant gypsum board.
Plumbing	**Male.** One water closet, two urinals, and one wall-hung lavatory. **Female.** Two water closets and one wall-hung lavatory. Provide a floor drain in each toilet.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design”. Provide power to the air hand dryers. Provide at least one duplex outlet in the drill hall wall to one side of the entrance to the urinalysis area to accommodate a registration table and equipment.
Lighting	Provide system per he paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** Provide at least one outlet in the drill hall wall to one side of the entrance to the urinalysis area. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Water closet and urinal partitions must not impede direct vision supervision during urinalysis testing. Water closet partitions must have doors for when the toilet is used at other times, but these doors must be securable in a fully-open position. Toilet accessories: air hand dryers, toilet paper dispensers, robe hooks, grab bars, and soap dispensers. Mirror.
Furnishings Fixtures & Equipment (FF&E)	
User-provided FF&E	
Special Requirements	Ensure the layout of the room provides adequate space behind each water closet and urinal for a supervisor to stand during urinalysis testing.

Table 4-41. Communications Room(s)

Description/ Usage	Secure room housing equipment for NMCI equipment. Additional rooms may be required for a multi-story building.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Resilient sheet or tile such as rubber or vinyl with rubber base. Do not use VCT. **Ceiling.** ACP or none required.
Plumbing	None required.
HVAC	Provide system per the paragraph in Chapter 3 entitled, “HVAC”.
Fire Protection	Provide system per the paragraph in Chapter 3 entitled, “Fire Protection”.
Power	Provide outlets per the paragraph in Chapter 3 entitled, “Electrical Design” and for all dedicated equipment.
Lighting	Provide system per the paragraph in Chapter 3 entitled, “Electrical Design”.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** Navy to provide/install equipment. **Data.** Navy to provide/install equipment. **Security.** Navy to provide/install equipment.
Acoustics	No requirement.
Casework/Built-in Equipment	Equipment racks. Provide 4 ft. (1.2 m) x 8 ft. (2.4 m) painted plywood panel on wall.
Furnishings Fixtures & Equipment (FF&E)	
User-provided FF&E	Computer servers and equipment.
Special Requirements	Provide lockable door.

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APPENDIX A REFERENCES

ACOUSTICAL SOCIETY OF AMERICA

http://acousticalsociety.org/

ANSI/ASA S12.60, *Part I, American National Standard Acoustical Performance Criteria, Design Requirements and Guidelines for Schools, Part 1: Permanent Schools.*

ARCHITECTURAL WOODWORK INSTITUTE

http://www.awinet.org

AWI Quality Standards Illustrated

DEPARTMENT OF DEFENSE

Technical Guide for the Integration of Secret Internet Protocol Router Network (SIPRNET

DEPARTMENT OF DEFENSE, UNIFIED FACILITIES CRITERIA PROGRAM

http://dod.wbdg.org/.

UFC 1-200-01, *General Building Requirements*

UFC 2-000-05N (P-80), *Facility Planning Criteria for Navy/Marine Corps Shore Installations*

UFC 3-101-01, *Architecture*

UFC 3-120-10, *Interior Design*

UFC 3-201-01, *Civil Engineering*

UFC 3-201-02, *Landscape Architecture*

UFC 3-301-01, *Structural Engineering*

UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*

UFC 3-420-01, *Plumbing Systems*

UFC 3-450-01, *Noise and Vibration Control*

UFC 3-501-01, *Electrical Engineering*

UFC 3-600-01, *Fire Protection Engineering For Facilities*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings.*

UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*

UFC 4-021-02NF, *Security Engineering: Electronic Security Systems*

UFC 4-510-01, *Design: Medical Military Facilities*

NATIONAL FIRE PROTECTION ASSOCIATION

http://www.nfpa.org

NFPA 101, *Life Safety Code*

UNITED STATES NAVY

CNIC Instruction 1710.1, Operation of Unmanned Fitness Spaces, http://www.navyfitness.org/fitness/Policy_and_Directives/unmanned_fitness_space_policy/

MIL HDBK 1013/1A, *Design Guidelines for Physical Security of Facilities,* http://www.wbdg.org/ccb/NAVFAC/DMMHNAV/1013_1a.pdf

NAVFACINST 11010.45*, Comprehensive Regional Planning Instruction*, Naval Facilities Engineering Command, https://portal.navfac.navy.mil/portal/page/portal/docs/doc_store_pub/11010.45(3)_2.pdf

OPNAVINST 11010.20G, *Facilities Projects Manual*, SECNAV/OPNAV Directives Control Office, N09B15, http://doni.daps.dla.mil/Directives/11000%20Facilities%20and%20Land%20Management%20Ashore/11-00%20Facilities%20and%20Activities%20Ashore%20Support/11010.20G%20w%20CH-1.pdf

UL LLC

http://www.ul.com/usa/

UL 634*, Connectors and Switches for Use with Burglar-Alarm Systems*

UL 639*, Standard of Safety for Intrusion Detection Units*

APPENDIX B SPACE PLANNING

B-1 SPACE PLANNING GUIDELINES.

The NOSC space program is determined by a detailed planning analysis to be conducted according to UFC 2-000-05N (P-80), *Facility Planning Criteria for Navy/Marine Corps Shore Installations.* Figures B-1.1 through B-1.2 illustrate sample interactive spreadsheets completed for hypothetical Navy facilities and programs that are defined by their respective Form DD1391.

Figure B-1.1 Example for 400 PN NOSC

NOSC - Navy Space Program Worksheet

FOR MOST MONITORS (1024x768) VIEW AT 100 to 110%.

Click Here to Reset Sheet

ENTER PROJECT NAME AND INFORMATION: 400 PN Example NOSC, Somewhere, USA

400 PN Example NOSC				Somewhere, USA	
Enter Number of Drill Personnel			400		
				ft²	**m²**
Administrative Support					
	ID Check	Standard for all facilities		96	8.92
	Recruiting Office	Enter Number of Recruiters (2-4)	2	250	23.23
	Quarterdeck	Standard for all facilities		500	46.45
	Full Time Staff (FTS)	Enter Number of FTS	12	1,560	144.92
	Service Counter/Waiting Area			260	24.15
	ID Service Area			60	5.57
	Navy Family Services Office	Select Yes or No	Yes	140	13.01
	Copier/mail nook			17	1.56
	Mail Distribution			60	5.57
	Mail Receiving	Select Yes or No	No	-	-
	Conference Room			500	46.45
	Funeral Honors Office	Standard for all facilities, includes coffin storage		400	37.16
	Distance Learning Center			1,000	92.90
	Mess	Standard for all facilities		160	14.86
	SIPRNET	Standard for all facilities		100	9.29
	Supply Storage			340	31.59
	Fitness Room	Standard for all facilities		450	41.81
	Public Toilets	Included in Multiplier			-
	Shower/Locker Room			1,006	93.48
	Showers			110	10.24
	Locker Room			896	83.24
	Break/Waiting Room			300	27.87
	Recycling Area	Standard for all facilities		76	7.06
	Telecommunications Closet	Included in Multiplier			-
	NMCI Closet	Standard for all facilities		90	8.36
Medical Suite		Select Medical Suite - Yes or No	Yes		
	Medical Office and Reception	Enter no. of Medical Staff:	2	(2 is min	430 39.95
	Check-in/Admitting/Vision			64	5.95
	Medical Exam Rooms			180	16.72
	Dental Exam Room	Enter no. of Dentists:	1	80	7.43
	Doctor Library and Transcription R	Standard Size if Included		200	18.58
	Dental X-Ray	Standard Size if Included		100	9.29
	Audio Booth	Standard Size if Included		216	20.07
	Immunization Room	Standard Size if Included		60	5.57
	Blood Draw	Standard Size if Included		120	11.15
	Medical Toilet	Standard Size if Included		50	4.65
	Medical File Room			96	8.92
	Medical Supply Closet			240	22.30
	Medical Equipment Storage	Standard Size if Included		300	27.87
Unit Areas					
	Unit Classrooms			8,000	743.20
	Unit Administrative Area	Enter no. of Units:	15		
	Private Offices			2,700	250.83
	Workstations			2,925	271.73
	Unit Toilets	Included in Multiplier			-
	Unit Storage			750	69.68
Drill Hall					
	Drill Hall			5,250	487.73
	Drill Hall Storage			420	39.02
	Urinalysis Area	Standard for all facilities		180	16.72
	Support Space	Included in Multiplier			-
		Subtotal - Total Net Building Area		**29,726**	**2,761.55**
	Net-to-Gross factor at 0.35	Use default or select from range:		10,404	966.54

* The net-to-gross factor accounts for circulation space, mechanical and electrical spaces, toilets, and wall thicknesses. The net-to-gross multiplier for Navy Operational Support Centers, as set by UFC 2-000-05N, is 35%.

TOTAL GROSS BUILDING	**40,130**	**3,728.09**
TOTAL PROJECT SCOPE	**40,130**	**3,728.09**

Figure B-1.2 Example for 800 PN NOSC

NOSC - Navy Space Program Worksheet

FOR MOST MONITORS (1024x768) VIEW AT 100 to 110%.

Click Here to Reset Sheet

ENTER PROJECT NAME AND INFORMATION: 800 PN Example NOSC Somewhere, USA

800 PN Example NOSC			Somewhere, USA		
Enter Number of Drill Personnel		800			
				ft²	m²
Administrative Support					
ID Check	Standard for all facilities			96	8.92
Recruiting Office	Enter Number of Recruiters (2-4)	4		480	44.59
Quarterdeck	Standard for all facilities			500	46.45
Full Time Staff (FTS)	Enter Number of FTS	20		2,600	241.54
Service Counter/Waiting Area				260	24.15
ID Service Area				60	5.57
Navy Family Services Office	Select Yes or No	Yes		140	13.01
Copier/mail nook				31	2.84
Mail Distribution				60	5.57
Mail Receiving	Select Yes or No	Yes		100	9.29
Conference Room				550	51.10
Funeral Honors Office	Standard for all facilities, includes coffin storage			400	37.16
Distance Learning Center				1,180	109.62
Mess	Standard for all facilities			160	14.86
SIPRNET	Standard for all facilities			100	9.29
Supply Storage				440	40.88
Fitness Room	Standard for all facilities			450	41.81
Public Toilets	Included in Multiplier				-
Shower/Locker Room				1,119	103.98
Showers				159	14.79
Locker Room				960	89.18
Break/Waiting Room				450	41.81
Recycling Area	Standard for all facilities			76	7.06
Telecommunications Closet	Included in Multiplier				-
NMCI Closet	Standard for all facilities			90	8.36
Medical Suite	Select Medical Suite - Yes or No	Yes			
Medical Office and Reception	Enter no. of Medical Staff:	4	(2 is mini	710	65.96
Check-in/Admitting/Vision				128	11.89
Medical Exam Rooms				270	25.08
Dental Exam Room	Enter no. of Dentists:	2		160	14.86
Doctor Library and Transcription R	Standard Size if Included			200	18.58
Dental X-Ray	Standard Size if Included			100	9.29
Audio Booth	Standard Size if Included			216	20.07
Immunization Room	Standard Size if Included			60	5.57
Blood Draw	Standard Size if Included			120	11.15
Medical Toilet	Standard Size if Included			50	4.65
Medical File Room				192	17.84
Medical Supply Closet				480	44.59
Medical Equipment Storage	Standard Size if Included			300	27.87
Unit Areas					
Unit Classrooms				16,000	1,486.40
Unit Administrative Area	Enter no. of Units:	30			
Private Offices				5,400	501.66
Workstations				5,850	543.47
Unit Toilets	Included in Multiplier				-
Unit Storage				1,500	139.35
Drill Hall					
Drill Hall				6,000	557.40
Drill Hall Storage				740	68.75
Urinalysis Area	Standard for all facilities			180	16.72
Support Space	Included in Multiplier				-
	Subtotal - Total Net Building Area			**47,998**	**4,459.00**
Net-to-Gross factor at 0.33	Use default or select from range:	0.33		15,839	1,471.47

* The net-to-gross factor accounts for circulation space, mechanical and electrical spaces, toilets, and wall thicknesses. The net-to-gross multiplier for Navy Operational Support Centers, as set by UFC 2-000-05N, is 35%.

TOTAL GROSS BUILDING	**63,837**	**5,930.47**
TOTAL PROJECT SCOPE	**63,837**	**5,930.47**

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APPENDIX C GLOSSARY

ACRONYMS

ABA	Architectural Barriers Act
ACP	Acoustic Ceiling Panel
ACS	Access Control System
AFCEE	Air Force Center for Engineering and the Environment
AFRC	Armed Forces Reserve Center
AWI	American Woodwork Institute
BIA	Bilateral Infrastructure Agreement
CAC	Common Access Card
CCTV	Closed Circuit Television
CNIC	Commander, Naval Installations Command
CONUS	Continental United States
DoD	Department of Defense
ESS	Electronic Security System
FC	Facilities Criteria
FDS	Functional Data Sheets
FF&E	Furniture, Fixtures & Equipment
fps	frames per second
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
HSS	High Security Switches
HVAC	Heating, Ventilation, and Air Conditioning
IDS	Intrusion Detection System
LEED®	Leadership in Energy and Environmental Design

MCNR	Military Construction Navy Reserve
NAVFAC	Naval Facilities Engineering Command
NAVFACINST	NAVFAC Instruction
NMCI	Navy Marine Corps Intranet
NOSC	Navy Operational Support Center
OCONUS	Outside continental United States
OPNAV	Office of the Chief of Naval Operations
OPNAVINST	OPNAV Instruction
POV	Privately Owned Vehicle
SECNAV	Secretary of the Navy
SOFA	Status of Forces Agreements
STC	Sound Transmission Coefficient
UFC	Unified Facilities Criteria
UPS	Uninterruptable Power Supply
U.S.	United States
VTC	Video Teleconferencing

UFC 4-179-01
16 January 2004

UNIFIED FACILITIES CRITERIA (UFC)

DESIGN: NAVY FIREFIGHTING SCHOOL FACILITIES



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UNIFIED FACILITIES CRITERIA (UFC)

DESIGN: NAVY FIRE FIGHTING SCHOOL FACILITIES

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEERING SUPPORT AGENCY

Record of Changes (changes indicated by **1**\ ... /**1**/)

Change No.	Date	Location

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

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CHAPTER 1

INTRODUCTION

1-1 **PURPOSE AND SCOPE**. This UFC is comprised of two sections. Chapter 1 introduces this UFC and provides a listing of references to other Tri-Service documents closely related to the subject. Appendix A contains the full text copy of the previously released Military Handbook (MIL-HDBK) on this subject. This UFC serves as criteria until such time as the full text UFC is developed from the MIL-HDBK and other sources.

This UFC provides general criteria for the design of firefighting school facilities.

Note that this document does not constitute a detailed technical design, maintenance or operations manual, and is issued as a general guide to the considerations associated with the design of firefighting school facilities.

1-2 **APPLICABILITY**. This UFC applies to all Navy service elements and Navy contractors; Air Force service elements should use the references cited in paragraph 1-3 below; all other DoD agencies may use either document unless explicitly directed otherwise.

1-2.1 **GENERAL BUILDING REQUIREMENTS**. All DoD facilities must comply with UFC 1-200-01, *Design: General Building Requirements*. If any conflict occurs between this UFC and UFC 1-200-01, the requirements of UFC 1-200-01 take precedence.

1-2.2 **SAFETY**. All DoD facilities must comply with DODINST 6055.1 and applicable Occupational Safety and Health Administration (OSHA) safety and health standards.

NOTE: All **NAVY** projects, must comply with OPNAVINST 5100.23 (series), *Navy Occupational Safety and Health Program Manual*. The most recent publication in this series can be accessed at the NAVFAC Safety web site: www.navfac.navy.mil/safety/pub.htm. If any conflict occurs between this UFC and OPNAVINST 5100.23, the requirements of OPNAVINST 5100.23 take precedence.

1-2.3 **FIRE PROTECTION**. All DoD facilities must comply with UFC 3-600-01, *Design: Fire Protection Engineering for Facilities*. If any conflict occurs between this UFC and UFC 3-600-01, the requirements of UFC 3-600-01 take precedence.

1-2.4 **ANTITERRORISM/FORCE PROTECTION**. All DoD facilities must comply with UFC 4-010-01, *Design: DoD Minimum Antiterrorism Standards for Buildings*. If any conflict occurs between this UFC and UFC 4-010-01, the requirements of UFC 4-010-01 take precedence.

1-3 **REFERENCES**. The following Tri-Service publications have valuable information on the subject of this UFC. When the full text UFC is developed for this

subject, applicable portions of these documents will be incorporated into the text. The designer is encouraged to access and review these documents as well as the references cited in Appendix A, MIL-HDBK 1027/1B.

1. US Air Force

AFETL 91-4, Site Selection Criteria for Fire Protection Training Areas, 14 June 1991

APPENDIX A

MIL-HDBK 1027/1B
FIREFIGHTING SCHOOL FACILITIES

SYSTEM
INTERNATIONAL

MIL-HDBK-1027/1B
31 JANUARY 1998

Superseding
MIL-HDBK-1027/1A
31 JULY 1994

DEPARTMENT OF DEFENSE
HANDBOOK

FIREFIGHTING SCHOOL FACILITIES

AMSC N/A AREA FACR

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

ABSTRACT

This handbook provides basic design guidance developed from extensive reevaluation of facilities necessary to support new firefighting devices. It is intended for use by experienced architects and engineers. The contents cover the technical and environmental requirements of the structures that house them.

FOREWORD

This handbook has been developed from an evaluation of facilities in the shore establishment, from surveys of the availability of new materials and construction methods, and from selection of the best design practices of the Naval Facilities Engineering Command (NAVFACENGCOM), other Government agencies, and the private sector. This handbook was prepared using, to the maximum extent feasible, national professional society, association, and institute standards. Deviations from these criteria cannot be made without prior approval of the NAVFACENGCOM Criteria Office.

Design cannot remain static any more than can the functions it serves or the technologies it uses. Accordingly, recommendations for improvement are encouraged and should be furnished to Commanding Officer, Atlantic Division, Naval Facilities Engineering Command (LANTNAVFACENGCOM), Code 403, 1510 Gilbert Street, Norfolk, VA 23511-2699; telephone (757) 322-4243.

DO NOT USE THIS HANDBOOK AS A REFERENCE DOCUMENT FOR PROCUREMENT OF FACILITIES CONSTRUCTION. IT IS TO BE USED IN THE PURCHASE OF FACILITIES ENGINEERING STUDIES AND DESIGN (FINAL PLANS, SPECIFICATIONS, AND COST ESTIMATES). DO NOT REFERENCE IT IN MILITARY OR FEDERAL SPECIFICATIONS OR OTHER PROCUREMENT DOCUMENTS.

TRAINING FACILITIES CRITERIA MANUALS

Criteria Manual	Title	Preparing Activity
MIL-HDBK-1027/1	Firefighting School Facilities	LANTDIV
MIL-HDBK-1027/2	General Training Facilities (Proposed)	SOUTHDIV
MIL-HDBK-1027/3	Range Facilities and Miscellaneous Training Facilities Other Than Buildings	SOUTHDIV
MIL-HDBK-1027/4	Aviation Training Facilities	SOUTHDIV

FIREFIGHTING SCHOOL FACILITIES

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Section 1: INTRODUCTION

1.1 Scope. This military handbook prescribes design criteria necessary to support new firefighting training devices and to outline technical and environmental requirements of structures which house them.

1.2 Application. Training facilities covered by this handbook as identified by the devices contained within are as follows:

a) 19F1A and 19F1B - Advanced Shipboard Firefighting Trainers

b) 19F3 and 19F3B - Basic Shipboard Firefighting Trainers, which consist of four training structures:

(1) B1 - Engine Room - Bilge Fire Trainer

(2) B2 - Galley/Berthing Fire Trainer

(3) B3 - Pit Fire Trainer

(4) B4 - Pit Fire Trainer

c) 19F3A and 19F3C - Combined Basic/Advanced Shipboard Firefighting Trainers, which consist of a 19F1A portion and 19F3-B3 trainers

d) 19F4 and 19F4A - Basic Shipboard Aircraft Firefighting Trainers

e) 19F5 and 19F5A - Basic Recruit Shipboard Firefighting Trainers

f) 21C12 and 21C12A - Submarine Firefighting Trainers

g) Gas Chamber - Chemical Warfare Trainer

h) Seawolf

1.2.1 Types of Trainers. There are two types of trainers: warm and cold weather designs. Cold weather design is applicable to sites in climates where annual heating degree days are 1100 or greater. Warm weather design is applicable to sites in climates where annual heating degree days are less than 1100.

Section 2: DESIGN CRITERIA

2.1 Site Development

2.1.1 Flooding Considerations. When planning the site for a new 21C12 and 19F series facility, the finished floor area of the crawl space should be high enough to preclude flooding during a 100-year storm. The training device equipment that will be installed in the crawl space is expensive and would be destroyed if the crawl space were flooded.

2.1.2 Prevailing Wind. Prevailing wind direction should be one of the first considerations in selecting a site. Heat and products of combustion may be objectionable to adjacent buildings located downwind. Show prevailing wind direction on drawings.

2.1.3 Drainage. Rainwater should be channeled away from device structures because water that enters the structure should be first treated and then disposed of in the sanitary sewer. Since firefighting agents are collected in the structures, surface runoff can be disposed of in the storm system without treatment.

2.1.4 Circulation Patterns. Design the site layout to allow for personnel circulation patterns between each of the various support facilities and trainers.

2.1.5 Support Facilities. There are various support facilities that must be provided with the 19F and 21C12 series trainers. Provide classroom space, restrooms, showers, and changing area to support the students and instructors. In addition, provide a maintenance area, utilities space, storage area, and wastewater treatment system. Design initial planning to allow for bulk deliveries of fuel and dry storage.

2.1.6 Security. Fence the grounds around a firefighting school to restrict entry of unauthorized personnel. Fence each fuel and CO_2 storage area, and exterior doors to firefighting school facilities should be of the lockable type.

2.1.7 Setbacks and Clearances. The exterior of firefighting structures should have a clearance of 16 m away from any

obstruction, trees, building, structure, etc., to allow free access of natural ventilation air to the crawl space, and to allow access for snow and ice removal.

2.1.8 Pollution Permits. The preliminary design should include the initiation of air and water pollution permit applications.

2.1.9 Contaminated Soil. As a result of several firefighting trainer sites having contaminated soil, evaluate selected firefighting trainer sites for soil and groundwater contamination during the planning stage of the project. Permits may be required for the site cleanup.

2.1.10 Design for Accessibility of Physically Handicapped Personnel. Provisions for physically handicapped personnel are not required in firefighting training facilities. Firefighting trainers are required to be designed for able-bodied naval personnel.

2.1.11 Energy Conservation. Normal building energy conservation measures are not a consideration in the firefighting facilities because of the facilities application, i.e., because heat is generated by the fires, energy conservation measures are not feasible. Energy studies are not required to be performed for firefighting trainers because the trainers are the same as trainers at other locations, and each trainer has the same mechanical and electrical systems. The one area of the firefighting facilities that will have conditioned air is the instructor station and the electrical room, which should be designed to conserve energy in compliance with the latest techniques and applicable standards. Refer also to MIL-HDBK-1190, Facility Planning and Design Guide.

2.1.12 Design Similarity. Design and construct firefighting training structures the same from site to site (i.e., firefighting training structures should have the same internal dimensions, internal arrangements, similar functions, similar equipment, etc.). Design similarity is required to ensure that all naval personnel are exposed to similar training environments.

2.2 Utility Design

2.2.1 General

2.2.1.1 Service. The various services, water, fuel, 100 percent foam (surrogate) concentrate, and, possibly, compressed air should be routed to each training structure by underground pipe. Each service should include a manual shutoff valve for maintenance purposes. The valves to a given structure should be grouped together in a valve pit with a cover small and light enough to be lifted by two men. No cover should weigh more than 57 kg and each cover should have lifting handles. The propane valve should be in a separate pit.

2.2.1.2 Design for Simultaneous Operation. Design and size utilities for the firefighting training school to allow for training structures to operate simultaneously.

2.2.1.3 Freeze Protection and Snow. Firefighting facilities should be protected against freeze damage. Because training structures are not usually heated, interior and exterior water-based utilities located aboveground should be protected. Large valve pits with many valves should also include protection for freezable utilities. Refer also to pars. 3.2.3 and 3.11.8 for additional requirements. Methods of freeze protection include drain-down, heat tracing, and air purge. The following criteria applies to this handbook:

a) When a drain-down system employs some method of automatically sensing ambient temperature and controlling a valve, install a manual valve in parallel with the automatic valve. The manual valve will provide an added measure of protection.

b) Provide freeze protection at any location where there is the possibility of freezing temperatures. Sites as far south as Mayport, Florida, should have freeze protection.

c) In those locations subjected to regular snow accumulations, ensure that the design will not impede the operation of exterior equipment. Design facilities to accommodate snow removal procedures.

d) Since the foam stations and foam reels cannot be adequately drained they should be freeze-protected by a removable, insulated and electrically heated cover. The cover should be completely removable so that during training the hose stations maintain a shipboard appearance.

2.2.1.4 Breathing Air. The quality standard for compressed air to be used for breathing air is Federal Specification (Fed. Spec.) BB-A-1034, Compressed Air, Breathing. Breathing air is not a requirement in surface fleet training facilities; however, it is a requirement for submarine fleet trainers. Refer to par. 3.12.4.6 for requirements. Breathing air for instructors by the use of personal "SCOTPAK" units is not covered by this handbook.

2.2.1.5 Fire Department. Training facilities are designed on the basis that experienced instructors with adequate fire control equipment will be present at--all times that training is being conducted. The fire suppression capability will be supplemented by a municipal or military fire department whenever possible, with fire department notification provided by properly spaced exterior fire alarm boxes, fire telephones, or other approved means. Provide fire hydrants at each firefighting school site in accordance with the National Fire Protection Association (NFPA) 24, Installation of Private Fire Service Mains and Their Appurtenances.

2.2.1.6 Electromagnetic Interference (EMI). Test firefighting project sites for EMI to determine required EMI protection for trainers. EMI testing should be accomplished by the Naval Air Warfare Center Training Systems Division (NAWCTSD) during preliminary design to determine cost impact. If NAWCTSD test results indicate EMI shielding is required, NAWCTSD should determine if the device equipment can be shielded. If device EMI shields are determined to be inadequate, then NAWCTSD should notify the Engineering Field Division (EFD) or Engineering Field Activity (EFA), NAVFACENGCOM, and LANTNAVFACENGCOM of facility EMI shielding requirements.

2.2.2 Equipment Outages

2.2.2.1 Standby. There is no requirement for standby equipment in excess of full design capacity for the systems supporting a firefighting training facility. Critical support

systems, those whose downtime would affect a large portion of the training, should be designed with parts totaling full capacity, e.g., two 50 percent fans or two 50 percent pumps. Then while a piece of equipment is not operating and being repaired, the second piece of equipment can be carrying 50 percent of the load. In all cases, critical equipment should be designed to provide as much reliability and maintainability as possible.

2.2.2.2 Emergency Power. Emergency power is generally not a requirement for firefighting facilities. The fuel and CO2 systems are required to be failsafe, shutting off fuel and CO2 when electrical power is lost. Without a continuous source of fuel, there can be no fire, because there is no combustible material inside a training structure. For this reason the propane entry station consisting of the "block and vent" (Appendix J, Figure J-2) should be located outside of the training structure.

The availability of electricity at most training facilities is reliable enough that periodic outages will not adversely affect training. In the event of electrical power outage at a trainer, provide a battery backup annunciation and alarm at the 24-hour duty desk and at the instructor's station. Provide capability to silence the alarm at both locations.

2.2.2.3 Emergency Water. Emergency water should be water supplied under sufficient pressure to fight fires without the use of electrical energy. Water flow tests should be performed to determine the adequacy of the water supply system. A separate emergency water system is not necessary for the 19F series trainers for the same reasons stated above under emergency power. The Navy's portable gasoline powered P-250 pumps and the Municipal Fire Department are available for non-trainer structure fires.

2.2.2.4 Lightning Protection. As a minimum, the requirements of NFPA 78, Lightning Protection Code, should be followed. Lightning protection is not required for the propane tanks.

2.2.2.5 Lighting. The fenced-in grounds and parking area around the firefighting facility should be lighted to provide general security.

2.2.3 Fuel

2.2.3.1 Propane. Propane should be the fuel for the 19F and 21C12 series trainers. It has a standard and reliable chemical composition as opposed to natural gas which is a blend of chemicals. Propane gives the desirable flame characteristics and has been tested for environmental acceptability in the training situation. Complete stoichiometric burning of propane requires 23 cubic meters (cu. m) of air for each cubic meter of fuel at atmospheric pressure. The following criteria is provided pertaining to propane as outlined in NFPA 58, Storage and Handling of Liquefied Petroleum Gases:

a) Properties and characteristics of liquefied petroleum (LP) gases. Propane has certain properties and characteristics which must be understood by the persons handling and processing these products.

(1) They are normally gases but are changed to liquid state by the application of moderate pressure. At atmospheric pressure commercial propane boils at minus 42.2 degrees C. It is evident that at normal atmospheric temperatures and pressures, propane will be in a gaseous form. Propane in liquid state and open to the atmosphere will evaporate (not boil) although the atmospheric temperature may be below its boiling point.

(2) LP gases contain no toxic components such as carbon monoxide. However, the vapors should not be inhaled as serious accidents could occur from ignition of gases contained in the lungs.

(3) LP gases are heavier than air. With air equal to 1.0, the specific gravity of propane is 1.52. LP gas will, therefore, collect in low places but will eventually diffuse into the atmosphere.

(4) The explosive range of propane-air mixture is lower and narrower than with other fuel gases and is 2.15 (lower explosive limit) to 9.6 (higher explosive limit) percent in air. The lower explosive limit is the limit at which combustion of propane can be sustained. The higher explosive limit is the limit at which the combustion of propane cannot be sustained.

(5) In accordance with requirements of NFPA 58, LP gases are effectively odorized to positively indicate presence of gas down to concentration in air of not over one-fifth the lower explosive limit.

(6) The pressure exerted by propane gas in a container is entirely dependent upon the temperature of the contents. Excessive pressure may be relieved by discharging gas from above the liquid thus reducing the temperature of the liquid or by application of a cooling agent to the outside of the container. In the interest of safety, it is preferable to reduce the temperature of the liquid rather than permit the escape of high pressure gas with resultant potential hazard.

b) Propane data as listed in NFPA 58:

Total heating value after vaporization:	25 140 kJ/L (liquid) 92 430 kJ/cu. m 50 000 kJ/kg
.271 cu. m of vapor per L of liquid at 15.56 degrees C	

Vapor pressure in kPa at:

20 degrees C	895
40 degrees C	1482
55 degrees C	1980

Specific gravity of liquid at 15.56 degrees C:	0.504
Initial boiling point at 1.00 atmosphere, degrees C:	-42

Flammability limit, percent of propane gas in air:

Lower	2.15
Upper	9.60

c) The design of the fuel system should be in accordance with NFPA 54, National Fuel Gas Code and NFPA 58 and NAVFAC Design Manual DM-22, Petroleum Fuel Facilities. NFPA 58 covers the LP gas system including the container, the vaporizer,

the unloading station, and tank and pipe appurtenances up to the double block and bleed valve at each building. NFPA 54 covers any part of the system where the propane gas pressure is less than 1370 kPa.

d) Fuel should be stored in a single location which provides easy access for tank trucks. This is to facilitate inventory taking, reduce installation costs, and increase safety. Use a minimum of two tanks to store the fuel. This allows for tank maintenance without interruption to the training. The total storage should equal 30 days' consumption. Design a full storage tank to contain 80 percent liquid equivalent to 30 days' storage and 20 percent vapor. The vapor space allows for thermal expansion and must never be used for liquid storage. Fence the storage area to restrict pedestrian and vehicular traffic. The fence should have a main entrance gate and a second gate on the opposite fence from such gate for emergency exit. At fence openings, provide a remote shutoff station for the emergency shutoff valves, refer to subpar. o). The fence area should have anti-vehicle barricade posts to protect tanks from an accidental collisions from vehicles or trucks. In accordance with NFPA 58, the storage area should not have walls, barricades, curbed areas, etc., which would prevent access and lateral ventilation from flushing the area. Provide the tanks in accordance with the American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section VIII, unfired pressure with a minimum working pressure of 2100 kPa. Propane storage tanks should have an American Society of Mechanical Engineers stamp of approval on the tanks. No used tanks are allowed. Tank foundations should be proper for the soil bearing conditions and the weight of the tank plus its full weight of water because of the future hydrostatic testing of each tank. Tank exterior shells should be coated with proper corrosion protective material where the tank shell rests on the foundation. This may be accomplished with a properly saturated pad. The tank should be adequately grounded.

e) The tank valves and other appurtenances should be listed and approved for LP gas use by Underwriters Laboratories, Inc. (UL), Factory Mutual Research Corporation (FM), or other qualified testing facility. The tank pressure relief valves should be in accordance with the specifications of UL or ASME. The vent outlet from such valves should be a minimum of 2150 mm

in height and should discharge vertically upward. The discharge vents should be equipped with a loose rain cap so that it will not restrict the flow of propane vapor through such vent. The rain cap or end of the vent should be installed to direct the discharge vertically upward only. It is preferable to install the pressure relief valves on a multiport manifold so that one valve at a time can be shut off for repair or replacement while the tank is properly protected by the remaining valve or valves which are still in service and cannot be shut off, thus, ensuring full required relieving capacity. The vertical discharge of propane vapor 2150 mm above the top of the container assists in dispersing propane in a general safe manner.

f) Storage tank liquid and vapor operating connections are to be equipped with internal valves. These internal valves function as a primary shutoff valve and have built-in excess flow protection. The valves are to be operated manually at the installed location, or from a remote location via pneumatic actuator. Provide a fusible plug at the valve location to close the valve in the event of fire.

g) The water drain discharge opening of the pressure relief valves must be equipped with a diverter to deflect any product flow when the valve operates away from impingement on the tank or an adjoining tank. This is necessary to prevent a hot spot and a possible tank shell failure if such discharge would become ignited.

h) Each connection to the storage tank should be equipped with an excess flow valve or a backflow check valve as required in NFPA 58 except for the pressure relief valve and openings of 1 mm or smaller. The container should also be equipped with a pressure gauge.

i) Liquid piping between shutoff points should be equipped with a hydrostatic pressure relief valve to relieve the pressure caused by an increase in the liquid temperature resulting in an increase in pressure when the shutoff valves are in a closed position.

j) Accuracy in filling the tanks is important because of the expansion of the liquid as its temperature rises. The

amount of propane that can be placed in a tank over 4550 L water capacity as shown in Table 4-5.2.1 of NFPA 58 is 45 percent of the water weight capacity of the container. Then Table 4-5.2.3(b) shows that at 15.9 degrees C temperature the container can be filled to 88 percent. It is, thus, important to have accurate gauging devices. Such tanks generally have a variable gauge for general inventory control. The gauging devices are generally a float magnetic gauge with an indicator dial to show the percentage full of the contents at different temperatures; however, the gauging devices are not accurate enough to use them for maximum fill control because the float arm may become bent or other malfunction may occur that throws off the accuracy. As a result, a fixed liquid level gauge is required. This is a tube into the tank with the tube length made to extend down to the proper liquid level of 88 percent. There is a small valve with a restricted opening at the outer end. On filling of the container, the operator opens this valve and vapor will flow out during loading until the liquid reaches the bottom of the tube where a white cloud will appear at the outlet valve. This is not liquid propane but rather it is a water vapor cloud which is created when liquid propane expands to vapor and resulting refrigeration condenses the moisture in the air and creates the white cloud as fog. When this occurs, the operator should immediately shut off the flow of propane into the container and then shut off the gauge valve. Generally, at firefighting schools, transport trucks will be used.

k) Propane will be delivered to the containers by transport truck or, in some cases, by tank car. Generally at firefighting schools, truck transport will be used. Truck transports are generally 30 000 to 42 000 L capacity. Usually, such transports are equipped with an unloading pump. In such cases, the unloading hose is connected to the storage unloading station liquid line for unloading. The vapor return hose is also connected to the storage tank vapor line. This connection assists in the liquid transfer as it prevents a buildup of vapor pressure in the receiving tank. The transport might be equipped with a vapor compressor instead of a pump to use for off-loading. Off-loading involves vapor being drawn off the storage tank and discharged into the transport tank which creates a higher pressure differential in the transport tank and thus forces the liquid to flow into the storage tank. When the

liquid has been off-loaded from the transport to the storage, there will be some residual propane vapor in the transport. The vapor is recovered by switching the compressor valving so that it will then draw vapor from the transport and discharge it into the storage tank. This vapor piping to the storage tank should discharge into the liquid of the tank and not into the vapor space. This assists in condensing the vapor to liquid and thus speeds up the transfer. The recovery of the vapor results in an economic benefit.

l) Propane or water may be delivered to the storage by tank cars. In such cases, a proper tank car unloading facility must be installed. The facility should be a platform facility adjacent to the tank car unloading location. The facility should be equipped with liquid and vapor pipe lines and a hose connection at the platform. The hose connection should be of proper length to properly reach the tank car valve dome. There will be two liquid hoses so that a connection can be made to both liquid eduction valves on the tank car. These will be connected to the platform liquid piping at a three-way fitting. At the hose connection to this fitting, a backflow check valve should be installed at each hose connection to prevent backflow into the tank car. The tank car liquid education and the vapor openings on the manhole cover plate are equipped with excess flow valves on the underside of the manhole cover. Hose connections are also equipped with shutoff valves in the protective dome. A pressure relief valve is installed in the center of the protective dome with an opening in the dome cover above the relief valve. The tank car is equipped with a sampling tube extending down from the manhole cover to the sump at the tank bottom so that a sample of the propane or water may be drawn off. There is also a thermometer well extending into the car tank. The thermometer well have an antifreeze solution in it to a height of about 310 mm to provide conductivity of propane liquid temperature to the thermometer when it is inserted in the well.

m) The transport trucks or tank cars should always have the wheels blocked by chock blocks to prevent movement while parked and especially while unloading. The transport truck or tank car unloading point must be equipped with an emergency shutoff valve to prevent a discharge from the storage

tank(s) in case of a pullaway or break of the unloading hose or other equipment. Refer to NFPA 58. The emergency shutoff valve should be installed in the fixed piping between the tank and a substantial bulkhead with hose or swivel-type piping connections on the opposite side of the bulkhead from the emergency shutoff valve.

n) The bulkhead should be substantial and should be of concrete. The piping should be fully anchored to the bulkhead not just by inserting the pipe through a sleeve.

o) Provide emergency shutoff with three modes of operation: manually; remote control; and thermally. A preferable installation can be made which provides both thermal and remote control. The installation entails the running of plastic tubing to strategic points in or near the storage and unloading points pressurized with air, carbon dioxide (CO_2), etc., so that the pressure holds the valve open. Then if there is a fire, the plastic will melt, thus, enabling the valve to be closed. Install the plastic tubing so that it will be activated at all potential points of a flame. Install the tubing at a point where the emergency valve will be activated if there is a flame downstream beyond the bulkhead. For remote control, there may be a snap action release valve at several strategic locations in the tubing so that activation of valves releases the pressure and closes the emergency shutoff valve. The plastic tubing must be tied to the unloading hose so that a pullaway of the hose will break the tubing. In this way, a pullaway of the hose will activate the emergency shutoff valve and close the discharge from the tank storage. The excess flow valves in the transport piping should stop the flow from its tank. If it is a pullaway break, the transport tank valves should always have been closed before moving the vehicle.

p) After unloading the liquid from either a transport truck or a tank car, bleed the liquid propane from the connection after shutting off the valve at both the hose end and at the unloading piping. Many accidents have occurred because such bleeding has not been done. There should be a bleed attachment built into the unloading equipment for this purpose. If the attachment is not provided then bleeding can be done by only partially disconnecting the hose, thus, creating some additional hazards.

Remote shutoff control should be located at the 24-hour duty station and at each fence opening. The truck unloading station emergency shutoff should have a dual control of cable release and remote shutoff.

q) Normally vapors for use will be drawn off of the container from the vapor space above the liquid. Propane boils from a liquid to a vapor at a liquid temperature of minus 42.2 degrees C or above and thus replaces the vapor being used. However, this evaporation creates heavy refrigeration which cools down the temperature of the liquid. If the draw is heavy enough it will result in insufficient vaporization thus requiring the use of a vaporizer to convert the liquid to vapor.

r) There are two basic types of vaporizers. One is the indirect type which is heated by a heating unit remote from the vaporizer. The indirect type should furnish heat by steam, hot water, or other heating medium. The other is a direct-fired type. The standards for vaporizers is detailed in NFPA 58. Many times a pump is necessary to provide the necessary flow from the storage tank to the vaporizer because if the vapor pressure in the storage tank gets low, the proper quantity of liquid will not flow to the vaporizer, thus the need for the liquid pump. The installation should be in accordance with NFPA 58 and should have the electrical equipment in accordance with NFPA 70, National Electrical Code. Waterbath and indirect-fired vaporizers are both acceptable for use at firefighting training facilities. Use an indirect-fired vaporizer when there is a sufficient sized central steam or high temperature hot water heating plant or system available. In this case, the indirect-fired vaporizer would be less expensive than the waterbath vaporizer. Use a waterbath vaporizer when there is no central heating plant or system available. In this case, the waterbath vaporizer would be less expensive than an indirect-fired vaporizer and a new heating plant. No direct-fired vaporizers other than the waterbath type are to be used.

s) When using indirect-fired vaporizers, NFPA 58 applies. FM Loss Prevention Data, Section 7-55/12-28, Liquefied Petroleum Gas apply. In addition, install and design the waterbath vaporizer in accordance with the following:

(1) Waterbath vaporizers should be FM approved.

(2) Waterbath vaporizers should be located to maintain the space clearances as required by FM.

(3) Provide emergency shutoff valves with fusible links. Provide the following emergency shutoff valves in accordance with NFPA 58 and FM Loss Prevention Data:

(a) Liquid propane supply from the truck unloading station to the storage tank.

(b) Liquid propane supply from the storage tank to the vaporizer.

(c) Gas propane supply from the vaporizer. Regardless of which type of propane vaporizer is used, the truck unloading station should be located 23 m minimum from the tank and vaporizer. Refer to Appendix J, Figure J-1.

t) Indirect-fired vaporizers can be located indoors in specially designed vaporizer rooms. Refer to NFPA 58 for requirements. If a vaporizer room is provided then provide a separate propane alarm detection system for the room. This alarm detection system should provide an alarm (sound and flashing warning sign) in the instructor's station at the 24-hour duty desk, and locally at the vaporizer room entrance. Provide a 24-hour battery backup.

In addition to the alarm detection system, for propane vaporizers installed indoors, provide the following safety features:

(1) The exhaust fan should be located near the floor and should vent to the outside with high and low intakes in the door. The exhaust fan should be energized by an on-off switch located outside of the room.

(2) Doors with panic hardware.

(3) A leak detector readout with the readout outside.

(4) A leak detector kit located outside.

u) A totalizing, vapor type meter should be provided at the tank installation, at the vaporizer discharge, to record fuel used at the facility. The fuel system should be sized by

adding the demand rates listed herein for each trainer to be constructed. Flow meter should be a turbo meter with temperature and pressure compensation. Provide meter with digital interface connections.

(1) The propane will be delivered to the individual structures by underground pipe with a single entry to each structure. The propane piping at the site should be routed in a closed loop so as to maintain a constant supply pressure. Do not use galvanized steel pipe for underground installation. Underground pipe and fittings should be carefully coated for protection from corrosion and should be equipped with cathodic protection.

(2) The propane entry should consist of the apparatus and piping as shown in Appendix J, Figure J-2. Install a totalizing consumption meter on the structure side of the "house valve" to record the amount of propane used by that building. The device contractor will tie into the propane entry as shown in Appendix J, Figure J-2. Provide the propane entry outside. A list of valves, fixtures, appurtenances, and controls required for the propane system are shown in Appendix J, Figures J-3 through J-7.

(a) Provide underground piping located under roadways, parking areas, etc., in a vented protective conduit in accordance with API 2510, Design and Construction of LP Gas Installations at Marine and Pipeline Terminals, Natural Gas Processing Plants, Refineries, Petrochemical Plants, and Tank Farms.

(b) Propane piping should be welded and should be provided in accordance with ANSI B31.3, Chemical Plant and Petroleum Refinery Piping, and should be Schedule 80. On existing facilities, propane piping with threaded fittings should be back-welded.

(3) In addition to the above, provide a bank of two gaseous propane strainers with isolation valves at the propane entry for each training structure. The strainer bank should be located upstream from the isolation valve serving the flow meter. Each strainer should be sized and designed as follows:

(a) The propane demand flow rate, L/s.

(b) Stainless steel 1000 kPa basket type in-line strainer with flanged connections and ASME code stamp.

(c) Provide with a 30 micron filter screen.

(d) Support large basket strainers on outside reinforced structural concrete pads. Provide fence with locked gate and warning sign displaying "WARNING - PROPANE. NO SMOKING WITHIN 15 M."

(e) Designed for outside use.

(f) Provide means for cleaning including relieving propane pressure prior to opening the strainer.

(g) A potential manufacturer who can provide this strainer is Stream-Flow-Strainers, Inc., Buffalo, NY, (800) 263-8251, or Haywood Industrial Products Inc., Elizabeth, NJ (201) 351-5400. Other manufacturers are also available.

v) Safety precautions to be observed in handling LP gases:

(1) Smoking and open flames are prohibited in areas of storage tanks, unloading stations, and vaporizer.

(2) Motor vehicles are prohibited from entering the storage area. Motor vehicles should be prohibited from entering or leaving unloading area while transport trucks or tank cars are being unloaded.

(3) Test for leaks with soapsuds and a pressure drop test.

(4) Connect ground wire to tank cars and truck trailers before any unloading or loading operation is started.

(5) Wear rubber (neoprene) gloves when gauging tank cars, truck trailer, and storage tanks and when performing other operations.

(6) Keep vapor or liquid off skin and clothing. Liquid in contact with skin produces the same injury as a freeze burn.

(7) Thorough ventilation is required in buildings, especially at floor level.

(8) Use spark proof tools and explosion proof flashlights.

(9) Open valves slowly. If excess flow valves are closed, they may be opened by closing the line discharge valve for a few minutes, thus permitting pressure above and below excess flow valve to equalize internally through the small hole provided for this purpose, enabling the excess flow valve disk to drop into the open position.

(10) The coefficient of thermal expansion of the liquefied gas is high, therefore, liquid should not be confined in any isolated section of pipe except where a pressure relief valve is provided.

(11) Do not overfill storage tanks. The maximum allowable fill is 80 percent full, refer to NFPA 58 for exact fillage amounts.

(12) Do not pressurize tank cars above the safety valve setting as stenciled on the car. If faulty equipment on the car prevents normal unloading do not loosen or remove car valves under any circumstances. Fill in "Bad Order Tag" and attach to defective car part. Inform firefighting school supervisor of defective car and await further instructions on disposition of the car.

(13) Bleed vapor and liquid unloading and loading hoses before uncoupling from tank cars or truck transports.

(14) Bleed pressure from vapor compressor crankcase before removing oil fill plug.

(15) Before undertaking repairs the container or section of pipe to be repaired must be isolated by closing valves or physically disconnecting the involved section from communicating lines, as the situation warrants, followed by thorough purging with CO2.

(16) Hoses and fittings must be maintained in good order. Damaged or unsafe hoses must be removed from unloading area and must not be used for any purpose.

w) The propane interconnection at the device contractor tie-in point will be a block and vent propane entry as shown in Appendix J, Figure J-2. This interconnection will then meet the requirements set forth in NFPA 54 and also the FM insurance requirements.

x) The two most hazardous events associated with the gaseous fuel burning trainers are the fuel handling operations and the accumulation of unburnt fuel in the trainer. The risk of fuel handling operations is mitigated by strict adherence to NFPA 58, DM-22, and this handbook. The risk should be further reduced by having the receiving and storage systems maintained by the device maintenance contractor or someone experienced with large propane systems. The danger from accumulated unburnt fuel in the trainer is adequately eliminated during the occupied period by a system of ventilation, sensors, and interlocks. During the unoccupied period, the risk is reduced by natural ventilation and the proper operation of the key operated Hands-Off Automatic (HOA) switch in the instructor's station. Proper operation requires air flushing and purging the crawl space prior to energizing the crawl space electrical circuits. (Refer to par. 3.6.4)

y) The maximum fill level (fixed liquid level) gauge on the top of the tank is inconvenient at times to read. Thus, a backup variable liquid level rotogauge may be installed in the center of the tank head. If the float type liquid level gauge is not operating or if you want to check its accuracy, the rotogauge may be used. The rotogauge has a manually operated arm which traces the inside circumference of the tank. When

installed and maintained properly, the rotogauge will give you a true reading.

z) The firefighting training facility will have a 24-hour propane detection system provided by the device contractor. Refer to par. 2.6.a). The facility contractor is required to interface with the detection system via the data terminal cabinet (DTC) as follows:

(1) For 19F series trainers, provide an alarm system to alarm by sound and flashing warning sign at the quarterdeck or other 24-hour duty station. The warning sign should state "DANGER - PROPANE ALERT."

(2) For 21C12 series and Seawolf trainers, refer to par. 3.12 for requirements.

(3) In addition to propane alarms, the 24-hour duty station should be equipped with remote shutoff capability of propane from storage tanks and vaporizers.

2.2.3.2 Natural Gas. Natural gas is largely methane but includes ethane, propane, and butane. It has two disadvantages in regards to its use as a fuel for 19F series devices. First, the device would have to be modified. Natural gas has less than one-half of the Btu content of propane based on heating value of 93 MJ/cu. m of propane and 37 MJ/cu. m of natural gas. Therefore, pipes, nozzles, and other components, would have to be larger to accommodate the increased flow rate. The flame characteristics so important to realism also would be different. Additionally, natural gas is lighter than air, with air having specific gravity equal to 1, natural gas has a specific gravity between .58 and .70. Trainer architectural and safety aspects would have to be redesigned for this lighter than air hazard. Second, tests have not been run to determine the effect that using natural gas would have on the training environment. Therefore, natural gas cannot be used for the device training fires. Natural gas, however, can be used as heating fuel.

2.2.3.3 Oil and Gasoline. Oil and gasoline are no longer preferred as firefighting school fuels. These liquid hydrocarbon fuels produce many kinds of air and water pollution which can only be partially treated at great cost and may not be

acceptable by the local, State, or Federal environmental regulations.

2.2.4 Water

2.2.4.1 Potable Water. Potable water should meet the following criteria:

a) Firefighting facilities based on the 19F and 21C12 series trainers should use fresh water throughout. Salt water cannot be used because of the corrosive effect on the expensive device.

b) Recycled water can be used. Previous tests have indicated that wastewater treatment would be required to provide recycled water. The training structure effluent contains a large chemical oxygen demand (COD) that would have to be removed before delivering it back to the fire field. Refer to par. 5.3.3 for wastewater characteristics.

c) Water delivered to the site should be metered and supplied through a backflow preventer in accordance with AWWA C506, Backflow Prevention Devices--Reduced Pressure Principle and Doublecheck Valve Types. The pressure drop of this equipment must be considered when calculating the availability of water.

d) The range for water or foam pressure at the hose nozzle for the 19F series trainers is 820 to 965 kPa). Submarine trainers (21C12) should also require a minimum nozzle pressure of 820 to 965 kPa. The total discharge head of each pump should allow for hydraulic losses and wear.

e) The water system should be sized by summing the demand and consumption listed herein for each 19F and 21C12 series trainer.

f) During the development of the project, the EFD Code 16 (Utilities Division) should verify a reliable source of potable water. Water usage rates should be determined based on a once-through water system. Water flow tests should be conducted to determine the adequacy of the water supply system.

g) Other than the firefighting water, potable water for drinking and cool-down showers should be supplied to each device structure. The drinking fountain should be a pipe which shoots the water in an arch to a drain and the shower should be an emergency shower. Eyewash showers are not required.

h) Emergency water is defined as water delivered under pressure, over 700 kPa during a power outage. Emergency water is not required for the 19F and 21C12 series trainers because water could not extinguish the fire in an emergency.

i) Due to previous problems of piping failure from bursting under pressure, do not use PVC or other plastic materials for firefighting water piping. Piping should be suitably rated for 2100 kPa.

2.2.4.2 Water Storage. Sufficient water storage should be provided to ensure that the water demand can be met under all operating conditions without starving the pump suction. Water storage should be available on the site or in the vicinity. Water storage should be sufficient to supply the facility needs such that once a class is started (including classroom time), it can be finished. Design the water storage tank in accordance to AWWA standards. Tank should include the following: level gauge, automatic means for filling, vent, manways, OSHA approved ladders, etc.

2.2.5 Wastewater. Effluent from the training structures should be collected in an equalization tank, treated, and pumped at a metered rate into the sanitary sewer system. The ultimate disposal of the effluent should be through a biological treatment process. If the public owned treatment works (POTW) does not incorporate that degree of treatment, the fire facility should biologically treat the wastewater prior to discharging it (refer to Section 5).

2.2.6 Electrical Power. Provide sufficient electrical power in underground conduit to each structure to meet the needs of the building and device equipment, including the computer. Demand quantities are listed herein. Provide spare capacity in both power and control conduits. Separate conduits should be

used for power and control wiring. Spare conduits for the device contractor's use are identified under the respective trainer's requirement.

2.3 Supporting Facilities. Firefighting facilities should have a utilities building and a bulk storage building with an agent bottle refill.

2.3.1 Utilities Building. The utilities building design should conform to the following criteria:

a) The utilities building should have a minimum floor area of 232 sq. m.

b) The utilities building should include water pumps, foam concentrate mixing station, motor control centers, wastewater treatment monitoring equipment, central utility annunciator panel, and a maintenance area.

c) Provide a minimum of two pumps piped in parallel to supply 965 kPa water to the farthest hose. For submarine trainers, provide one full-sized pump for standby when existing potable water pressure is sufficient; when potable water pressure is low, provide two full-sized booster pumps in parallel. Design the pumping system as an industrial process system and not to meet normal fire protection requirements. Provide a flow sensor to turn on the second pump, based on demand. The second pump should be protected from short cycling with a timer which keeps the pump running for at least 10 minutes, regardless of demand. Each pump should be rated for continuous duty and should include a non-slam check valve. The design of the water system should be such that the pumps are protected from "dead head" during erratic demand variations experienced at a firefighting training facility. The method of relieving "dead head" pressure should ensure that the pump cannot overheat during this condition. The pressure relief should be by diaphragm relief valve. Provide a manual lead pump select switch and the lead pump should be started manually. Process water piping serving the hose stations should be painted red. Provide pumps with mechanical seals.

d) Aqueous film-forming foam (AFFF) are concentrates, based on fluorinated surfactants plus foam stabilizers, usually

diluted with water to a 3 to 6 percent solution. The foam formed acts both as a barrier to exclude air or oxygen, and to develop an aqueous film on the fuel surface capable of suppressing the evolution of fuel vapors. The foam produced with AFFF concentrate is dry chemical compatible and thus is suitable for combined use with dry chemicals. At firefighting training facilities, an AFFF surrogate is used in lieu of real AFFF for cost and environmental reasons. The foam surrogate concentrate, Calsoft, Ultrawet K, or equivalent, will be delivered and stored in bulk form. Refer to par. 4.2 for details on AFFF. It will be pumped to the utilities building concentrate mixing tank where it will be diluted with potable water to a strength equal to 100 percent AFFF concentrate. A batch process should be used and provisions for mixing should be included to prepare the solution. The method chosen for mixing should consider the potential foaming problem. The 100-percent solution will be pumped as required to each proportioner holding tank on the fire field. It will also be used to fill 19 L foam concentrate cans for use in the training structures. Carbon steel cannot be used for piping and storage of AFFF surrogates. Acceptable materials are stainless steel and copper piping. AFFF concentrate piping tanks and appurtenances should be painted green. All 6 percent and 3 percent AFFF piping should be painted green and red striped. AFFF pumps should be positive displacement type with internal relief and mechanical seals.

e) An electrical room should be provided in the utilities building to house electric controls and utilities related motor control centers, such as, water, fuel, chemicals, waste pumps, and others.

f) Utility system information, such as pressures, temperatures, liquid levels, run status, and flows should be brought to a central annunciator panel. The fuel information should be sensed indirectly so that no fuel is piped inside the building. Tanks and reservoirs should have level indicator devices.

2.3.2 Storage and Refill. Storage and refill facilities should meet the following criteria:

a) Provide a minimum floor area of 232 sq. m for bulk storage for all trainers, except the 21C12 trainer which should have a minimum of 111 sq. m of floor area.

b) Provide bulk storage for large CO_2 bottles, palletized purple potassium powder (PKP) containers, 19 L cans of foam concentrate, PKP and CO_2extinguishers, and OBA canisters. This storage should be kept from freezing and kept dry. The maximum temperature should not exceed 54.2 degrees C. The layout should consider the handling of material by fork truck. A minimum of 9.2 sq. m of well ventilated space should be provided for filling empty PKP and CO2 fire extinguishers. This area should contain scales and support jigs to facilitate the filling operation which should be done in accordance with NAVSHIPS Technical Manual, Chapter 55, Section 555-4.1.

c) Additional storage may be required for storing of collateral equipment and spare parts. Contact the using activity for requirements.

d) The dry storage and refill areas should contain floor drains which lead to the equalization tanks.

2.4 Other Facilities

2.4.1 P-250 Demonstration. Provide the P-250 demonstration with all 19F type trainers. The P-250 pump cannot be mounted on the 19F4 trainers. P-250 demonstration facilities should meet the following criteria:

a) The P-250 is a gasoline-powered, portable water pump. For demonstration, provide an in-ground sump of a minimum 4200 L along with bleachers for the trainees (see Appendix A, Figure A-15). The sump should have a drain and a 50 mm fill valve. Provide a chain rail for personnel safety. During the demonstration, the pump should take suction from the sump and discharge back to it.

b) When the installation is located inside an enclosed structure, the exhaust from the gasoline engine should be removed. The P-250 pump uses process water for bearing lubrication. This water should be discharged through the exhaust pipe. Provide an exhaust system to carry away the

exhaust including a trapped drain to carry the lubrication water to the equalization tanks. Refer to par. 5.3.3 on pretreatment and equalization tanks. For outside P-250 locations, provide means to drain the lubrication water to the equalization tanks. The lubrication water could contain small amounts of oil and gasoline. The drains serving the P-250 pump should be piped to an oil and water separator for removal of gasoline and oil from the P-250 pump lubrication water. A new P-250 pump has been introduced which eliminates oil and gasoline in the lubrication water.

2.4.2 Wild Hose. Provide the wild hose demonstration with 19F type trainers. The wild hose cannot be mounted on the 19F4 and 19F4A trainers. The wild hose demonstration area should meet the following criteria:

a) The wild hose demonstration area should include access to a 40 mm hose station, 30 480 mm of 40 mm hose, 65 mm to 40 mm adapter, another small section of 40 mm hose, and a 3048 mm high steel pipe column. A section of 40 mm hose should be strapped to the column with 2438 mm hanging loose from the top. The other end of the 40 mm hose section should be at ground level to allow coupling of the longer hose. (See Appendix A, Figure A-13.)

b) The wild hose should be installed outdoors except in extreme climate locations where an enclosed area is a necessity for year-round training. Provide enclosed areas inside training structures with Plexiglas barriers to facilitate viewing the wild hose without getting personnel wet.

> Caution: The length of the free end of hose with the nozzle should always be less than the distance to the walls, ceiling, and floor to prevent damage to the structure.

2.4.3 Smoke House. A separate facility for smoke training has not been identified.

2.4.4 Hose Drying Area. Provide a rack for laying out twelve 15 000 mm lengths of hose to dry. It should be located in an open area if possible to take advantage of natural air

movement. Hoses should lay on an angle to promote drainage. Provide one rack per training structure.

2.4.5 Maintenance Contractor Area. The maintenance contractor area should be a work or office type room with a 2450 mm high ceiling to be used by the device maintenance contractor. The minimum floor areas should be as follows:

a) For 19F5, 19F5A, 21C12, and 21C12A trainers, 11 sq. m.

b) For 19F1A, 19F1B, 19F3, 19F3B, 19F3A, 19F3C, 19F4, or 19F4A trainers, 45 sq. m.

c) For other training devices, locate the maintenance contractor area at the utility building or other support building.

2.4.5.1 Room Provisions. Provide the room with the following:

a) Telephone connection

b) Air conditioning, heating, and ventilation

c) 120 volt, single phase, heavy duty electrical outlet

d) Lighting

e) Lockable door

2.5 Interfaces

2.5.1 General. Firefighting training facilities are procured through two separate contracts. The first is a construction contract which provides the training structure, the site development, the supporting facilities, and the utilities. The second is a device contract which provides the trainer, computer, and its related equipment. Everything discussed in this handbook should be provided by the facilities contractor unless indicated otherwise. Two copies of military construction (MILCON) project facility drawings and any changes thereof, and as-builts should be supplied to NAWCTSD when available.

2.5.2 Device Contractor. The device contractor should provide the following equipment:

a) Fireplace mockups

b) Nonfireplace mockups

c) Telltale and obscuration smoke systems

d) Halon and aqueous potassium carbonate (APC) agent simulators

e) Explosive gas monitoring system (propane detectors)

f) Temperature and safety monitors

g) Training and maintenance communication devices

h) Ventilation devices used by the trainee

i) Shiplike labelings

j) Power ventilation necessary to distribute smoke

k) Equipment necessary to "clean up" electrical service

l) Equipment necessary for electromagnetic shielding

m) Special compartment lighting

n) Bulkhead rib insulation (21C12)

o) Partitions in 21C12 instructor's station

p) Flush deck nozzle system (19F4)

q) Bulkhead flapper (21C12 and 21C12A)

r) Red Devil blower and adapter (21C12 and 21C12A)

2.5.3 Facility Contractor. Unless indicated otherwise, device services should be brought to a single point close to the exterior of the training structure. The device contractor should make final connections after the facility contractor leaves the site.

2.5.3.1 Electric. Electrical service designated for the device and computer should terminate in a single-fused disconnect in the electric room near the instructor's station. For those buildings without an instructor's station, the disconnect should be located in a ground-level burner room.

Power for facilities installed equipment, such as, lights and exhaust fans, should be run through a separate, fused disconnect and wired ready for use. This disconnect should be located in a ground-level burner room.

Power provided should be directly from the station or municipal grid system. If the power source needs to be modified or "cleaned up" to protect the computer equipment, the device contractor will provide the necessary equipment.

2.5.3.2 Data Terminal Cabinet (DTC). Exhaust fans, motorized dampers, and motorized valves located in, a trainer should be controlled by individual, HOA switches in the instructors station. The automatic mode should have the necessary relays to be energized by a 24-Vac, 100 mA, binary signal from the future device computer. Wire each relay to the DTC. The DTC should be located in the instructor's station, except the DTC for the 19F4 trainer should be located in the electrical space below the instructor's station. Controls which are recommended to be wired to the DTC should include the HOA switches and relay mentioned above. The 24-Vac relays associated with HOA switches wired to the DTC should be provided with arc suppression protection. The use of non-suppressed relays can produce a large voltage spike which is detrimental to the device computers.

The DTC should include a terminal strip where these controls are wired to unique lugs. Mating lugs on the terminal strip should be ready for the device contractor to tie into to complete the installation. Each lug should be identified by the

facilities contractor by the function connected to it. For typical control interface, see Appendix A, Figures A-18 through A-20D.

2.5.3.3 Fuel. Refer to par. 2.2.3.

2.5.3.4 Fireplace. Areas indicated on the floor plans as fireplace areas should have no floor grating or plate and should be free of any structural members. Acceptable tolerance should be plus or minus 6.4 mm maximum. Provisions for supporting the future device are shown in Appendix A, Figures A-9A and A-9B. Provide a temporary bolted post and chain railing around the opening for safety until the device is installed.

2.5.3.5 APC Extinguishing Agent Simulation. Provide a 40 mm fire water line to the deep fat fryer fireplace and terminate with a globe valve below the floor grating.

2.6 Device. (For information only and does not pertain to the device contract.) The device equipment provided in the trainers consist of the following:

a) Fireplaces should be computer-controlled propane burners hidden in a mockup which is designed to represent the item burning. See Appendix A, Figures A-1, A-2, and A-3. Most fireplaces will be floor-mounted and fed from the crawl space. Fireplaces which are not fed from the crawl spaces, such as: electrical panel, wire bundle, and vent duct fires, should include propane equipment in their electrical cabinets. Each of these cabinets will contain a propane sniffer which will detect any propane which has leaked into the cabinet. There will also be propane sensors on both sides of the wall underneath electrical cabinets containing burners. When activated, this sniffer will shut down its fireplace until the propane is removed from the area.

b) Design device equipment to go through a 914 mm personnel door unless other provisions are made.

c) The artificial smoke generator (provided by the device contractor) is started at the beginning of a training session and runs continuously. Air at 538 degrees C should be discharged from bypass ducts which keep the system at operating

temperature. The unit requires one-half hour at the start to attain operating temperature. When smoke is required, the chemical is injected into the hot air and ducted to the proper location. The building ventilation should remain on even during the application of smoke. The bypass duct should discharge into the ventilation system or be controlled so that no artificial smoke can exit through it. Different smoke generation rates are obtained by relieving air before the chemical is injected into it.

d) The smoke generator should be powered by propane and electricity and located on the ground adjacent to the training structure.

2.7 Gas Chamber

2.7.1 General. Use the gas chamber to provide chemical warfare countermeasures training; it is not part of the 19F and 21C12 series firefighting structure. However, the gas chamber should usually be provided with the 19F5 facility. The chemical agent to be used for training is tear gas. Use the gas chamber to train 1 class of 100 personnel at a time, 2 to 3 classes per day, and 20 classes per week.

2.7.2 Training. Recruits and instructors will enter into the gas chamber wearing the MCU2/P gas masks. Prior to their entrance in the chamber, tear gas is made on a hot plate and is subsequently exposed to the recruits as they remove their gas masks. When gas training is complete, the recruits and instructors march out of the chamber to an area where they can get fresh air. After completion of gas training, an instructor opens the emergency exit/vent doors and energizes the exhaust system to exhaust the tear gas-laden air from the gas chamber. During winter, the instructor will deenergize the heating system prior to energizing the exhaust system. When tear gas has been removed from the gas chamber, the exhaust system will be deenergized and the heating system will be energized, as required. After each use, the gas masks will be sterilized by the recruits by dipping or wiping the masks with a 2 percent iodine and 98 percent water solution. The masks are then rinsed or wiped with water and wiped dry.

2.7.3 Site Development. The gas chamber should be a separate structure and should be located at least 15 m away from any building or facility to prevent the migration of tear gas into an occupied area or building. Consideration should be given to the prevailing wind direction. The gas chamber discharge should be sited so that tear gas is not blown to occupied areas or buildings located downwind.

2.7.4 Architectural. The floor plan for the gas chamber is provided in Appendix H, Figure H-2.

2.7.4.1 Layout. Layout of the gas chamber should conform to the following criteria:

a) The gas chamber should be a 120 sq. m based on inside dimensions, one-story building consisting of a 9144 mm by 9144 mm gas chamber room, a decontamination station, a storage room, and a mechanical room.

b) The building should consist of concrete masonry unit wall construction. Ceiling should be a 2450 mm high gypsum-board type. Protective sealant should be applied to both the walls and the ceiling of the gas chamber room. Sealant should be chemically-resistant to tear gas (vapor and powder) and capable of preventing migration of tear gas and water through the walls and the ceiling of the gas chamber room. Protective sealant should be an epoxy or urethane coating system.

c) There should be means of access to the space above the ceiling, which will be used for maintenance purposes. Access to the ceiling should be via the storage locker or the mechanical room. The doors should be the insulated, hollow metal type. Each door should be provided with a clear 460 mm by 460 mm shatterproof window. There should be no windows in the walls. Provide emergency exit doors with panic hardware.

2.7.4.2 Decontamination Station. Use the decontamination station for sterilizing the gas masks. The decontamination should consist of an iodine-water solution sink for sterilizing the gas masks, a rinse water sink for rinsing the gas masks, and a drying counter or table for hand drying the masks. The sinks and counter or table should be stainless steel.

2.7.4.3 Storage Locker. Store gas masks, tear gas powder or capsules, and collateral equipment in the storage locker separated from the gas chamber. Provide built-in wall storage consisting of pigeon-hole type compartments in the storage locker for storing 200 gas masks with haversacks. See Appendix H, Figure H-2, for detail information pertaining to wall storage.

2.7.4.4 Collateral Equipment. Collateral equipment to be furnished by the station are:

a) Washdown hose and storage rack

b) Hot plates

c) Hot plate counters

d) Gas masks

2.7.5 Plumbing. Provide hot and cold water to the sinks in the decontamination station. Provide floor drains in the gas chamber room and decontamination room. Provide a 20 mm hose bib in the gas chamber room for hose washdown of floors, walls, and ceiling. Drains should connect into piping leading to equalization basin.

2.7.6 Mechanical. Provide a mechanical exhaust and winter heating system for the building (heat the building to 10 degrees C inside. Do not provide air conditioning. The mechanical exhaust system should be separate from the heating system and should be provided for the gas chamber room. The exhaust system should be sized for 60 air changes per hour. A sign should be placed on the gas chamber room wall, near the exhaust system controls, stating, "IMPORTANT - WHEN OPERATING EXHAUST SYSTEM, TURN OFF HEATING SYSTEM AND OPEN ALL DOORS." The exhaust fan should have a non-overloading wheel. The exhaust system should contain a discharge stack to disperse the tear gas high enough into the air above the building to prevent recirculation back into the gas chamber and migration to other areas and buildings. The exhaust system should contain a motorized damper which will be closed during gas training to prevent the loss of tear gas. Do not use an air heating system for heating the building. The heating system should consist of unit heaters or fin tube

radiation. The heating equipment should be designed for water cleaning by hose and should also be able to withstand the accumulation of tear gas powder.

During tear gas training, when the recruits are entering the gas chamber room, the heating will be turned off by the instructor. When recruits are in the gas chamber, the instructor will turn the heating systems back on. The exhaust system will be off throughout the gas training. After completion of gas training, the instructor will turn the heating system off in the gas chamber room, open doors, and energize the exhaust system to rid the gas chamber of tear gas. After exhausting the tear gas out of the chamber, the instructor will turn the exhaust system off and energize the heating system.

2.7.7 Electrical. Provide lighting in gas chamber rooms. Provide waterproof, surface-mounted, incandescent light fixtures in the gas chamber room. Provide three heavy-duty, waterproof wall outlets in the gas chamber room. Two of the wall outlets should be located near the hot plates. Provide a red, rotating beam light outside at the main entrance to the chamber to serve as a warning light during training. A sign should be placed on the building, near the main entrance, stating, "CAUTION - GAS TRAINING IN PROGRESS WHEN RED LIGHT IS FLASHING." Electrical power to the building should be 120/208 Vac/single phase/60 Hz.

2.7.8 Tear Gas Characteristics. Tear gas is available in two forms: powder and powder-in-capsule. Approximately 6.5 to 20 grams of powdered tear gas will be used per class for the gas chamber.

a) Chemical: alpha-chloroacetophenone, $C_6H_5COCH_2C_1$

b) Threshold Limit Value (TLV): 0.3 mg/m^3

c) Melting Point: 59 degrees C

d) Density: 1.324 gram/ml (powder)

e) Vapor Pressure: 1.6 Pa

Section 3: TRAINING STRUCTURE

3.1 Training Courses. The various 19F and 21C12 series firefighting trainers have been designed to support the following courses:

a) J-495-0418 - General Shipboard Firefighting Training Course: Taught in the 19F3 and 19F3A trainers, a 2-day course for a maximum of 108 students in the 19F3 and 60 students in the 19F3A. Students are exposed to Class A, B, and C type fires.

b) J-425-0424 - Advanced Shipboard Firefighting Team Evaluation Course: Taught in the 19F1A and 19F3A trainers, a 2-day course for a maximum of 30 students. Students should locate, identify, and extinguish the classes of fires and communicate with Damage Control Central.

c) J-495-0413 - Shipboard Aircraft Firefighting Training Course: Taught in the 19F4 trainer, a 2-day course for a maximum of 60 students. Students should conduct firefighting and rescue exercises with fixed wing and helicopter crash fires.

d) J-495-0414 - Aviation Facility Ship Helicopter Firefighting Team Training Course: Taught in the 19F4 trainer, a one-day course for a maximum of 29 students. Students should conduct firefighting exercises with helicopter crash fires.

e) J-495-0424 - Advanced Shipboard Firefighting Team Training Course: Taught in the 19F1A and 19F3A trainers, a 4-day course for a maximum of 30 students.

f) A-495-2071 - Submarine Basic Firefighting.

g) A-495-2072 - Submarine Advanced Firefighting.

h) A-495-2073 - Submarine Team Firefighting.

Subpars. f) through h):

(1) The basic course is a 2-day course: 8 hours of classroom and 8 hours of trainer instruction. Maximum class size is 25 students.

(2) The advanced course is a 2-day course: 16 hours of combined classroom and trainer instruction. Maximum class size is 12 students.

(3) The team course is a one-day course: 4 hours of trainer instruction. Maximum class size is 14 students.

3.2 General. Design the training structure to house the various 19F and 21C12 series devices and provide realistic training situations. It should be ruggedly constructed to withstand the temperature cycling from the intense heat of the flame to a stream of cold water from a hose. It should withstand the impact of a high velocity hose stream.

3.2.1 Heat Protection. Building structural components should have sufficient room for thermal expansion. The maximum flame temperature of the device is 899 degrees C when using propane fuel. Assume the products of combustion reach 349 degrees C and an individual compartment may reach 204 degrees C. Any item located in a compartment should be able to withstand the radiant heat or be shielded from it. It takes about 5 minutes for a small fireplace and about 20 minutes for a large fireplace, such as a bilge fire, to return to the starting temperature assuming 2 minutes of cooling water spray.

3.2.2 Personnel Spacing. There will be approximately 1550 mm of spacing between trainees on a hose team.

3.2.3 Weather and Freeze Protection. Weather protection of the training structure should meet the following criteria:

a) Structures should be sufficiently enclosed and heated to allow training in subfreezing weather (where this is a requirement) without adverse effects, such as, ice buildup on grating or doors. Other than for training and water freeze protection, there is no low temperature limit on the structure or associated equipment during off hours.

b) Crawl space should be heated to 4.4 degrees C during unoccupied hours to maintain the structure above freezing. Unit heaters should be used to provide heat.

c) During occupied hours, enclosed staging areas should be heated to 10 degrees C and also should be ventilated for summer heat removal. The staging area ventilation should be the forced type so the pressure there is always above the compartment pressure. This will ensure that the smoke stays in the training compartments.

d) When roof staging areas and second story emergency walkways are enclosed, a 1850 mm by 2450 mm high removable wall panel in the staging area should be provided. This will allow larger equipment to be hoisted during installation and maintenance.

e) Staging areas should drain into the structure to ensure that firefighting agents and rainwater are collected. Staging areas should be provided with trench type drains. Rainwater from roofs does not have to go to the crawl space.

3.2.4 Drainage. The area around exterior trainee entries to a fire space should be provided with an apron which slopes to a drain. The drain should lead to the wastewater treatment system. This apron will collect the firefighting agent used to cool the door prior to student entry and should be large enough for that purpose. If the apron will be subject to collecting rainwater, a pair of post indicator valves should be placed on the drain line; one should lead to the storm drain, the other should lead to the wastewater treatment. It will be the instructor's responsibility to correctly position the valves so the rainwater goes to the storm drain when the structure is not in use and the training water goes to treatment when the structure is occupied.

3.2.4.1 Drainage Piping Material. Because of exposure to heat and AFFF, the drainage piping in the training structure should be capable of withstanding 400 degrees C and should be constructed of either copper or stainless steel. When piping is not exposed to heat, PVC piping can be used.

3.2.5 Escape Trunks. Escape trunks should be 1550 mm on a side and should descend from the roof to the first floor by way of a vertical wraparound ladder. The roof entry should be a small hatch and the lower entry should be an Ellison door. A horizontal safety net should be stretched across the escape

trunk at a maximum of 2450 mm intervals. The safety net in escape trunks should be first quality parachute nylon webbing in accordance with BUSHIPS Dwg. 804-5184163. Webbing should have 800 kg test load and should be waterproof. Borders should have safety snaps for attachment to wall-mounted eyelets. The net should be fastened to the walls so it can be removed for maintenance. Provide a 900 mm by 900 mm opening in the safety net where the ladder passes through. Provide door in escape trunk for access from crawl space area for maintenance. The door should have louvers for ventilation. The escape trunk should be provided with 950 L/s mechanical ventilation with the supply air coming from the crawl space. Refer to par. 3.11.9.2.

3.2.6 Consumables. Each 19F and 21C12 series trainer was designed to handle a specified student loading as indicated herein. The training schedule and demand and consumption of consumables are also indicated. When the student loading of a proposed project differs substantially from the indicated values, the design demand and consumption may be proportioned up or down to suit the project.

3.2.7 Burner Rooms. Burner rooms should have a minimum ceiling height of 2134 mm and a floor level with the crawl space floor. The device contractor will provide necessary hardware for mounting and maintaining training components away from air intake louvers. For access into the burner room where a change in elevation occurs, provide stairs with a landing and railing.

3.2.8 Obstructions. Provide obstructions where they are indicated on the floor plan drawings in the appendices. Obstructions should be constructed of 4.8 mm steel plate, making a solid top and sides and having an open bottom. Obstructions should be bolted to the floor grating from underneath in such a way that they can be positioned anywhere in the room.

3.2.9 Separation Chamber and Piping Traps

a) Effluent coming from a fire training structure should dump into a separation chamber. The primary purpose of the chamber is to separate the propane which accumulates in the pipe peripheral air space from the remainder of the wastewater piping. The chamber should be open at the top or covered with a 150 mm diameter vent pipe. The inlet should be valved with a

lockable post indicator type valve, and should be high enough above the outlet invert so the influent can fall even in freezing weather. The inlet should be baffled. Both inlet and outlet should terminate inside the chamber with a pipe flange and sufficient room for a future pipe fitting. The outlet should be a dip tube which draws from the bottom of the chamber. A running trap should be provided in the outlet line adjacent to the chamber (see Appendix A, Figure A-16 for separation chamber detail).

b) "NO SMOKING" signs should be posted facing all directions around the separation chamber since it is a source of propane.

c) No traps should be provided in the piping leading from the crawl spaces. Floor drains leading from other spaces in the training structure should have vented traps or should tie into the wastewater line upstream of the separation chamber running trap. This precaution will prevent propane migration through the piping.

3.2.10 Fireplace Compartment Dimensions. Dimensions given for fireplace compartment sizes are inside clear dimensions. These inside clear dimensions are critical and should be maintained; allowable tolerance should be plus or minus 6.35 mm maximum. For example, if a fireplace compartment has refractory coatings and steel plate liners on the walls, then the inside clear dimensions are from liner to liner of the walls.

3.3 Repair or Crash Lockers. Each structure, except the 21C12 and 21C12A trainers, should have at least one repair locker to house the paraphernalia required for firefighting. Unless indicated otherwise, repair lockers should be 3048 mm on a side with a 2438 mm sloping roof and gutter. Repair lockers should have natural ventilation at floor and roof and should have a floor drain. Hollow metal doors should be used on repair locker entries. The following repair locker equipment should be provided by the respective training school:

a) Damage control plotting board to track status of the fire and extinguishment process

b) OBA canisters and OBA's

c) CO_2 bottles

d) PKP bottles

e) Repair parts

f) Nozzles

Crash lockers should be the same as repair lockers.

3.4 Doors and Hatches. Various types of entryways defined here are used throughout firefighting training structures. Doors used for emergency exits should be adequately marked and should have panic hardware.

3.4.1 Watertight Doors. Watertight doors should be provided in accordance with NAVSHIPS Dwg. 805-1400066, galvanized steel with three dogs unless indicated otherwise, see Appendix A, Figure A-12. Refer to NAVSHIPS Dwg. 805-1400074 for details of airtight doors. Airtight doors as shown on NAVSHIPS Dwg. 805-1400074 can be used in lieu of watertight doors since submergence in water is not a requirement. Airtight doors are a good simulation to watertight doors. No hasp assembly is required. Three dogs are used instead of eight because the door will warp when subjected to heat and many of the dogs would not work. Since the door will have to be replaced periodically because of warping, it is desired to keep the door as inexpensive as possible. Quick-acting watertight doors should be a watertight door provided with a single lever to operate the three dogs at once. Refer to Appendix A, Figure A-7. Quick-acting, airtight doors should be provided in accordance with NAVSHIPS Dwg. 805-1400074.

3.4.2 Hollow Metal Doors. Hollow metal doors should be standard exterior doors with standard door knobs. Panic hardware should be used on doors labeled "Emergency Exit." Typically, doors should be 900 mm wide except that doors to instructors' stations, burner/electrical rooms, and electrical equipment rooms should be 1200 mm minimum width doors to allow for equipment access.

3.4.3 Wire Mesh Doors. Wire mesh doors should be constructed of 38 mm angle steel with 9.5 mm by 12.7 mm steel wire mesh fastened to it.

3.4.4 Automatic Closing (Ellison) Doors. Automatic closing (Ellison) doors should be in accordance with NAVSHIPS Dwg. 803-5184129. Refer to Appendix A, Figure A-8. Ellison doors are nonwatertight, steel, balanced doors which close automatically by the action of an internal spring. Ellison doors should be shielded from the radiant heat of the fireplaces. The door should be 900 mm wide. These doors are considered to be proprietary and are provided by Ellison Bronze Co., Inc.

3.4.5 Large Hatch. A large hatch should be provided in accordance with BUSHIPS Dwg. 805-1624089. This hatch should be 900 mm by 1550 mm with six wrench-operated dogs, spring-balanced and should include a 635 mm, quick-acting, spring-balanced, raised scuttle.

3.4.6 Small Hatch. A small hatch should be provided in accordance with BUSHIPS Dwg. 803-1645097. This hatch is 900 mm by 1070 mm raised, oval, quick-acting, and spring-balanced. It should include 330 mm diameter handwheels on both sides which operate four dogs. Provide safety chains or rails around the top of hatches.

3.5 Ladders

3.5.1 Inclined Ladders. Inclined ladders should be designed in accordance with NAVSHIPS Dwg. 805-1749113. The weight of the ladder should be supported from floor beams instead of deck grating. The slope of the ladder should not exceed 60 degrees from the horizontal and unless indicated otherwise, should have landings at either end with a minimum of 1070 mm clear space. When the ladder rises more than 6100 mm of vertical height, an intermediate landing should be provided in accordance with OSHA.

a) The top tread of an inclined ladder should be 225 mm wide and start 51 mm away from the deck cowling. Other treads should be 150 mm wide. Non-slip treads, within wet conditions, should be used exclusively. Head room clearance

anywhere on the ladder should be maintained at 2150 mm in accordance with OSHA. The inclined ladder should be constructed of hot-dipped galvanized steel.

b) Where an inclined ladder passes through a crawl space, an airtight barrier should be provided so the crawl space air cannot enter the inclined ladder space.

c) Where the inclined ladder leaving Compartment 1 passes through the first floor concrete ceiling, it should be surrounded by a barrier. The barrier should be tight to the ceiling and extend into the compartment to 2150 mm above finished floor. This barrier will keep any products of combustion higher than 2150 mm from entering the inclined ladder space.

3.5.2 Vertical Ladders. Vertical ladders should be designed in accordance with NAVSHIPS Dwg. 804-1749235. Following standard shipboard design, the wraparound ladder rungs should be 177.8 mm from the wall. The rungs should be of serrated 316 stainless steel to provide a nonslip surface. A 0.83 sq. m opening should be provided in the safety net where the ladder passes through.

3.6 Lighting and Electrical

3.6.1 General Lighting. General lighting should be provided for each space in a firefighting structure using appropriate building type fixtures and switches.

The fireplace areas should use indirect lighting from the crawl space areas. The fixture should be wall mounted at 900 mm above finished floor (AFF), facing outward or with a (25 degree) stanchion. Luminaires should not be floor mounted, facing upward. Provide a fixture similar to that shown in Appendix A, Figure A-22. Specify the particular type and lamp wattage appropriate for the design (Type 1 or 2). Luminaires should meet Underwriters Laboratories Inc. (UL) 595, Marine-Type Electric Lighting Fixtures, for marine locations. A globe guard should be provided. The above requirements will: (a) protect the fixtures from heat and direct spray of the water; (b) allow for the water to drain away from the fixture; and (c) avoid letting water penetrate the fixture and conduit

system. These lighting levels are not intended for use with training personnel. The lights in the crawl spaces are only intended to aid and supplement maintenance and inspection personnel who carry individual task lighting. Provide approximately 53.8 Lx of illumination level. The light switches associated with the crawl space lights should be located outside the entryway(s) for the compartments.

It is requested that the following requirement be added to the operation and maintenance support information (OMSI) for the facility:

Perform monthly inspection of the two gaskets (ballast and globe) associated with each fixture. Replace gasket when deterioration is evident.

Staging areas should be provided with general lighting for nighttime operation.

3.6.2 Special Compartment Lighting. Special compartment lighting should be provided for use by the trainee and should be provided and controlled by the device contractor.

Every attempt should be made to minimize the length of conduit in the compartment. When conduit is run in the compartment it should be shielded from the fire and water spray and should contain wire with high temperature insulation suitable for greater than 260 degrees C. High temperature wire should be in accordance with Military Specification MIL-W-25038, Wire, Electrical, High Temperature and Fire Resistant, Type 1.

3.6.3 120-Volt Alternating Current (Vac) Convenience Outlets. The 120-Vac convenience outlets should be provided in the crawl spaces, burner rooms, and instructor's station.

3.6.4 Electrical Interlocks in Crawl Space and Burner Rooms. The electrical interlocks in crawl spaces and burner room should meet the following criteria:

a) Provide a lockable, key operated HOA switch in the instructor's station to disable lighting circuits, receptacle circuits, and power circuits in the crawl space(s) and burner room(s). The HOA switch should be wired to the DTC in the same

manner as the other HOA switches. After the device is installed, the computer will interlock these circuits with the ventilation such that they remain deenergized until after a preset purge time. The computer will deenergize these circuits again at the end of the occupied time. The HOA switch should remain locked in the automatic mode after the device is installed. Provide a minimum of one HOA switch for each burner room and crawl space; (two total) for the 19F5 or 19F5A; provide one for each 19F3 or 19F3B building (four total); (one total) for the entire 19F1A or 19F1B building. The key operated feature of this switch should prevent accidental changing of the position and the key should only be in the possession of the senior person in the instructor's station. The positions of this switch function are as follows:

(1) Hand - The fans must be operating for a preset time of 3 minutes before the power and lighting circuits noted above can be energized from this position. Prior to the installation of the trainer device, this position is used to provide light and power for construction and testing work in the crawl space. After installation of the trainer, this position can be used to provide utilities for normal maintenance work or to provide power and lighting in the event of a computer malfunction.

(2) Off - Power and lighting circuits deenergized.

(3) Automatic - The computer starts the purge cycle by operation of the ventilation fans and checks the sensors in the crawl space and central cabinets containing propane piping prior to energizing the power and lighting circuits. Exact sequence and timing of this operation is completed by NAVAIRWARCEN Training Systems Division at the time the trainer device and the computer are installed. The switch will then be locked in the automatic position.

b) Crawl space should contain propane burners, piping, valves, and regulators. As discussed above, the ventilation system will be interlocked with the main propane valve. Propane will not be introduced to the trainer until the

crawl space is purged. In addition, the crawl space will contain propane detectors (provided by the device contractor) which will prevent the introduction of propane if 10 percent of the lower explosive limit (LEL) of propane is detected in the crawl space or burner rooms.

c) Electrical receptacles, lighting fixtures, and other electrical equipment in crawl space and burner rooms should normally be deenergized and can be energized only after the above interlocks are satisfied.

d) The crawl space exhaust fan and power enable controls should include the following features:

(1) Detect fan run status via a differential pressure sensor.

(2) Detect a closed damper (with fan running) via a differential pressure sensor.

(3) Transmit the analog fan differential pressure to the device computer.

(4) Turn off fan upon detection of failure or closed damper.

(5) Indicate when fan fails to respond to a control action.

(6) Latched fan start circuit in hand control mode (upon restoration of power after a failure, fan will be off).

(7) Use the fan status in purge timer interlock with crawl space power. Timer interlocks should be provided with adjustable settings from 0 to 30 minutes, and set at 3 minutes.

(8) Indicate when crawl space power enable fails to respond to a control action.

(9) Crawl space power indicator light.

(10) Latched crawl space power enable circuit in hand control mode (upon restoration of power after a failure, crawl space power will be off).

3.6.5 Alarm for Loss of Electrical Power. (For all trainers.) Provide a battery backup annunciation and alarm at the 24-hour duty desk and the instructor's station which will activate in the event of an electrical power outage at a trainer. Capability to silence the alarm should be provided at both locations.

3.7 Floors. There should be five types of floors in a fire training device structure: a training floor, a staging floor, a crawl space floor, a maintenance floor, equipment floor, and a computer room floor. Consider Occupational Safety and Health Administration (OSHA) requirements for walking surfaces. Floors should be designed for a floor loading of 292.8 kg/sq. m except for the computer area, which should use standard computer floor design, and the deck surrounding the fireplace of the 19F4 and 19F4A. Additional support should be provided by the device contractor to mount any equipment which exceeds the indicated loading.

3.7.1 Training Floor. The training floor is the floor inside the fire compartment that the trainees walk on. This floor should be steel grating to give sure footing, good distribution of ventilation air which comes from below, and instant removal of firefighting agents. Unburned propane can be introduced into the compartment during flame suppression; therefore, even distribution of ventilation air is important to dilute it and flush it away. This floor should be supported from the crawl space floor below and the walls. Grating should be made of mild steel and should be hot-dipped galvanized with a maximum vertical depth of 25 mm and holes that are 19 mm by 50 mm maximum, from centerline to centerline. Benefits of high temperature steel grating material are not cost effective in the firefighting facilities. A nonskid surface should be provided on the grating. Grating should be sectionalized and securely fastened so it can easily be removed for maintenance. Two men should be able to handle each section. Refer to par. 3.7.6 for additional requirements for grating. The training floor should meet the following additional criteria:

a) Floor support steel should be indirectly attached to the walls and crawl space floor to allow room for thermal expansion. Connections should have slotted bolt holes to allow for thermal expansion. Floor support steel should be hot-dipped galvanized.

b) Areas designated as fireplace locations should be free of lights, equipment, flooring, and floor support members. The perimeter of the fireplace area should be designed, as shown in Appendix A, Figure A-9, to support the future device mockup around its perimeter. Fireplace support should be 70 mm below the trainer floor. Since this area will remain open until the device contractor installs the mockup, a temporary post and chain railing should be provided around the perimeter.

Design Note: Drawings should show locations of sectionalized grating. Grating sections should be dimensioned and sized on drawings. A note should be provided on drawings to indicate the contractor should use the dimensions given as a guide only. Adjoining grating sections should match and be at the same elevation.

3.7.2 Crawl Space Floor. The crawl space floor should be located directly under each training floor. Each crawl space floor should be at or above grade for safety reasons. It should be constructed of concrete. The functions of the crawl space floor are to collect agents which come through the training floor grating, to separate training compartments in the case of two-story structures and provide a platform for the maintenance of burner and sensor equipment. The crawl space floor should have chamfers where the walls meet the floors. The cants should be 150 mm high and 150 mm wide.

a) Where the crawl space floor meets any wall, provide a 150 mm high by 150 mm wide cant strip, fillet or curb. The purpose of this cant strip is to prevent propane gas from accumulating in the corners of the floor or wall interface. The cant strip will allow the propane gas to flow away from the walls.

Caution: Wastewater piping leading from a crawl space should be routed to a separation chamber prior to discharging into the piping leading to the propane in the piping. The separation chamber should be provided as shown on Figure A-15 of Appendix A.

b) There should be 1372 mm of clear space between the structure of the training floor and the crawl space floor, unless noted otherwise. This area should remain clear of obstructions to allow for burner tubes and burner equipment. The perimeter of the crawl space should be as open as possible for burner tube installation and access to ventilation air. However, for heating, ventilating, and air conditioning (HVAC) equipment placement, ductwork, and piping runs in the crawl space, should be limited to a space 600 mm wide above the louvers, along the exterior wall. Space in front of the crawl space louvers should not be used, since it is the path of the ventilation air. In addition, the heated supply air duct for cold weather trainers can be located outside.

c) Personnel access should be provided to crawl space areas. Ground level accesses should be ramped to facilitate dolly traffic.

3.7.3 Staging Floor. The staging floor is the area where the students are organized before starting a firefighting sequence. The staging floor can be made of concrete or grating. The concrete design should have generous slopes to channel away water and collect it for treatment. If the area is exposed to the rain, the collection piping should be configured to allow rainwater to bypass the treatment system. The staging floor should be designed to meet the following additional criteria:

a) A catchment should be provided by each trainee door to ensure that the agent used by the trainee to cool the door is directed to the treatment system. Rainwater should be handled as stated above.

b) When the staging area is above a fireplace compartment, as in the case of roof staging, the flooring must be separated from the heat generated in the space below. Galvanized steel grating should be provided in these areas. The grating floor should be at least 508 mm above the concrete

ceiling of the fireplace compartment. This concrete ceiling should be sloped to drains located above each fireplace compartment.

c) Trench drains should be provided.

3.7.4 Maintenance Floor. The maintenance floor is used in the electrical rooms and should be constructed of concrete with no covering.

3.7.5 Computer Floor. The computer floor is a raised computer deck conforming to MIL-F-29046, Flooring Raised, General Specification for. Twelve inches of clear space should be provided under the decking. This flooring should be used in the instructor's station(s). The adjacent electrical room does not require a raised computer deck.

3.7.6 Grating Floors and Platforms. For grating floors and platforms located outside, provide galvanized steel grating with a non-skid surface. Grating should be hot-dipped galvanized, open type, 25.4 mm by 4.7625 mm bars, welded with section modulus of 5625 cu. mm, moment of inertia of 71,552 mm^4, and maximum weight of 36.112 kg/sq. m.

3.8 Walls. Walls around training compartments should resist thermal cycling from 538 degrees C in the fire area to the coldest ambient temperature at the site, plus the effect of cold water applied during the extinguishment of the fire. Walls should not be porous because, in colder climates, the wetted wall could be damaged when the water freezes. Walls should withstand the mechanical stress of a stream of high-pressure water.

3.8.1 Wall System. Walls directly behind the cable raceway, electrical panel, trash can, storage compartment, and dryer fireplaces should not have columns in them and the crawl space directly below should also be free of columns. Holes up to 0.18 sq. m will be cut through the walls in these areas by the device contractor. Holes any larger will be structurally reinforced by the device contractor.

In addition, walls surrounding fireplaces should be lined with a steel panel. The panel and its supports should

allow for thermal expansion. Weathering steel (ASTM A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel With 50 psi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick or ASTM A242/A242M, Standard Specification for High-Strength Low-Alloy Structural Steel should not be used because the rust is not self-limiting in this application. Steel liners protect the refractory coating from the effects of the water spray and raise the training compartment temperature by reflecting the heat back into space.

a) The refractory system should be a one-inch thick calcium silicate board like "Westtemp" as manufactured by Fire Facilities, Inc. of Antioch, IL.

3.8.2 Windows. Windows should be provided in training compartment walls as shown on the floor plans in Appendix B, Figures B-3 and B-4; Appendix C, Figures C-2 and C-3; Appendix D, Figures D-1, D-2, and D-3. These windows provide a means for spectator viewing. Windows should be 139 sq. m be made of heat strengthened glass, and have hinged, sheet metal covers on the outside.

3.8.3 Cool Down. Walls adjacent to fireplaces will probably overheat, so a method to cool them down between training exercises should be provided. The preferred method is a water spray system consisting of nozzles and a motorized valve wired back to the data terminal cabinet, which will have manual control. The motorized valve should have a manual bypass which will be used for the trickle cooling flow control. Nozzles should be located so that water dripping from them will not detract from the training. These nozzles and their piping will require an adjustable flow rate of water to maintain a trickle to protect them from the heat.

The main purpose of the cool-down system is to provide cooling of the wall and ceiling steel plate liners after a training scenario. The spray nozzles are controlled by a solenoid valve via the DTC/device computer. There should also be manual control by the hand/off/automatic switch. Dripping is accomplished by a manual bypass globe or needle valve. This valve bypasses the solenoid. The spray nozzle should be open type, stainless steel (316 SS) with 125 degree spray pattern, 10 mm orifice. Install cooling nozzle in pendant position.

Cooling spray nozzles should be directed horizontally or 30 degrees down from the horizontal and towards the wall at the fireplace with the spray hitting ceiling and wall liners. The nozzle should not be located over fireplace openings because the constant water drip is not desired over the device equipment. A minimum flow of 1.893 L/s is used for each nozzle.

Note: NAVAIRWARCEN Training Systems Division has the final say as to the location of these nozzles. They do not want direct spray onto their device equipment. They may require some of the nozzles be relocated during their facility (construction site survey) inspections. Some of the manufacturers that can meet the above requirements are:

Spraying Systems Co., (312) 665-5000
Bete Fog Nozzle, Inc., (413) 772-0174

3.9 Roofs and Ceilings

3.9.1 Training Compartment Ceilings. Ceilings in the training compartments should be constructed of reinforced, lightweight concrete with a refractory coating of sprayed on calcium aluminate cement. No alternates are acceptable. When a steel false ceiling is required, it is to help control trainer compartment heat and to protect the refractory coating.

3.9.2 Staging Area Roofs. Roofs over staging areas should protect trainees from the elements, such as the hot sun in the south and the snow in the north. Staging areas should have a roof.

In those structures where the roof access enters the fireplace compartment directly, the access way should be shielded to impede the escape of hot gases. The shield should be constructed of steel plate which should form a rectangular box. The box should surround the inclined ladder. The bottom edge of the box should stop 2000 mm above the training floor in Compartments 1 and 2 of the 19F1A and 2750 mm above the floor in the 19F3-B1 structure. The forward side of the box should be far enough in front of the ladder so a person descending the ladder cannot bump his head. The shield should be airtight where it meets the ceiling.

3.10 Instructor's Station and Electrical Space. Each 19F series trainer has its own instructor's station which, along with the adjacent electrical space, houses most of the electronic equipment associated with the device. Operations of buildings associated with a given device are controlled from the instructor's station. A single point ground plate is required for trainers. Grounding plates are required in the instructor's station and its accompanying electrical room under the raised computer room flooring. The instructor's station and electrical space should be waterproof from the outside weather.

3.10.1 Air Conditioned Space. The instructor's station and adjacent electrical space should be designed as an air conditioned office. When the instructor's station is adjacent to a training compartment, it should be thermally insulated from it, including structural members.

3.10.2 Temperature and Relative Humidity. Environmentally control the instructor's station and the adjacent electrical room to 25.5 degrees C and 50 percent relative humidity in the summer and 20 degrees C and 30 percent relative humidity in the winter. Wintertime humidification and reheat for summertime dehumidification is not a requirement. In accordance with NAVFAC MIL-HDBK-1012/1, Electronics Facilities Engineering, dehumidification should not be provided in the air conditioning unit for an electronic equipment space. The instructor's station and adjacent electrical room should be individually controlled by independent thermostats.

3.10.3 Fire Protection. A fixed, fire protection system is not required for the instructor's station or the adjacent electrical space. However, portable CO_2 extinguishers should be provided by the facility contractor. Refer to par. 4.4 for the requirements of portable CO_2 extinguishers.

3.10.4 Window Glass. The window glass size and location should be as indicated in the specific device sections. Glass should be the insulated, shatter-resistant type. The bottom of the window should be 900 mm above the floor.

3.10.5 Plugged Tap. Each instructor's station will have an analog pressure indication for the firefighting water supplied

to the structure. Its location should be clearly indicated on the facility drawing. The sensor should provide the analog pressure signal to the gauges in the instructor's station and should have a DTC connection.

3.11 Ventilation

3.11.1 General. The facility exhaust system serves three main functions:

a) Continuously purges the structure of unburned fuel;

b) Provides the secondary air necessary for complete combustion and realistic fire characteristics; and

c) Collects products of combustion for possible treatment.

Ventilation air should be induced into each building by the exhaust fans. Provide air test ports throughout the system for testing and balancing. Burner rooms should be ventilated to control heat buildup and to cool the room for summer temperature control. Ventilation flow rates (L/s) come from NAVAIRWARCEN Training Systems Division and fleet project teams. Provide details on how to seal space around high temperature ducts at wall, floor, and roof penetrations. High temperature exhaust fans should have total enclosed fan cooled motors, when located outside in the weather.

3.11.2 Purge. Purging of the facility exhaust system should meet the following criteria:

a) Ambient air should enter the building through louvers in the crawl space perimeter. When there is a burner room adjacent to the crawl space, the crawl space perimeter should be left open to the burner room and the louvers located in the burner room exterior wall. The building design should allow free air movement in the burner room and crawl space and prohibit the possibility of any stagnant air spaces where unburned fuel could accumulate. Fuel is heavier than air and could create an explosive situation if not flushed away.

b) Purge air should flow at the full design rate.

3.11.3 Combustion Air. The exhaust system should deliver sufficient air to allow complete combustion. In the case of propane, it takes 23 parts of air for each part of fuel for theoretical complete combustion. Device burners do not provide any primary air therefore combustion air must be provided by the facility ventilation. In addition, enough excess air must be delivered to provide realistic flame characteristics. When a fuel is burned in the open, the flame induces into it approximately 10 times the air needed for perfect combustion. The trainer should be capable of providing this air to produce a natural looking fire. This excess air should enter the compartment at low velocity and not be directed at the flame.

3.11.4 Exhaust. The exhaust system should be designed to conform to the following criteria:

a) Once inside the compartment, the air should be heated, collected at the ceiling, ducted to a common point then to the exhaust fans and then to the treatment if necessary. The duct and fan layout should allow for the future addition of a pollution control device. Every attempt should be made during the design of the structure to ensure that air is collected and leaves the structure through the exhaust system. Minimize leaks. Roof entries provide another escape path for the products of combustion and should be ducted into the exhaust system through manual dampers.

b) Each training compartment should have a separate duct to carry away the products of combustion.

c) The exhaust stack should be designed to have a height of 1.4 to 2.0 times the training structure height, which would eliminate short circuiting and contamination of fresh air entering the trainer. The stack should be designed to meet the American Conference of Governmental Industrial Hygienists (ACGIH) 2080, Industrial Ventilation, A Manual of Recommended Practice.

d) A low velocity area should be provided prior to the exhaust fan inlet to allow the PKP particulate to settle

out. The duct system should have provisions for cleaning out the PKP particulate which will settle out. Access doors and low velocity areas should be used in long horizontal runs and at the base of vertical runs. Provide a 50 mm trapped drain in the duct section.

3.11.5 Dilution Air. Dilution air should be required to protect the compartment environment from a buildup of products of incomplete combustion, unburned fuel, and heat. Air specifically for dilution is not needed. This requirement is satisfied by secondary air.

3.11.6 Equipment

3.11.6.1 Louvers. Louvers should run continuously around the perimeter of crawl spaces. They should be sized for a maximum pressure drop of 25 Pa at the design "air in" flow and be a minimum of 460 mm high. Louvers should be of corrosion-resistant material and designed so they can be removed individually for maintenance. Louvers should be designed to meet the following additional criteria:

a) In areas where snow accumulation can be expected on a regular basis, the design of the louver system should prevent drifting snow from blocking the openings.

Caution: The structure should never be operated with any portion of louver openings blocking the free entrance of air. Unburned propane could easily build to the LEL in pockets if ventilation is impeded.

b) In climates where the annual heating degree days are greater than 1093 degrees C, perimeter louvers should be provided with motorized dampers. Motorized dampers allow the crawl space to be closed during unoccupied hours so the crawl space can be maintained above freezing.

3.11.6.2 Dampers. Where more than one compartment is connected to the exhaust fan system, the air from each duct should be controlled by a motorized, modulating, floating point damper from the instructor's station. In the "automatic" mode, the damper should be controlled by the device computer. In the

"hand" mode, the damper should be controlled by an open-stop-close pushbutton set. The damper should be capable of infinite positioning in either mode of operation.

a) Motorized dampers connected to the DTC in the instructor's station should be provided with a positive feedback control. Damper position status should be provided in the instructor's station. Floating point dampers should be provided with a modulating control output and the two position dampers should have binary control. See Appendix A, Figures A-18 and A-19.

b) Variable speed motor should be provided for the primary fan in each system, so the fan can be economically turned down during periods of no fire. This control would operate from reduced flushing flow to fully open when directed by the device computer. Any control used should have the following requirements:

(1) Modulation controls should have positive feedback and interface with the DTC.

(2) Exhaust fan controls should provide means to indicate in the instructor's station the following status:

Fan on-off condition
Damper position
Fan modulation - rpm (only if variable speed control is used)
Alarm air temperature
Exhaust air temperature

(3) The exhaust system should be provided with safety warning signs to indicate personnel hazard from heat of ducts.

c) A manual damper should be located in the duct leading from all compartments so the maximum exhaust flow from that space can be limited.

d) Dampers should be designed for high temperature operation at 538 degrees C. High temperature dampers should be constructed of stainless steel, same material as the ductwork.

Bronze bearings should not be used in high temperature dampers. Bronze bearings have a maximum temperature rating of 149 degrees C. Other bearing materials which should not be used in high temperature dampers are: nylon, Teflon, and stainless steel. The following bearing is acceptable for use with 538 degrees C high temperature dampers:

MATERIAL	BEARING TYPE	MAXIMUM TEMPERATURE RATING DEGREES C
Carbon and/ or Graphite	Sleeve	538

e) Dampers should be electrically operated and should be installed in the exhaust ductwork outside of the training compartment. Damper actuators for high temperature dampers should be accessible for maintenance.

f) Dampers should have a quick opening and closing time. The maximum time of operation of the dampers from any position to another position should be 15 seconds.

3.11.6.3 Fan. The exhaust system for each building should be sized to pull approximately two times the "air in" rate due to volumetric expansion of the heated air. These values are listed in Table 1 entitled "Main Ventilation Air for Fireplace Compartment" for each structure. Design temperature for flow calculations should be 315.5 degrees C. The design temperature for materials should be 538 degrees C. The fan and the exhaust system should meet the following criteria:

a) The exhaust system should consist of at least two fans totaling 100 percent of the ventilation requirement. The exhaust system should be designed for operation at 538 degrees C and should be provided with high temperature expansion joints suitable for operation at 538 degrees C in lieu of flexible duct connectors. The exhaust system ductwork should be constructed of low carbon stainless steel, 304L or 316L. Carbon steel should not be used because of high temperatures; the corrosion rate is increased and its structural strength is reduced due to the segregation of carbon. Ductwork design pressure should be noted on the drawing and should be based on the addition of the following:

(1) Maximum suction pressure of the exhaust fan at no flow conditions.

(2) Wind loads.

(3) Live load of 100 kg/sq. m on the top of horizontal exterior duct and inside horizontal duct areas of access.

(4) Interior horizontal duct loading of 14 g dust/(System L/s) equally distributed across the duct system horizontal surfaces.

(5) High temperature ductwork should be designed and constructed in accordance with Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA), Industrial Duct Construction Standards and ACGIH, Industrial Ventilation Guide. Ductwork should be welded. Welding procedures should be carefully specified and should be either American Society of Mechanical Engineers (ASME) or American Welding Society, Inc. (AWS) and should incorporate pure argon shielding gas. Suitable procedures are described in AWS B2.1.005, Standard Welding Procedure Specification (WPS) for Gas Metal Arc Welding of Austenitic Stainless Steel (for austenitic stainless steel) and AWS B2.1.006, Standard Welding Procedure Specification (WPS) for Gas Metal Arc Welding of Carbon Steel to Austenitic Stainless Steel (for carbon steel to stainless steel), except use pure argon shielding gas. Procedure AWS B2.1.006 is used for welding the duct to any structural support member. Use a low carbon and low hydrogen welding rod.

b) Several factors should be considered in the selection of a fan type. The fan horsepower and energy consumption should be as low as possible. Motors for exhaust fans should be sized for the lowest outside ambient temperature. The fan should be able to ride the fan curve to 50 percent of its design flow rate without adverse effects.

c) Noise is a consideration. A fan should be chosen for quiet operation and located in a sufficiently remote area so as to not interfere with training.

d) Manually adjustable inlet dampers should be provided for flow adjustment and segregation for maintenance.

e) Provide pressure drop indication across each fire compartment exhaust fan. The analog indication signal should be routed to a remote indicator in the instructor's station and then to the DTC. In addition, a pressure switch(es) should be provided which will sense the differential pressure across each fire compartment exhaust fan. The switch should have an adjustable setpoint that when reached will shut off the fan and send a binary signal to the DTC. The setpoint should be chosen to indicate impending fan surge or to ensure that the ductwork will not implode. If the airflow is restricted too much, the switch will stop the fan before equipment is damaged.

Table 1
Main Ventilation Air for Fireplace Compartment
of 21C12 and 21C12A Structures

PROPANE DEMAND L/s	VENTILATION AIR OUT AT 315 degrees C L/s
96	34 456

Notes: 1. Fan static pressure should be determined by comparing two modes of operations:

a. During burner operation: bring 15 degrees C air through the louvers and exhausting 315 degrees C air through the exhaust system.

b. Between firefighting scenarios (burners off): bring 15 degrees C air through the louvers and exhausting 15 degrees C air through the exhaust system.

2. The fan motor should be sized for bringing the lowest ambient air temperature expected through the louvers and exhausting it at the same temperature.

3.11.7 Control. Control of the ventilation should be performed as follows:

a) Before the start of training each day, the ventilation system should be energized with motorized dampers open and doors closed (in those structures with doors) to purge the structure of any unburned fuel which may have accumulated overnight. The purge should last at least 3 minutes.

b) When treatment equipment is required, a ventilation system control scheme should be provided to satisfy the device requirements discussed above, plus the treatment equipment in an economical manner.

c) Any motorized airflow adjustment device should be controllable by the device computer. The fans should run continuously or be off if not needed for extended periods of time. Floating point motors are for future sophistication.

d) To prevent back spin during startup of exhaust fans, provide the following:

(1) Individual controls for each fan and have it interfaced with the DTC.

(2) Each fan should have a two position back spin prevention motorized damper at the fan inlet. The damper should remain closed until the fan is started.

3.11.8 Preheat. In extreme climates where the annual heating degree days is greater than 2000, the ventilation air will require preheating. In trainers where the trainee walks into the path of the ventilation air, such as, bilge, berthing, or trash can fires, the air must be preheated. Where the trainee does not walk in the air path, as in the pit fire, the preheat temperature can be reduced for energy savings. The air passing through the burner rooms in extreme climates should be preheated. The preheating system should meet the following criteria:

a) Heating equipment should be sized to heat the design airflow from the low ambient design temperature to 10 degrees C. (This temperature was chosen because the heating

design temperature is at night and only occurs during a small percentage of the time. Such a system would provide 15.5 degrees C air 95 percent of the time.)

b) Design of the preheat system should not compromise the crawl space purge requirement. The preferred preheat system is to heat outside air and to distribute air over the louver, motorized damper, and backdraft damper combination in the crawl space. Air should be heated from outside ambient temperature to a temperature hot enough to allow a mixed air temperature of 10 degrees C. Mixed air is comprised of cold outside air from the louver combination units and hot air from the preheat system. The preheat system should be designed to heat the ventilation air by adequately mixing the air coming from louver combination units and the preheat system when the fire compartment exhaust fans are either exhausting 315.5 degrees C air (burners operating) or 10 degrees C air (burners off).

3.11.9 Other Rooms

3.11.9.1 Burner and Electrical Rooms. Some training structures have separate burner and electrical rooms. These rooms should be provided with filtered ventilation air which can be discharged directly to the outside, separate from the facility ventilation system. Fans in these rooms should run continuously while training is being conducted in that portion of the building. Control for this system should be by an HOA switch wired to the DTC. When there is no propane burner in the electrical room, the ventilation is for summer heat removal and should be controlled by a local wall switch in parallel with a thermostat. This ventilation does not apply to air conditioned electrical rooms associated with the instructor's station. Doors for electrical rooms should be 1200 mm wide.

3.11.9.2 Escape Trunks. Escape trunks should be provided with an exhaust fan located just below the roof hatch. This wall mounted fan should be wired to the DTC in the instructor's station so that anytime the escape trunk becomes too hot for training, the instructor can activate the fan. The exhaust fan for the escape trunk should be thermostatically controlled and should interface with the DTC.

3.11.10 Safety

3.11.10.1 Fuel Sensors. Ventilation should be designed to eliminate the possibility of any accumulation of unburnt fuel. Because fuel settles in low unflushed areas, careful crawl space and facility ventilation design can preclude this. To monitor this condition, the device includes fuel sensors located in the crawl space and in the electrical rooms which contain burners. These sensors sample their immediate location for fuel in excess of a percentage of the LEL. If an excess is registered, they shut down the control console in the instructor's station and sound an alarm. These sensor systems, installed by the device contractor and maintained by the using activity, should be located in strategic places.

> Caution: Sensors and the ventilation system should be kept in good working order to prevent an incident.

3.11.10.2 24-Hour Propane Alarm. If the trainer is not in operation and 24-hour propane sensing is in effect, a means for remote alarm activation should be provided (by device computer) at the DTC. Any alarms or other indicators are the responsibility of the facility contractor. The DTC will be the interface where the facility contractor will receive the 24 Vdc continuous signal. A 24-hour propane alarm from the DTC should be provided at the 24-hour duty watch station. Refer also to par. 2.2.3.1.

3.11.10.3 Fan Interlock. Another level of safety should be provided to prevent the danger of accumulated unburned fuel in the trainers. Danger from accumulated unburned fuel in the trainer during the occupied period can be adequately eliminated by a system of ventilation fans, sensors, and interlocks. During unoccupied periods the risk is reduced by natural ventilation and proper operation of the purge fan. Proper operation during occupied periods requires flushing the crawl space prior to energizing crawl space electrical circuits. Crawl space electrical circuits therefore, should be interlocked with main exhaust fans. At least one fan should be operating during the maintenance period before training. Fans and dampers as interlocked in the sequence in par. 3.11.9.1 should be further interlocked to include a timer relay to energize electrical circuits after a 3-minute delay from the key operated

HOA switch. The timer relay will alleviate the human error of energizing the crawl space electrical circuit prematurely. Refer to Appendix A, Figure A-20.

3.11.10.4 Insulation or Shielding. Where exhaust ducts pass from one fire compartment into the occupied space of another, they should be shielded or insulated or otherwise outfitted to ensure that personnel cannot be burned. If insulation is used, its jacket should be able to withstand the heat and force of a hose jet.

3.12 21C12 and 21C12A Structures

3.12.1 General. The 21C12 and 21C12A structures will be used to provide hands-on practical firefighting, training for submarine personnel. The structure is designed to train a class of 25 students maximum. Refer to par. 3.1, subpars. f) through h) for class types.

3.12.2 Siting. On some projects, the 21C12 and 21C12A will be combined with the 21C6, submarine damage control trainer. Criteria for the 21C6 device is maintained by NAVAIRWARCEN Training Systems Division in Orlando, Florida. The 21C6 may only be physically attached to the 21C12 and 21C12A trainers at the bulk storage room. However, access to the bulk storage room via ramp and truck platform is required. Other exterior walls of the 21C12 and 21C12A should remain exposed to the outside.

3.12.3 Architectural. Floor plans for the 21C12 and 21C12A structures are provided in Appendix G.

3.12.3.1 Layout. The 21C12 and 21C12A structures should consist of one fireplace compartment containing three fireplaces. The compartment is accessed from staging areas on either side through a submarine watertight door. There are two submarine doors in the 21C12 and 21C12A structures. All three fireplaces should be able to run simultaneously.

Mechanical Equipment Room: A 232.25 sq. m (floor area) mechanical equipment room should be provided as a second floor above the bulk storage area.

3.12.3.2 Fireplace Compartment. The fireplace compartment should meet the following criteria:

a) Bulkhead should be located to maintain a clearance from the backwall of 228 mm plus or minus 12.7 mm. One wall should simulate a curved bulkhead. There should be two 3000 mm lengths of bulkhead, 3810 mm high with a curve radius of 4572 mm supported by ribs. Bulkheads should be spaced 4572 mm apart. Each bulkhead should have three support ribs spaced 900 mm apart. Ribs should be T-shaped, 254 mm high with a 203 mm top and constructed of 6.4 mm steel plate. Bulkheads and ribs should be made of steel in accordance with ASTM A36, Structural Steel. Wall ribs will be insulated by the device contractor to give a submarine-like appearance. The wall on the opposite side should be a vertical wall because it is hidden from the trainees by a 2150 mm, steel partition. This partition should contain two emergency air breathing (EAB) outlets located in 304 stainless steel housings which will shield the EAB outlets from the fires. EAB outlet housings are designated as "EO" in Appendix G. The emergency corridor is behind this partition. The corridor is not part of the training compartment and therefore does not have to retain a submarine-like appearance. Provide a 102 mm high steel kickplate around the edge of the training floor by mockups and fireplaces at the grating floor as shown in Appendix G, Figure G-1. The kickplate should minimize the trainee's feet from slipping into mockups and fireplaces. Broom finish concrete floors located in fireplace compartments. Provide two floor drains in the emergency corridor.

b) Short masonry walls opposite the partition should support the SHS1 hose station and EAB cabinets. The main walkway and emergency corridor floors should be concrete while the 1200 mm wide walkways leading to fireplaces should be steel plate. A grating equipment floor should be 310 mm below the training floor which should be continuous under the mockup. Mockups should be mounted on the grating equipment floor. Mockups should be located within 76 mm of steel walkway to preclude someone from getting their foot caught in the void. The device contractor should provide a personnel safety barrier between the mockups to prohibit a person from falling onto the grating equipment floor.

c) The facility contractor does not have to provide a temporary railing around the walkway since the grating equipment floor will be only 310 mm below. A chain railing should be provided by the facility contractor around the bilge fireplace.

3.12.3.3 Crawl Space. There should be a crawl space below the grating portion of the training compartment which maintains a 1372 mm clear space between the equipment floor and the floor of the crawl space. The concrete crawl space floor should be approximately 1550 mm below the equipment floor. The crawl space should extend below the fireplace compartment and part of both staging areas are as shown on Figure G-1 of Appendix G. Refer to floor plans in Appendix G for additional details.

3.12.3.4 Staging Areas. Staging areas should be at the training floor elevation and should be made of concrete. Each staging area should include 1 combined SHS1 and SHS3 hose station, 1 EAB cabinet, 2 oxygen breathing apparatus (OBA) canister racks, 10 OBA cabinets, 1 shower with hot and cold potable water, 1 water cooler, and doors leading to the outside and the bulk storage area. A portion of the staging area should be set aside for storage of many fire extinguishers required during training. Broom finish concrete floors in staging areas.

a) Hose drying in the 21C12 and 21C12A should be provided in the staging areas. Hose drying consists of naturally drying the hoses on the staging area floor between training classes.

b) Staging areas should be enclosed at the sites. No artificial smoke should be introduced into the staging area. Because of the fireplace compartment ventilation, its artificial smoke should never drift into the staging area.

3.12.3.5 Burner Room. Directly behind fireplaces should be a burner room. Across from each burner is the computer electrical cabinet which operates it. The bilge fire burner will be located in the crawl space.

3.12.3.6 Bulk Storage

a) Directly adjacent to staging areas should be a bulk storage area with the same floor elevation as staging area

floors. This storage space will take bulk deliveries of consumables, store them, and prepare them for use. Extinguishers should be passed between staging and bulk storage, refilled, and returned for use. There should be at least enough extinguisher bottles for three classes.

b) The bulk storage room should include an extinguisher fill station capable of replenishing CO_2, PKP, and AFFF extinguisher bottles. A truck platform should be provided for receiving bulk materials. The configuration should suit the type of packaging expected for the consumables for a given site. Refer to Section 4 for characteristics of CO_2, PKP, AFFF, and their systems.

3.12.3.7 AFFF Fill Station. The foam fill station for the 21C12 and 21C12A structures should consist of a mixing tank, measuring tank, pump, water supply, spill containment, and drain. Foam concentrate should be delivered in 200 L gal drums. A single .631 L/s low head pump should be piped to pump concentrate from the drum to the .631 L/s measuring tank and supply the extinguisher's fill hose. The concentrate should then flow to the mixing tank by gravity. Water should be supplied to the 1137 L mixing tank through an open sight funnel. The mixing tank should have a closed top with a hinged cover, liquid level sight glass, and drain located at the bottom of the tank. A restricted bypass should ensure that there is flow through the pump during extinguisher fill operations when the trigger fill nozzle is closed. Mixing of the solution should be done manually.

a) Hoses 15 mm in diameter should be provided for concentrate suction, solution discharge, and cold water washdown.

b) The fill station should be provided with 820 kPa shop air to supply the propellant charge for the extinguishers. This air should not be supplied from the EAB system compressor but from a separate 820 kPa shop air compressor. Each AFFF extinguisher takes 2 L of air at 689 kPa for a full charge. The compressed air supply for the AFFF extinguisher fill should be

sized for a minimum airflow of 2.36 L/s at 820 kPa. Piping, a means for filling the extinguishers, and a suitably sized air receiver should also be provided.

c) The entire foam fill station should be surrounded by a containment to collect spills. Ramps should be provided for access to the containment. Floor drains should be provided in the containment and in two sites in the bulk storage area where filled bottles will be stored. A room designated as an extinguisher washdown room should be located adjacent to the fill station. The AFFF fill station should be in accordance with Appendix G, Figure G-10.

d) EAB and AFFF fill compressors are sources of loud noise and vibration and should be located to minimize noise and vibration interference with training. Noise control for these compressors should be provided.

3.12.3.8 CO_2 Extinguisher Fill Station. A CO_2 extinguisher recharging station should be provided for the 21C12, 21C12A, 19F5, and 19F5A structures. The recharging system should consist of low-pressure refrigerated bulk storage tank and system with CO_2 at -17.8 degrees C and 2100 kPa, and a manual extinguisher fill pump. The system should be insulated and should have safety valves between isolation valves. Safety valves should vent outdoors. Ensure isolation valves are operable without interference with piping insulation. See Appendix I, Figures I-1 through I-7 for CO_2 details.

3.12.3.9 Repair Lockers. Repair lockers are not required for the 21C12.

3.12.3.10 Ceilings. The ceiling in the fireplace compartment should be 2438 mm above the training floor and constructed of grating hung from the roof. Access to the space above the ceiling should be provided. The roof should be a minimum of 3658 mm above the training floor.

3.12.3.11 Doors. Doors in the training structure should be 44.45 mm, hollow, metal doors unless indicated otherwise. Submarine doors between staging areas and the training compartment should visually simulate the watertight door on a

SSB(N) 616 Class Submarine. However, the door should retain only those functions which are necessary for firefighting training. The submarine door should be mounted in a steel frame bulkhead, located in the concrete wall of the fireplace compartment. Provide stainless steel grip rails with non-slip surface above the submarine doors, on both sides of the walls. Also provide support plates for smoke curtains at the submarine doors in the trainer compartment. The using command activity should provide smoke curtains. A support and door stop should be provided to secure the submarine door when in the open position. The submarine door should be as shown on BUSHIPS Dwg. 805-1400064. The submarine door should be specified as follows:

- Watertight quick-acting (WTQA)
- 316 stainless steel material
- 103.4 kPa test pressure
- Right-hand or left-hand operation
- 457 mm by 914 mm size
- Lever operation - six rotating dogs on frame

3.12.3.12 Fireplaces. The exact dimension of the burn areas are:

	FIRE TYPE	DIMENSIONS
a)	Bilge/ Oil Spray Combination Fireplace	3048 mm by 1219 mm 1548 mm by 610 mm
b)	Hull Insulation Fireplace	4572 mm wide by height of bulkhead (mounted between bulkheads)
c)	Electrical Panel Fireplace	305 mm by 1219 mm

The bilge fireplace should be in the equipment floor of the training compartment. The hull insulation fireplace, oil spray fireplace, and electrical fireplace should be openings in the burner room wall. The oil spray fireplace should penetrate the curved bulkhead or wall behind the bilge fireplace.

3.12.3.13 Instructor's Station. A space 6706 mm by 6096 mm should be provided as a combined instructor's station, electrical, and maintenance room. A raised computer floor should be provided throughout, with 310 mm clear space below the raised floor. Lightweight partitions will be added by the device contractor. These partitions will not support any device equipment without having additional bracing provided beneath the raised floor. There should be no windows in the instructor's station. The instructor's station should be heated and air conditioned.

3.12.3.14 Miscellaneous. Artificial smoke will be introduced in the training compartment only. There will be no artificial smoke in the staging areas or in the emergency corridor.

3.12.4 Mechanical

3.12.4.1 Use Rate. Utilities for the 21C12 and 21C12A structures (see Table 2) are designed to support ten 4-hour classes of 25 students each week (2 classes per day). A class will be divided equally into two groups. Each group will go to a staging area and remain there for the class duration. Fires should be fought by the teams separately and simultaneously. However, only one fire hose will be used at a time since a majority of submarine firefighting is done with portable extinguishers. Table 2 is based on training 250 students per week, 1000 students per month, and 11,000 trainees per year.

3.12.4.2 Firefighting Agents. The 21C12 and 21C12A training structures should contain four hose stations, two stations are the combined type and the other two stations are the individual type. Each of the two combined hose stations should consist of hose stations SHS1 and SHS2. The combined hose stations are located in the staging areas. The two individual hose stations are SHS1 and SHS2 and are located in the fire training compartment. The hose stations should be served by one 40 mm angle-globe valve. Provide a bronze end hose cap with the angle-globe valve for thread ends. The valve should have male hose threads at the cap connection. The angle-globe valve should be perpendicular to the wall and should be served by piping routed in or through the wall. Refer to Section 4 regarding details of hose stations.

Fifteen-lb CO_2, 8.2 kg PKP, and 9.46 L AFFF extinguishers should also be used. Since the use rate for extinguishers will be high, ready storage is located in the staging area. After beneficial occupancy, instructors should locate the extinguishers in the trainer compartment.

Table 2
21C12 and 21C12A Structures

CLASS NO.	NO. OF CLASSES PER YEAR	NO. OF PERSONNEL
A-495-2071	288	(25 PER CLASS)
-2072	24	(12 PER CLASS)
-2073	24	(14 PER CLASS)

PROPANE USAGE

BASIC COURSE A-495-2071

CLASS OF FIRE	NO. OF FIRES/ CLASS (25 STU)	FIREPLACE TYPE	PROPANE DEMAND L/S	PROPANE USE PER FIRE (L)	TOTAL PROPANE L/CLASS
A	13	Hull insulation	49.6	8915	115 889
B	13	Bilge/Oil Spray	42	7471	97 126
C	13	Electrical	4.7	368	4783
	39 Fires per class		203		217 796/ class;

803/class

Notes:
1. Propane demand is based on a gas pressure at the bilge and hull fires of 14 kPa.
2. The design propane demand for the building is 96 L/s.
3. It was assumed that although there are more fires in the 2071 course they do not burn as long; therefore, the total consumption 217 796 L/class, based on the 2071 course, is the design maximum.

Table 2 (Continued)
21C12 and 21C12A Structures

AGENT USAGE

WATER

NO. OF FIRES/ CLASS	NO. OF HOSES/ FIRE	WATER L/s	WATER TIME/ FIRE min	WATER/4 HOUR CLASS L
36	2	13	6	27 288

EXTINGUISHERS

NO. OF FIRES/ CLASS	PKP BOTTLES/ CLASS	PKP L/CLASS	AFFF BOTTLES/ CLASS	AFFF L/CLASS	CO_2 BOTTLES/ CLASS	CO_2 kg/ CLASS
25	12	98	25	98	25	170

Notes:
1. Water is used at the design rate during an 0010 course fire.
2. Extinguisher sizes are 8.2 kg, 9.5 L, 6.8 kg for PKP, AFFF, and CO_2 respectively.
3. AFFF indicated is based on 56.6 g of 40 percent concentrate in 9.5 L of water.
4. Extinguishers are used at the design rate during an 0011 course fire.
5. PKP extinguishers will use 40 CO_2 charges per class.
6. Though water is used for firefighting, extinguishers are the primary method for fighting fires on submarines.

Table 2 (Continued)
21C12 and 21C12A Structures

TOTAL UTILITIES			
	DAILY	WEEKLY	MONTHLY
Propane	305 cu. m	1525 cu. m	6098 cu. m
Water	81 864 L	272 880 L	682 200 L
AFFF Concentrate (100%)	14 L	68 L	212 L
PKP	98 kg	588 kg	2354 kg
CO_2	511 kg	2384 kg	7661 kg

Notes: 1. Daily rates assume three 4-hour classes in the trainer a day.
2. Weekly rates for water assume (10)-0010 and five -0011 classes a week; for extinguishers, assume five -0010 and (10)-0011 classes a week.
3. Monthly rates assume (25) 0010 and (25) 0011 classes.
4. AFFF Concentrate (100 percent) is 20 percent AFFF, 80 percent water.

Caution: Any extinguisher located inside the training compartment must be shielded from fires. If it were exposed to the radiant heat, pressure inside the extinguisher could build to unsafe levels.

3.12.4.3 Ventilation for 21C12 and 21C12A Structures. Ventilation for the 21C12 and 21C12A structures should conform to the following criteria:

a) The design ventilation for the 21C12 and 21C12A should be based on the simultaneous operation of all three fireplaces or 34 456 L/s "air out."

b) The training compartment should have a 330.2 mm diameter ventilation duct which should be used for training purposes. This duct should run above the main walkway and terminate with a cap above the ceiling in staging area 1. The other end should lead to the fan room above staging area 2. There should be a bulkhead flapper at both staging area wall penetrations. A 200 mm branch leading to the fire area should be fitted with a 200 mm female blower adapter to allow the trainees to connect a Red Devil blower. The blower should be used to aid in evacuating smoke from the space during the training exercise. Bulkhead flappers and blower adapter should be provided by the device contractor. The horizontal run and the elbow in staging area 2 should have access panels for cleanout. Device contractor should provide the Red Devil blower and adapter.

c) In the fan room, the trainee vent duct should connect to the main compartment exhaust system through a motorized damper and a manual damper. During a training scenario when the trainee secures the mockup compartment ventilation, the motor damper should close automatically, stopping the flow of smoke into the branch duct. Note the actual compartment ventilation should be unaffected. The fan should run continuously. When the trainee attaches the Red Devil blower to the branch duct and reactivates the trainer ventilation, the motor damper should reopen, discharging into the main exhaust duct.

d) The main ventilation system for the fireplace compartment should have intakes above the ceiling level at the bilge and hull fireplaces, above the entrance to the emergency corridor at the ceiling level at the bilge and hull fireplaces, above the entrance to the emergency corridor at the ceiling level, and at the roof level above the emergency corridor door leading to staging area 2. Each of the intake ducts should have manual dampers for volume control. The main ventilation system should be provided with a floating point damper in the main exhaust duct run serving the fireplace compartment.

e) The main ventilation system duct work should be oversized as follows:

(1) The main duct run should be sized for 100 percent of the fireplace compartment ventilation.

(2) The intake and ductwork for each of the two fireplaces, bilge and hull, should be sized for 100 percent of the fireplace compartment ventilation. The manual damper for each of the two intakes should be set to exhaust 826 m^3/min) at 316 degrees C of exhaust gases.

(3) The intakes and ductwork for the roof level and emergency corridor exhaust point should each be sized for 25 percent of the fireplace compartments ventilation. The manual damper for each of the two intakes should be set to exhaust 207 m^3/min) at 316 degrees C of exhaust gases.

(4) Ventilation exhaust equipment and systems should be designed and selected for continuous operation at 399 degrees C.

3.12.4.4 Air Conditioning and Heating. The electronic equipment in the instructor's station is expected to add 11 237 W to the air conditioning load. This can be broken down into 6629 W in the operator station and 4608 W in the electrical room. Design for five people in the instructor's station rooms. One staging area should be heated during the unoccupied times. The staging area should be designated as a hose drying area where wet hoses can be stored until the next training session.

3.12.4.5 Cooling Spray. Cooling spray nozzles should be located above the grating ceiling aimed to direct water on the mockups. The single water supply pipe leading to the nozzles should have a motorized valve with a manual bypass controlled from the DTC. The cooling will be activated between exercises whenever the training compartment becomes too hot. The cooling system should not be part of the training scenario. Each cooling spray nozzle should have a constant dripping of water to cool compartment walls. Refer to par. 3.8.3.

3.12.4.6 Breathing Air. Two types of breathing apparatus are used in the 21C12 and 21C12A structures, the OBA and EAB devices. The OBA canisters for this structure should be racked in accordance with Appendix G, Figure G-5. There should be two such racks in each staging area for a ready storage of 44 OBA canisters per team. The OBA headpiece should be stored in lockers constructed in accordance with Appendix G, Figure G-7. There should be 10 OBA lockers in each staging area. The EAB outlet housings should be constructed in accordance with Mare Island Dwgs. 612-1889964A1 and 612-1889964A2, see Appendix G, Figure G-11. Housings should have doors. There should be eight EAB outlet housings, four in the fireplace compartment, two in the emergency corridor, and one in each of two staging areas.

> Caution: Care must be taken during design and construction of the breathing air system to eliminate any possibility of the air in the EAB system rising in temperature such that it would be hazardous to health. The EAB system piping should not be routed in the fireplace compartment.

a) Store EAB head gear in a cabinet in accordance with Appendix G, Figure G-6. Two cabinets must be located in each staging area and two cabinets must be located in the fireplace compartment.

b) The EAB system must be in accordance with the schematic shown on LANTDIV Sketch No. SK-M-43-86. The EAB system must be a 689 kPa system. Naval Facilities Guide Specification (NFGS) 15484, Medical Gas and Vacuum Systems, on nonflammable medical gas systems can be used; however, modify the guide specification to suit requirements of this 21C12 and 21C12A criteria.

c) The EAB system should meet: (1) Fed. Spec. BB-A-1034, Source II and (2) 29 CFR 1910, OSHA Safety and Health Standards for General Industry Grade D breathing air requirements. Delete reference to Table II. The EAB compressor should be an oil-free, breathing air compressor: single-stage, positive displacement, non-pulsating, and liquid ring type, Nash Engineering Company, Model OC-5C or equal. To meet breathing requirements, the EAB system may require use of a refrigerated

air dryer and a high purity air filter/cleaner. Fresh air intake to the EAB compressor should be located away from any potential air contamination sources.

d) Air samples taken from the completed system should be tested and approved in accordance with: (1) Fed. Spec. BB-A-1034, Source II and (2) 29 CFR 1910 Grade D breathing air requirements prior to system acceptance and twice per year. The EAB system is not required to be certified per Naval Material Command (NAVMAT) P-9290, System Certification Procedures and Criteria Manual for Deep Submergency System.

3.12.5 Electrical

3.12.5.1 Power. The power requirement for the device should be 35.5 kVA. It should be 120/208 Vac, three-phase, 60 cycle and include 21.4 kVA in the burner room and 14.1 kVA in the instructor's station.

There should be two heavy duty type electrical outlets in the training compartment located on the edge of the main walkway. One outlet should be 480-Vac, three-phase, 60 cycle and the other should be 120-Vac, single-phase service.

3.12.5.2 Lighting. The 21C12 and 21C12A structures parking lot and grounds should be lighted for nighttime operation. The training compartment should be lighted for maintenance from underneath the grating.

Emergency egress corridors should be lighted with low wall fixtures located to be shielded from the fires. Locate switches on both sides of emergency exit doors. These lights should only be used for maintenance purposes so that the lights should not interfere with training.

The device contractor should provide training compartment lighting which is remotely controlled from the instructor's station.

3.12.6 Propane Alarm System. The firefighting training facility should have a 24-hour propane detection system in the trainers. The detection system should be provided by the device contractor and monitored by device computers.

The facility contractor is required to interface with the detection system via a DTC and an alarm system. The facility contractor should provide the following:

a) A DTC for the trainer, refer to par. 2.5.3.2.

b) An alarm system with audible alarms, warning lights (backlighted signs), and manual pull stations.

The alarm system should be wired to the DTC and should consist of the following: (See Appendix G, Figure G-17 for the alarm system schematic.)

3.12.6.1 Central Control Panel. Provide a central control panel at the quarterdeck or 24-hour duty station. The panel should be wired to the DTC, should be UL listed, and should have indicating lights indicating the source of alarm from the DTC, auxiliary control stations, and manual pull stations.

a) Provide manual control on the central control panel for actuating and deenergizing the audible alarms and warning signs.

b) The DTC should be capable of energizing and deenergizing the alarm system.

c) The central control panel with the appropriate label should contain connections for future propane to the fire department.

d) A propane alarm condition can be actuated by the DTC, manual pull stations, central control panel, or auxiliary control stations. The alarm condition can be deenergized only by the DTC, central control panel, or auxiliary control stations. Audible alarms can be deenergized only by auxiliary control stations.

e) In the event of an alarm condition, appropriate warning signs, audible alarms, and the DTC should be alarmed by the central control panel.

3.12.6.2 Audible Alarms. Provide audible alarms at the following locations:

a) Classrooms and offices

b) Locker rooms and restrooms

c) Storage rooms

d) Staging and training areas

e) Quarterdeck or 24-hour duty station

f) Main corridors and vestibules

g) Mechanical and fan rooms

h) Propane storage areas

3.12.6.3 Propane Warning Signs. Provide separate propane warning signs at the following locations:

a) Front entrance

b) Loading dock

c) Quarterdeck or 24-hour duty station

d) Instructor and operator station

e) Propane storage area

Warning signs should be the backlighted type and should flash when there is an alarm condition. Propane warning signs should state "DANGER - PROPANE ALERT."

3.12.7 Manual Pull Stations. Provide separate manual pull stations which actuate an alarm condition at the following locations:

a) Outside propane tank storage area

b) Mechanical rooms

3.12.8 Auxiliary Control Stations. Provide auxiliary control stations which consist of manual pull stations. Auxiliary

control stations should be capable of deenergizing the audible alarms. Provide auxiliary control stations at the following locations:

a) Instructor and operator station

b) Quarterdeck or 24-hour duty station

3.12.9 Intercom System. Provide an intercom system to include the following:

a) Audible alarms should override the intercom system until the alarms have been secured. When audible alarms have been secured, the intercom system should be operable. Intercoms should not be provided in fireplace compartments, crawl space, and burner rooms.

b) The intercom system should have public announcement capability with speakers located in all rooms of the facility, except as noted above.

3.13 19F1A and 19F1B Structures

3.13.1 General. The 19F1A and 19F1B structures should be used to train in the Advanced Shipboard Firefighting Team Evaluation Course, J-425-0424. The structure is designed to train an 0424 class of 30 students and can train two classes or 60 students each week operating a single shift.

3.13.2 Architectural. Floor plans for the 19F1A and 19F1B structures are in Appendix B.

3.13.2.1 Layout. The 19F1A and 19F1B structures contain eight training quadrants on two floors accessible by a centrally located corridor. Staging should be done on the upper level. The structure, including the corridor, should be divided in half by a smoke tight wall allowing for separate and independent training to proceed simultaneously. To better control the products of combustion, the second floor crawl space floor should also be smoke tight. Corridor walls and the escape trunk enclosure should be continuous from the crawl space floor to the concrete ceiling over the training compartment. Provide

ventilation openings at the base of these corridor enclosures on three walls. Personnel access to the space below the corridor floor should be by removing a grating section.

Except for the aforementioned walls, the crawl spaces should remain open and clear. Partition walls should stop at the training floor. Grating should be used exclusively for the training floors in the 19F1A structure.

3.13.2.2 Ceilings. A steel barrier or false ceiling should be provided in Compartments 1 and 2 below the second floor crawl space to facilitate buildup of residual heat so the room stays hot during the whole exercise. The ceiling shields the crawl space floor above from direct radiant heat, keeping it cooler. A clearance of approximately 310 mm should be maintained between the barrier and the walls.

3.13.2.3 Doors and Hatches. The door type should be as shown on the floor plan. Exterior doors on the first and second training levels are for emergency use only. Their location may be shifted to accommodate structural requirements. Hollow metal doors should be used for non-training doors for identification purposes. During search and identification classes, the trainee should be instructed to use only watertight doors.

a) Access to the first floor from the second floor should be through a horizontal large hatch. These hatches are to be located between floors instead of on the roof because the roof location would require the roof to be 2438 mm wider. Also the hatch will get hotter located between floors which is a plus for training.

b) The heat shield for the Ellison door is a definite requirement, however, the shield restricts access to Compartment 1 from the escape trunk. For trainee safety, the bilge fire will be programmed to be off, or in the low fire position, in that corner during escape trunk training so the trainees can walk in that area of the fireplace.

3.13.2.4 Fireplaces. Exact dimensions of burn areas are given in Table 3 incrementally by compartment.

Table 3
Dimensions of Burn Areas for 19F1A and 19F1B Structures Figures

COMPARTMENT	TYPE	SIZE
Compartment 1 5791 by 5791 mm	Bilge Fire	2 rectangular areas 1524 by 3658 mm, 610 by 1524 mm
	Oil Spray	610 by 1524 mm above bilge
Compartment 2 5791 by 5791 mm	Bilge Fire	2 rectangular areas 1524 by 3048 mm, 1524 by 3048 mm
	Obstruction	914 by 1829 mm (914 mm H)
Compartment 3 4572 by 5486 mm	Clothes Dryer	1981 mm H by 1372 mm W by 1016 mm D
	Electrical Panel	305 by 1219 mm (Note 1)
	Obstruction - Laundry Table	762 mm by 1524 mm (762 mm H)
Compartment 4 4572 by 5486 mm	Deep Fat/Stack	610 by 1524 mm (Note 1)
	Wire Bundle (Cable Raceway)	3048 by 457 mm (Note 1)
Compartment 5 4572 by 5791 mm	Radar Display Console	610 by 914 mm
Trash Can		1829 by 1829 mm
	Escape Trunk (No exit)	1524 by 1524 mm
Compartment 6 4572 by 5791 mm	Weapons Fire Enclosure	2134 mm by 2134 mm by 2438 mm H
	Storage Room	2134 mm by 2134 mm by 2438 mm H

Table 3 (Continued)
Dimensions of Burn Areas for 19F1A and 19F1B Structures Figures

COMPARTMENT	TYPE	SIZE
Compartment 7 4572 by 5486 mm	Mattress Fire	2134 by 1067 mm
	Locker Fire	914 by 1067 mm
	"Dummy" Mattress Mockup	2134 by 1067 mm
Compartment 8 4572 by 5486 mm	Motor Generator	914 mm off each wall 914 by 1219 mm
	Vent Duct	3658 by 610 mm (Note 1)

Notes: 1. No hole in floor is required for these fireplaces.
2. Dimensions for fireplace compartment sizes should be clear dimensions. When compartments have refractory coatings and steel plate liners on walls, the inside clear dimension should be from liner to liner.
3. Facility to provide fireplace steel gratings. NAWCTSD will supply drawings and cost estimate to the facility architect during design phase.

3.13.2.5 Enclosures

a) The enclosure in Compartment 4 is designed to complicate the training associated with the cable raceway fire. The enclosure should be 2134 mm by 2134 mm and should have 2600 mm high steel walls, a grating floor, a wire mesh door, and no ceiling. The raceway fireplace should be located 2150 mm above the floor and should be installed by the device contractor who should cut the necessary holes in the steel walls.

b) There are two enclosures in Compartment 6. One encloses the storage room fireplace and the other is the weapons enclosure. The storage room should be 2150 mm by 2150 mm. Walls and the door should be steel frame with heavy chain link fence fabric sides. Walls should be 2438 mm high. No ceiling should be provided. The floor should be a standard fireplace floor which means it should be open until the device is installed. Provide a chain inside the door to prevent entry until the floor is installed. The 2134 mm by 2134 mm weapons enclosure should be 2438 mm high steel in front and adjacent to the storage room. No ceiling. Provide a watertight door. The floor should have a fireplace floor perimeter, however, a temporary grating floor with associated temporary supporting structure should be provided. The weapons fireplace or fire enclosure should be installed sometime in the future, therefore, a temporary floor is more appropriate than a drained entry.

3.13.2.6 Instructor's Station. The instructor's station should conform to the following criteria:

a) The instructor's station should have two personnel doors and two windows with dimensions of 2438 mm by 762 mm.

b) The instructor's station and electrical room below it should be 3048 mm wide and air conditioned. Contractors should be cautioned to seal wall penetrations airtight. Note that other maintenance areas should be ventilated only.

c) Provide a 1550 mm diameter circular stairway between the two floors. The stairway provides secondary access, is circular to save space, and is too narrow for equipment passage. The transferring of equipment can be accomplished by exterior doors and stairs.

3.13.2.7 Miscellaneous. The following are additional architectural criteria pertaining to 19F1A structures:

a) Local OBA cabinets should not be used in the 19F1A structure. The OBA's should be stored in the repair lockers.

b) An escape trunk should be provided in Compartment 1.

c) The inclined ladder leading to Compartments 1 and 2, and 3 and 4 descends greater than 4300 mm, however, no intermediate landing is required. The inclined ladder should be slip resistant.

d) The Foam Reel Station (FR) and Halon systems between Compartments 1 and 2 should be protected from the fire by 1200 mm high heat shields. Heat shields should be constructed of pipe and sheet metal and be sized so radiant heat from the fire cannot reach the firefighting equipment.

3.13.3 Mechanical

3.13.3.1 Use Rate. The 19F1A and 19F1B structures are designed to house 13 distinct fireplaces to instruct a one-day course for two ship's teams of up to 24 members per team. The ship's teams are organized inport duty section fire parties, repair parties, rescue and assistance details and at-sea fire parties (average team size is 18). Each team should be assigned a building half for training. Each side of the building should have three training exercises per hour. Each team should fight a minimum of five fires with a sixth fire as the graded exercise for the course. The graded exercise for the team should be on the opposite building half from which the team trained. A typical schedule should consist of three classes (A, B, C) per week, 108 trainees per week or 5,400 trainees per year.

3.13.3.2 Firefighting Agents. The first and second training floors should have HS1 type hose stations while HS2 hose stations should be installed on the roof staging area. In addition, one foam hose station (FS) and one FR type hose station for foam, should be installed on the roof staging area. The FS by the escape trunk should supply foam to the FR in Compartment 2 and to the FR on the roof. Provide six 6.81 kg CO_2 cylinders, four 13.6 kg PKP cylinders and one 9.08 kg PKP cylinder. These cylinders should be provided by the facility contractor and located and installed by station personnel. Halon 1301 (device contractor installed) should be simulated in Compartment 1 and a foam reel FR, should be provided in Compartment 2. Foam should be used throughout the structure from hose reels and 18.95 L cans.

Provide a 40 mm fire water line to the deep fat fryer fireplace and terminate it with a globe valve below floor grating. The water should be used for APC extinguishing agent simulation.

For propane usage, agent usage, and total utilities, see Table 4.

Table 4
19F1A and 19F1B Structures

FIRE CLASS		TIME	NO. OF FIRES
A	Wednesday	AM	12 fires
		PM	12 fires
B	Thursday	AM	12 fires
		PM	12 fires
C	Friday	AM	12 fires
		PM	12 fires

PROPANE USAGE

CLASS OF FIRES	NO. OF FIRES/ GROUP (15 MEN) 2 DAYS	TOTAL FIRE TYPE	PROPANE DEMAND L/s	PROPANE USE PER FIRE L	PROPANE/ GROUP FOR 2 DAYS
A	3	Trash Can	4.75	425	1274
	3	Mattress/Locker	19.5	849	2547
	3	Steam Clothes Dryer	4.75	425	1275
	3	Storage Compartment	19.5	849	2547
	3	Vent Duct	4.75	425	1274
B	4	Bilge/Oil Spray (Note 1)	66	9905	39 620
	4	Bilge (Note 2)	83	12 395	49 582
	3	Deep Fat Fryer/ Fryer Hood	19.5	849	2547

Table 4 (Continued)
19F1A and 19F1B Structures

PROPANE USAGE (Continued)

CLASS OF FIRES	NO. OF FIRES/ GROUP (15 MEN) 2 DAYS	FIRE TYPE	PROPANE DEMAND L/s	PROPANE USE PER FIRE L	PROPANE/ GROUP FOR 2 DAYS
C	1	Electrical Panel	2.4	212	212
	1	Motor Generator	4.75	425	425
	1	Radar Display	4.75	425	425
	1	Cable Raceway	4.75	425	425
Alternate	6	A, B, or C		849-12 395	56 600
	36 fires/group				158 763 L/ group 580 L/ group

Notes:
1. Compartment 1.
2. Compartment 2.
3. There should be 12 fires per group, 24 fires per class, 72 fires per week.
4. Propane demand is based on a gas pressure at the burner of 7 kPa except for bilge fires which are based on 14 kPa.
5. The design propane demand for the structure is 66 + 83 + 9 = 158 L/s.

AGENT USAGE

CLASS OF FIRE	NO. OF FIRES/ GROUP	NO. OF HOSES 40 mm	WATER L/s	AFFF 6% L/s	PKP FIRE kg	CO2 FIRE	TIME min
A	15	2	4.4				3-5
B	8	1		95	5-9		8-10
C	4					(2)7 kg Bottles	

Table 4 (Continued)
19F1A and 19F1B Structures

AGENT USAGE (Continued)

CLASS OF FIRE	NO. OF FIRES/ GROUP	NO. OF HOSES 40 mm	WATER L/s	AFFF 6% L/s	PKP FIRE kg	CO2 FIRE	TIME min
Deep Fat	3	1	4.4		9		3-5
Alternate	6	1		95	9		

Notes: 1. Bilge fires should be fought sometimes using AFFF and portable PKP bottles.
2. The design water demand for the structure is 4.4 + 4.4 + 6, or 15 L/s.

TOTAL UTILITIES

	DAY 3/	WEEKLY	MONTHLY
Propane	311 300 L	622 600 L	9096 L
Water	166 760 L	333 520 L	1 334 080 L
AFFF Concentrate (100%)	3032 L	6064 L	24 256 L
PKP	227 kg	454 kg	1816 kg
CO_2	114 kg	227 kg	908 kg

Notes: 1. The water category includes the water portion of AFFF (94 percent water, 6 percent AFFF for design).
2. 67 percent of water usage occurs on Tuesday and Thursday.
3. Values listed equal two times the group rates for "19F1A Propane Usage" and "19F1A Agent Usage."
4. The monthly consumption equals four times the weekly values.

3.13.3.3 Ventilation

a) There should be an exhaust duct leading from each compartment with a separately operated motorized floating point damper. These ducts should terminate at the concrete ceiling and not penetrate the ceiling liner. These ducts should come

together above the roof staging area and lead to the exhaust fan system. The collection duct can be as much as 2438 mm wide and the bottom should be no closer than 2134 mm to the staging floor.

b) The design capacity of exhaust fans should be based on the simultaneous operation of compartments or 46 256 L/s "air out." For ventilation air per compartment, see Table 5.

c) The anticipated control is by device computer and is as follows: When a fire is initiated, the building exhaust system should control from flushing to full design ventilation. The damper for the functioning compartment should open to a full design ventilation position. Dampers in nonfunctioning compartments should remain in their minimum flushing position.

d) Although smoke should not be admitted directly into corridors, roof entryways should have an exhaust duct to capture any stray smoke. The duct should discharge into the main exhaust duct through a manual damper.

3.13.3.4 Air Conditioning. Electronic equipment in the instructor's station is expected to add 5274 W to the air conditioning load. Normal occupancy should be eight people. The electronic room below the instructor's station has an air conditioning load of 9816 W due to equipment. Individual thermostatic control of each area is required.

3.13.4 Electrical. The power for the device should be 75 kVA. Provide 120/208-Vac, three-phase service. Provide four lights for each training compartment switched by compartment. Locate a switch for each compartment by the closest crawl space door and another outside by the emergency door. These light fixtures should be provided to light the training compartment by shining up. There should be six lighting circuits per crawl space.

Table 5
19F1A and 19F1B Ventilation Air

COMPARTMENT	PROPANE DEMAND L/s	VENTILATION AIR OUT AT 316 degrees C L/s
1	66	11 942
2	83	14 774
3	5	2171
4	9	4342
5	5	2171
6	9	4342
7	9	4342
8	5	2171

Notes: 1. The design ventilation is the sum of compartments or 46 256 L/s "air out." The minimum flushing ventilation should be as low as the fans can turn down but never lower than 3776 L/s "air in."
2. Fan static pressure should be determined by bringing 10 degrees C air through the louvers and exhausting 315.5 degrees C through the exhaust system.

3.14 19F3 and 19F3B Structures

3.14.1 General. The 19F3 and 19F3B structures should be used to train the General Shipboard Firefighting Training Course, J-495-0412. The structure is designed to train an 0412 class of 108 students and can train three classes or 324 students each week operating a single shift. Approximately 15,500 students can be trained in a year.

a) The location of the four buildings of the 19F3 and 19F3B trainers are flexible; however, consideration should be

given to clustering them around the instructor's station located in the bilge fire building, to minimize control wiring lengths. No building should be further than 18 m horizontally from the instructor's station.

b) Line of sight is not a requirement between the instructor's station and pit fire buildings.

3.14.2 Architectural. Floor plans for the 19F3 and 19F3B structures are in Appendix C. The 19F3 and 19F3B devices are housed in four structures: the bilge fire building, galley/berthing building, and two pit fire buildings.

3.14.2.1 Bilge Fire Building (19F3 and 19F3B). The bilge fire building should have interior dimensions of 9144 mm by 9144 mm with a ceiling height of 4600 mm. This area should house a generalized mockup of a shipboard engineering space to provide realism while exposing students to a major Class "B" bilge fire. Staging should be on the roof and at one ground level entrance. One topside entrance should include a dogged watertight door built into a vestibule, leading to an inclined ladder. Provide reinforcing of the landing to prevent swaying when six students with fire hoses are descending. The ladder should have a 1550 mm long landing midway down its length. At bilge area 1, the dimension from the corner to the shield should be 3124 mm clear. At bilge area 2, the dimension from the corner to the escape truck liner should be 7163 mm clear.

a) The bilge fire building should have a second topside entrance by way of a watertight hatch and emergency escape trunk.

b) A ground level entry with staging area should be located under the vertical ladder in the bilge fire building. The staging area should include a 4572 mm by 4572 mm OBA locker with a ground level entry. The design of the OBA locker should be similar to a repair locker.

c) A 1219 mm wide walkway should be provided around the exterior of the building to allow for emergency egress and to allow exterior viewing of the training scenario. Two sets of stairs should provide access to the roof.

d) A metal false ceiling should be provided in the B1 building to facilitate the buildup of residual heat so the room stays hot during the whole exercise.

e) The perimeter dampers on the B1 building should be 609.6 mm high.

3.14.2.2 Galley/Berthing Fire Building. The galley berthing building should have interior dimensions of 9144 mm by 9144 mm and a ceiling height of 3048 mm. It should be divided in half with one half having mockups to represent a berthing space and having a weapons fire enclosure. The other half should contain a deep fat fryer fire, a cable raceway fire, and an electrical panel fire. Staging and access to the structure should be from staging area at same level as training floor through watertight doors.

a) Provide a 40 mm process water line to the deep fat fryer fireplace and terminate it in a globe valve under trainer floor. This water line should be used for APC extinguishing agent simulation.

b) A 1219 mm wide walkway should be provided around the exterior of the structure for emergency egress and viewing.

3.14.2.3 Pit Fire Building. The pit fire building should be 9449 mm by 7620 mm and contain a 4572 mm by 4572 mm fireplace to teach basic firefighting techniques. The ceiling should be 9144 mm above the training floor. A staging area should be provided so the students enter the structure through a 6096 mm wide by 3658 mm high opening in the wall. No door is required.

a) The floor around the fireplace should be steel plate with a non-slip surface. The floor should slope to the fireplace so agents are channeled to the crawl space. The rear perimeter plate should be 610 mm wide. There is no training requirement for the decking on either side or to the rear of the B3 or B4 building.

b) Columns used to support the fireplace perimeter should be located at each corner, one on each side in the center

and two in the front and back on 1524 mm centers. A vertical barrier should be provided around the perimeter of the fireplace to prevent water from getting beyond the perimeter.

c) Students will walk on the fireplace grating but this grating must be provided by the device contractor along with the weapon mockup ramp. When a device contractor supplied weapon mockup is indicated it must be stored inside the building.

3.14.2.4 Doors. Doors leading to the fire areas of the 19F3 and 19F3B structures must be quick-acting watertight doors. Doors leading to non-fire areas must be hollow metal doors. In the galley/berthing building, the door between Compartments 1 and 2 must be watertight.

3.14.2.5 Fireplaces. Dimensions of specific fireplace locations are listed in Table 6.

3.14.2.6 Instructor's Station. An instructor's station should be located on the roof of the bilge fire building and should control the 19F3 buildings. The instructor's station should be 3658 mm by 7315 mm. Directly below the instructor's station should be an air conditioned electrical space. Window dimensions should be 2591 mm with the bottom 1219 mm above the floor.

3.14.3 Mechanical

3.14.3.1 Use Rates

a) The 19F3 and 19F3B structures are designed to house eight distinct fireplaces to instruct a 2-day course for a class of 108 trainees. The afternoon of the first day, the class is split into two groups of 54 students each. Each group goes to a deck fire building, B3 or B4, where group is further divided into two groups of 27. First group is divided into four hose teams. All four hose teams fight the fire at one time. The second group of 27 is given lectures. Each group will receive a "dropped weapon" fire demonstration at the end of their deck fires. Once fires and demonstrations are completed for each group, the two groups on each building should rotate and repeat lectures and fires.

Table 6
Dimensions for 19F3 and 19F3B Structures Fireplace Locations

Bilge fire building B1	
2 rectangular areas:	2134 x 2438 mm; 1219 x 5182 mm
3 rectangular areas:	1524 x 2438 mm; 1524 x 2438 mm; 2743 x 1524 mm
Obstructions:	610 x 3048 mm x 2438 mm H 3048 x 2743 mm x 1829 mm H
Pit fire building, B3:	4572 x 4572 mm
Pit fire building weapon, B4:	4572 x 4572 mm
Galley/berthing building, B2	2134 x 2134 mm x 2438 mm H
Mattress/locker fire	3048 x 1067 mm
Dummy mattress mockup	2134 x 1067 mm
Mattress/locker mockup	4572 x 1067 mm
Deep fat/stack hood	610 x 1524 mm (Note 1)
Electrical panel	3048 x 1219 mm (Note 1)
Cableway	3048 x 914 x 2438 mm AFF (Note 1)

Notes: 1. No hole in floor is required for this fireplace.
2. Dimensions for fireplace compartment sizes must be clear dimensions. When compartments have refractory coatings and steel plate liners on walls, the inside clear dimension must be from liner to liner.
3. Facility to provide fireplace steel gratings. NAWCTSD will supply drawings and cost estimate to the facility architect during design phase. For Buildings B-3 and B-4, facility to provide fireplace steel grating supports. NAWCTSD will supply drawings and cost estimate to the facility architect during design phase.

b) The second day the class is divided into two groups of 54 students each. Each group then goes to either the B1 or B2 structure. In the B1 building, the group is divided into two groups of 27 students. One group goes to the top level of B1 and one group goes to the bottom level of B1. The top group performs a vertical entry into the space and attacks the oil spray-bilge fire. The lower group should attack the prop shaft bilge fire alternately with the top level group. When both levels have completed fires, groups alternate from the top to the bottom and bottom to the top and repeat. In the B2 building, the group of 54 is also split into two groups of 27 each. The first group of 27 is then split into two groups and each attacks the mattress and metal storage locker fires together from two separate entrances until each member has fought a Class "Alpha" fire as a nozzleman. The second group of 27 fights the electrical panel and the wire bundle fires until each member has extinguished a Class "Charlie" fire. The second group should also watch a demonstration on the deep fat fryer and stack hood fire. Once both groups are finished with their first part of B2, they should alternate with the other group until students have completed B2.

Until completion of each building, the group from B1 should go to B2 and the B2 group should go to B1 until students have completed both buildings.

For propane usage, agent usage and total utilities, see Table 7.

3.14.3.2 Ventilation. (See Table 8). Provide an exhaust outlet above each bilge area and in each compartment. Ducts from one fireplace should not run horizontally through the compartment of another fireplace. The design capacity of exhaust fans for the B1, B2, B3, and B4 buildings should be equal to the maximum building ventilation L/s "air out."

3.14.3.3 Air Conditioning. Electronic equipment in the instructor's station is expected to add 7800 W to the air conditioning load. Normal occupancy should be six people. The electrical room below the instructor's station has an air conditioning load of 7102 W due to equipment. Individual thermostatic control is required for each area.

Table 7
19F3 and 19F3B Structures

CLASS SCHEDULE

BUILDING	MON AM	MON PM	TUE AM	TUE PM	WED AM	WED PM	THU AM	THU PM	FRI AM	FRI PM
B1			X		Y		Z			
B2			X		Y		Z		MAINTENANCE	
B3		X		Y		Z				
			2/	2/		2/				
B4		X	X	Y	Y	Z	Z			

Notes: 1. Day 1 AM, Classroom lecture
2. Day 2 PM, Demonstrations
3. Three classes: X, Y, Z

PROPANE USAGE

BLDG	CLASS OF FIRES	NO. OF FIRES/ CLASS	FIRE TYPE	PROPANE DEMAND L/s/min	PROPANE USE PER FIRE/L	TOTAL PROPANE/ CLASS L
First Day PM						
B3	B	30	Pit	186	16 725	501 759
B4	B	30	Pit	186	16 725	501 759
Second Day						
B1	B	13	Bilge Area 1	79	9509	123 614
	B	14	Bilge Area 2	187	10 584	148 207
B2	A	9	Mattress/ Locker	9	849	7641
	B	9	Deep Fat Fryer/ Fryer Hood	9	849	7641
	C	9	Elect. Panel	2	212	1924
	C	9	Cable Raceway	5	425	3821

Table 7 (Continued)
19F3 and 19F3B Structures

PROPANE USAGE (Continued)

BLDG	CLASS OF FIRES	NO. OF FIRES/ CLASS	FIRE TYPE	PROPANE DEMAND L/s/min	PROPANE USE PER FIRE/L^3	TOTAL PROPANE/ CLASS L^3
Second Day (Continued)						
B3 or B4	D	12	Pit/Weapon	186	16 725	200 704
Alternate		9	A, B, or C	89	10 584	95 258
		144 fires/class				715 000 Class for 2 Days
						43 639 Class for 2 Days

Notes:
1. Propane demand is based on a gas pressure at the burner of 6.89 kPa except for the bilge and pit fires which are based on 13.78 kPa.
2. The design propane demand for each building is:
   B1 79 + 88 or 167 L/s
   B2 9 + 9 or 18 L/s
   B3 186 L/s
   B4 186 L/s
3. The design propane demand for the four buildings together is: 168 + 19 + 186 + 186 = 559 L/s

Table 7 (Continued)
19F3 and 19F3B Structures

AGENT USAGE

BLDG	CLASS OF FIRE	NO. OF FIRES/ CLASS	NO. OF HOSES 40 mm	WATER L/s	AFFF 6% L/s	PKP/ FIRE kg	CO2/ FIRE kg	WATER TIME min
First Day PM								
B3	B	30	51	8				3
B4	B	30	51	8				3
Second Day								
B1	B	27	25	6				3
	B		25		6	114		1
B2	A	9	51	6				3
	B	9	25	6		3		3
	C	9 7.5						
	C	9 7.5	-					
63 B3 or								
B4	D	12	51		8			1
Alternate		9	25	6				3
			25		6	5		1

Notes:
1. PKP should be used in 9 of the 27 fires in the B1 building.
2. The design water demand for each building is:
   B1 (6 + 6) x 2 or 24 L/s
   B2 6 x 2 + 6 or 18 L/s
   B3 8 x 2 or 16 L/s
   B4 8 x 2 or 16 L/s
3. The design water demand for the four buildings together is:
   24 + 18 + 16 = 58 L/s
4. B1 should have nine fires/hour.
5. B2, B3, and B4 should have 15 fires/hour.
6. In B1 each team (12 men) should approach a fire from each of three entryways.
7. B1 fire heights 3048 to 3658 mm.
8. B2 fire heights 3658 to 4572 mm.

Table 7 (Continued)
19F3 and 19F3B Structures

Notes (Continued):

9. PKP and CO_2 in B2 should come from portable extinguishers; 9 CO_2 charges for PKP bottles required per class.
10. Each class should use 72 OBA canisters with each canister being used three times.
11. B3 should have foam provisions similar to B4 so they can be used interchangeably.

TOTAL UTILITIES

	CLASS DAY 2	WEEKLY	MONTHLY
Propane	1 584 800 L	4 754 400 L	69 584 L
Water	265 300 L	795 900 L	3 183 600 L
AFFF Concentrate	5738 L	4548 L	18 192 L
PKP	687 kg	545 kg	2179 kg
CO_2	64 kg	191 kg	763 kg

Notes:
1. The water category includes the water portion of the AFFF (94 percent water, 6 percent AFFF for design).
2. 70 percent of the water usage for a class occurs on the first day of class. However, since the successive classes overlap, the design daily water consumption equals the values for one 2-day class.
3. The monthly consumption equals four times the weekly values.

Table 8
19F3 and 19F3B Ventilation Air

BUILDING COMPARTMENT		MAXIMUM PROPANE DEMAND L/s	VENTILATION AIR OUT AT 315 degrees C L/s	BUILDING VENTILATION AIR OUT L/s
B1	Area 1	79	14 113	63,500
	Area 2	88	15 859	
B2	Area 1	9	4342	8685
	Area 2	9	4342	
	Area 3	2	1086	
B3		186	56 640	56 640
B4		186	56 640	56 640

Note: Fan static pressure should be determined by bringing 16 degrees C air through the louvers and exhausting 315 degrees C through the exhaust system.

3.14.4 Electrical

a) Provide 120/208 V, three-phase service to each of the structures as follows:

B1 building	70 kVA
B2 building	37.5 kVA
B3 and B4 building	25 kVA each

b) Provide the following spare conduits from the instructor's station located at the of building B1 to B2, B3, and B4 buildings as follows:

B2 Building	3 - 76 mm conduit
B3 Building	3 - 76 mm conduit
B4 Building	3 - 76 mm conduit

The above conduits should be used only by the device contractor for both power and control wiring. Power and control wiring should be run in separate conduits.

3.15 19F3A and 19F3C Structures

3.15.1 General. The 19F3A and 19F3C structures will be used to train the General Shipboard Firefighting Training Course, J-495-0412; Advanced Shipboard Firefighting Evaluating Course, A-495-0419; and Advanced Shipboard Firefighting Team Training Course, J-495-0424. The structure is designed to train in a single shift an 0412 class of 60 students and can train up to four classes or 240 students each week; an 0419 class of 30 students and can train up to one class or 30 students each week; and an 0424 class of 30 students and can train up to two classes or 60 students each week. Splitting the year evenly, this trainer can teach 6000 students the general course and 1500 students the advanced team course annually.

3.15.2 Architectural. Floor plans for the 19F3A and 19F3C structures are in Appendix D.

3.15.2.1 Layout

a) The 19F3A and 19F3C structures are a single building which includes 19F1A and 19F1B type structures and 19F3 and 19F3B-B3 buildings connected by a large covered staging area. The respective portions of the 19F3A and 19F3C structures should duplicate the 19F1A, 19F1B, 19F3, and 19F3B-B3 buildings with the exceptions presented herein.

b) Compartments in the 19F1A and 19F1B portions of the structure have been enlarged and fireplaces have been relocated to accommodate the larger General Firefighting Course classes. The 0412 students should stage at ground level and in adjacent compartments on the second floor. Students should not travel between floors during a training scenario. Trainees in the 0424 course should travel between floors and a landing should be provided midway in the inclined ladder leading to Compartments 1 and 2. Doors leading from fireplace compartments in the 19F1A and 19F1B portions should be watertight. Those used by the trainees should be quick acting.

c) The pit fire, B3, or B4 portion is the same as for the 19F3 and 19F3B structures.

d) A 4572 mm by 4572 mm locker with an exterior access should be provided for OBA storage and should be designed as a repair locker. Standard OBA cabinets should be provided in the OBA locker. A wild hose demonstration area is required for teaching in the 19F3A and 19F3C structures. Where the climate allows year around training outside, the wild hose demonstration area should be outside. Trainees would watch the demonstration from the open sides of the staging area. In severe weather locations, the wild hose area should be provided in an area enclosed on three sides with the trainee side open. Means with unrestricted visibility should be provided to protect the bleacher from the hose water spray (a Plexiglas barrier meets this requirement). Refer to par. 2.4.2. Water should come from the HS2 hose station on the opposite side of the staging area.

e) Bleachers should be required in the 19F3A and 19F3C structures and should be capable of seating 120 people.

f) Demonstrations of portable extinguishers should be conducted on the B3 side of the staging area.

g) The staging area should be constructed of concrete or steel grating with appropriate floor drains. If bulk dry storage is to be located underneath the staging area, then a waterproof construction should be used. Subsurface storage should not be considered where there is a high water table or where flooding is probable. At least one-third of ventilation air for pit fireplace exhaust fans should be supplied into staging area.

h) The ventilation system should be manifolded such that Compartments 1, 2, 5, and 6 are on a separate system served by two equal sized exhaust fans. Compartments 3, 4, 7, and 8 should be on a separate system served by one exhaust fan.

3.15.2.2 Doors and Hatches. Doors leading from Compartments 1 and 2 to the staging area should be quick acting and watertight with 180 degree swing. The door leading to Compartment 2 should be installed in a removable panel such that when the door and panel are removed, a 914 mm by 2134 mm minimum opening is

available for the transfer of large equipment. The door should be used for installation and maintenance. A 1829 mm wide, 2134 mm high door should be located in the staging area to accommodate large equipment on hand trucks. The door should have a ramp access. Forklift truck access is not required.

a) First floor burner room doors should be located at each end of the burner rooms. They should be exterior doors except for the northwest corner which should be in the extended stair column. Second floor burner room doors should be accessed from the stair columns as in the 19F1A.

b) A large hatch should be provided at the top of the inclined stairs leading from the first floor and the second floor.

3.15.2.3 Fireplaces. For exact dimensions of fireplaces incrementally by compartment, see Table 9.

3.15.2.4 Instructor's Station. The instructor's station and the electrical room below the instructor's station should be similar to the rooms of the 19F1A and 19F1B. Interior dimensions should be approximately 13 411 mm by 3048 mm. Controls for the pit fire, B3, or B4 portion should be installed in the instructor's station.

3.15.2.5 Miscellaneous

a) No hose drying area is required but provide the following two items for hose drying: an outside hose drying rack and a heated storage for rolled up 15 240 mm long hoses. Rolled hoses should be stored vertically in storage racks. Racks should be designed to hold two rolls high and be located in the OBA locker.

b) P-250 training is a part of the 0412 course; therefore, a facility is required. P-250 training is a requirement for 19F3A and 19F3C structures.

Table 9
Dimensions for 19F3A and 19F3C Structures Fireplaces

COMPARTMENT	TYPE	SIZE
Compartment 1 7620 x 6096 mm	Bilge Fire, Oil Spray	2 rectangular areas 1524 x 3658 mm, 6096 x 1524 mm
Compartment 2 7620 x 6096 mm	Bilge Fire	2 rectangular areas 1524 x 3048 mm, 1524 x 3048 mm
	Obstruction	914 x 1829 mm, 914 mm H
Compartment 3 5487 x 6096 mm	Clothes Dryer	1981 mm H x 1372 mm W x 1219 mm D
	Electrical Panel	305 x 1219 mm (Note 4)
	Obstruction-Laundry Table	762 x 1524 mm (762 mm H)
Compartment 4 5487 x 6096 mm	Deep Fat/Stack Hood	610 x 1524 mm (Note 4)
	Wire Bundle (Cable Raceway)	3048 x 457 mm (Note 4)
	Closet	1219 x 1829 mm
Compartment 5 7620 x 6096 mm	Escape Trunk (No exit)	1524 x 1524 mm
	Weapons Enclosure	2134 x 2134 x 2438 mm H
	Storage Room	2134 x 2134 x 2438 mm H
Compartment 6 20 726 x 7620 x 6096 mm	Mattress/Locker Fire	3048 x 1067 mm
	“Dummy" Mattress Fire	2134 x 1067 mm
Compartment 7 5487 x 6096 mm	Motor Generator Wall	914 mm off each wall
	Vent Duct	3658 x 610 mm (Note 4)
	Enclosed Pit Fire	4572 x 4572 mm
Compartment 8 5487 x 6096 mm	Radar Display Console	610 x 914 mm

Table 9 (Continued)
Dimensions for 19F3A and 19F3C Structures Fireplaces

Compartment 8 (Continued):	
Trash Can	1829 x 1829 mm

Notes:
1. The cable raceway fire should be mounted 2438 mm above the grated floor and should be installed in an enclosure with 2591 mm high walls.
2. Bilge fire heights - Maximum 2743 mm.
3. Pit fire heights - 3658 x 4572 mm.
4. No hole in the floor is required for these fireplaces.
5. Dimensions for fireplace compartment sizes should be clear. When compartments have refractory coatings and steel plate liners on walls, the inside clear dimension should be from liner to liner.
6. Facility to provide fireplace steel gratings. NAWCTSD will supply drawings and cost estimate to the facility architect during design phase for all compartments and pit fireplace. Facility will also provide grating supports for pit fireplace.

3.15.3 Mechanical

3.15.3.1 Use Rate. Utilities for the 19F3A and 19F3C structures (see Table 10) are designed to support four general classes of 60 trainees each week. During the first session, the class should go to the pit fire location. The class should be divided into four hose teams of 15 trainees each. Two hose teams at a time should fight the fire alternately at a rate of 15 fires per hour.

a) During the second session this class should again be divided into four groups of 15 trainees. One group should go to Compartment 1, one should go to Compartment 2, one should go to Compartments 3 and 4, and one should go to Compartments 5, 6, 7, and 8. Each group should stay at a location for one hour then rotate to a different location. Each group should go to either Compartment 1 or 2 but not both.

Table 10
19F3A and 19F3C Structures

PORTION OF BUILDING	MON AM	MON PM	TUE AM	TUE PM	WED AM	WED PM	THU AM	THU PM	FRI AM	FRI PM
Classroom	V	W				X	Y			
Pit Fire/		V	W				X	Y		
Demonstration				V	W				X	Y
Bilge Fire				V	W				X	Y

Notes: 1. The 2 day-course includes a classroom session before fire training and a demonstration session after it.
2. Demonstration should be in front of the pit fireplace, therefore during the second day, another class should not be using this area.
3. Classes, 60 trainees each, are designated as V, W, X, and Y.

PROPANE USAGE

CLASS OF FIRES	NO. OF FIRES/ CLASS (60 MEN) 2 DAYS	FIRE TYPE	PROPANE DEMAND L/s	PROPANE USE PER FIRE L	TOTAL PROPANE/ GROUP FOR 2 DAYS
First Day PM					
B	30	Pit	186	16 725	501 759
Second Day AM					
B	20	Bilge Compartments 1 and 2	83	12 395	247 908
B	32	Deep Fat Fryer/ Fryer Hood	9	849	27 168
A	24	Mattress/Locker, Trash Can, etc.	9	849	20 376
C	24	Radar Display, Elect. Panel, etc.	5	425	10 188
	130 fires/class			807 116 L/class	
				22 046 L/class	

Table 10 (Continued)
19F3A and 19F3C Structures

Notes:
1. Propane demand is based on a gas pressure at the burner of 7 kPa except the bilge and pit fires require 14 kPa.
2. The design propane demand for the building is: 186 + 83 + 83 + 9 + 9 = 370 L/s.

AGENT USAGE

CLASS OF FIRE	NO. OF FIRES/ CLASS	NO. OF HOSES 40 mm	WATER L/s	AFFF 6% L/s	PKP/ FIRE Kg	CO_2/ FIRE kg	WATER TIME min
First Day PM							
B	30	51	8				3
Second Day AM							
B	20	25	6				2.5
		25		6	11		1
B	32	25	6		3		3
A	24	51	6				3
C	24					3	-
	130						

Notes:
1. PKP should be used in 7 of the 20 bilge fires.
2. The design water demand is: (8) 2 + (6 + 6) 2 + 6 + (6) 2 = 58 L/s.
3. PKP and CO_2 used on the fryer and electrical fires respectively should come from portable extinguishers; 32 - CO_2 charges for PKP bottles should be required for each class.
4. Each 0412 class should use 72 OBA canisters. Each canister should be used by three students.

Table 10 (Continued)
19F3A and 19F3C Structures

TOTAL UTILITIES

	CLASS 2 DAY	MONTHLY
Propane	792 400 L	7 414 600 L
Water	197 080 L	23 376 330 L
AFFF Concentrate (100%)	432 L	21 224 L
PKP	182 kg	2633 kg
CO_2	76 kg	1226 kg

Notes:
1. The water category includes the water portion of the AFFF (94 percent water, 6 percent AFFF for design).
2. 45 percent of the water usage for a class occurs on the first day of class. However, since the successive classes overlap, the design daily water consumption equals the values for one 2-day class.
3. The greatest weekly consumption is four times that for a single class.
4. The 2-day class totals are for a 0412 class.
5. The weekly rate is four times the 2-day class rate.
6. The monthly consumption includes seven 0412 classes and six 0424 classes.

b) The following utility rates should easily support the 0419 and 0418 courses because both have fewer fires per class. The 0418 course, when it is taught in the 19F3A and 19F3C, should be similar to when it is taught in the 19F1A and 19F1B. Only one course type can be taught in the 19F3A and 19F3C at any given time.

3.15.3.2 Firefighting Agents

a) There should be a foam reel in Compartment 2 which should get its foam from the FS on the east side of the roof and a FR between the Compartment 1 and 2 exterior doors. This second FR should get its foam from the FS on the west side of

the roof. The interior FR is fed from the east FS because both stations serve the same group during 0418 training. During 0412 training, each FR should be served by a separate FS.

b) Provide six 6.81 kg CO_2 cylinders, four 14 kg PKP cylinders, and one 9 kg PKP cylinder. These cylinders should be provided by the facility contractor and located and installed by the station personnel. Halon should be simulated in Compartment 1.

3.15.3.3 Ventilation. The design ventilation less the pit fire or the 19F1A, 19F1B portion of the structure should be based on the simultaneous operation of compartments or 49 088 L/s "air out." The minimum ventilation should be 3776 L/s. The design ventilation for the pit fire, B3, or B4 portion of the structure should be 56 640 L/s "air out." For ventilation air per area, see Table 11.

3.15.3.4 Air Conditioning. The electronic equipment in the instructor's station is expected to add 6739 W to the air conditioning load. Normal occupancy should be six people. The adjacent electrical room should have an air conditioning load of 9669 W due to equipment and a two-person occupancy. Individual thermostatic control for each area is required.

3.15.4 Electrical

3.15.4.1 Power. The power for the device is 100 kVA. Provide 120/208 V, three-phase service.

3.15.4.2 Lighting. The staging area should be lighted for training after dark. When walkways and stair columns associated with the 19F1A and 19F1B portions of the structure are enclosed, they should be lighted.

3.16 19F4 and 19F4A Structures

3.16.1 General. The 19F4 and 19F4A structures should be used to train the Shipboard Aircraft Firefighting Course, J-495-0413 and the Aviation Facility Ship Helicopter Firefighting Team Training Course, J-495-0414. The structure is designed to train

two 2-day 0413 classes of 60 students and one 1-day 0414 class of 30 students a week. Approximately 6000 students can be trained a year.

3.16.2 Architectural. Floor plans for the 19F4 and 19F4A structures are in Appendix E.

Table 11
19F3A and 19F3C Ventilation Air

COMPARTMENT	PROPANE DEMAND L/s	VENTILATION AIR OUT AT 316 Degrees C L/s
1	83	14 774
2	83	14 774
3	5	2171
4	9	4342
5	9	4342
6	9	4342
7	5	2171
8	5	2171
Pit	186	56 640

Note: Fan static pressure should be determined by bringing 16 degrees C air through the louvers and exhausting 316 degrees C through the exhaust system.

3.16.2.1 Layout. The 19F4 and 19F4A structures are designed to simulate aircraft fires onboard ship. The structure consists of an open training deck measuring 34 138 mm by 20 117 mm with one fireplace. The training deck should be constructed of concrete. The fireplace should be 15 850 mm by 10 973 mm centered leaving two 9144 mm wide and two 4572 mm wide areas for staging. These 4572 mm wide areas are acceptable even though the fire should be fought from any one of the four sides. There should be no more than three to five trainees on a 40 mm hose and 7 to 10 trainees on a 65 mm hose. The remainder of the class should observe the exercise. The perimeter of the fireplace should be lined with

70 mm thick refractory and a vertical stainless steel plate in accordance with Appendix A, Figure A-9 and should be designed for a load of 295 kg per linear foot. No coaming should be required around the outside perimeter of the training deck; however, a safety rail should be provided. This rail should be constructed of 38.1 mm steel pipe with two horizontal rails. Horizontal rails should line up vertically to prevent personnel from falling off the training deck. The safety rail should not have any netting or webbing.

a) The training deck should consist of a 102 mm lightweight heat-resistant concrete topping on a 6 mil polyethylene bond breaker, on a concrete structural slab. The topping slab should be designed to be sacrificial, provided in sections, and capable of thermal expansion. Expansion joint material should consist of a ceramic fiber blanket capable of resisting temperatures of 1093 degrees C minimum. The training deck elevation should be 2438 mm above grade to allow air access to the underside of the fireplace and to allow space for the electrical, foam, and storage rooms (each with a 2134 mm minimum ceiling height) beneath. Where the training deck is located above the first floor rooms it should be waterproofed. The crawl space under the training deck should maintain 1829 mm of clear height. There should be no doors leading from the ground level rooms directly into the crawl space and utility penetrations should be sealed airtight. Stairs should be provided at three locations to afford personnel access to the training deck. Additional ground access should be provided at each foam training deck. The area under the foam decks and stairs should allow free air access to the wire mesh covered openings.

b) Walls between the first floor rooms and the crawl space should be airtight. Any utility penetrations should be sealed. This precludes propane from drifting into these rooms. The crawl space should be bounded by two walls with floor to ceiling wire mesh covered openings. The other two walls should contain 4572 mm wide air tunnels with similar wire mesh covered openings.

c) Columns used to support the perimeter of the fireplace should be no greater than 5487 mm on center. These columns should be located as indicated on the floor plan in

Appendix E. Refer to par. 3.16.2.6 for other structural features pertaining to the fireplace opening.

3.16.2.2 Foam Deck. Eight identical foam decks should be located around the perimeter of the training deck. The floor of the foam deck should be constructed of steel grating and located 1067 mm below the training deck. The foam deck should include firefighting equipment found on both a destroyer deck (DD) and an aircraft carrier deck (CV). Each deck should be configured in accordance with Appendix E, Figure E-3. Although this combined deck is not set up to duplicate a station found on ships, appropriate gear is available for use. Included should be a foam reel with 38 100 mm of 40 mm hose, two faked hose racks, with 30 480 mm of 65 mm hose each, a stand pipe (SP) hose station with 1219 mm applicator, two faked hose racks, each with 30 480 mm of 40 mm hose, an electrical foam pump start station, and a communications station. Communications should be provided by the device contractor. Foam should be delivered to the deck through a 80 mm pipe with a 40 mm branch leading to the reel through a ball valve. The 80 mm pipe should terminate in a 65 mm service valve, in accordance with NAVSHIPS Dwg. 803-1385712. Both the foam pipe and the SP hose station should be deactivated by a valve out of sight of the trainee which can be operated by the instructors. The safety rail can be used for supports for the faked 60 960 mm of 40 mm hose. The deck steel grating should be sectionalized and securely fastened so it can be easily removed for maintenance.

a) The foam station is activated by depressing the electric foam pump start button which opens the water control valve and starts the proportioning pumps pressurizing the system with proportioned (3 percent) foam. See Figure E-6 in Appendix E. The fire can then be fought with both 40 mm and 65 mm hoses. The amount of foam used for any one training exercise should be 500 gpm or two 65 mm hoses. To depressurize the system, the electric foam pump stop button should be depressed.

b) On the smaller ships the foam reel is supplied by an FS station using an FP-180 foam proportioner; however these reels are not on the flight deck. The device 19F4 is for training firefighting techniques on aircraft decks; the FP-180 training should be accomplished onboard ship.

c) Access to the foam deck should be by inclined stairs from the training deck and a vertical ladder from the ground. The foam deck should have a safety railing around its perimeter. Two safety chains should be provided at the access openings for the ladder to grade and at access to training deck. The vertical ladder should only be used as an emergency exit from the foam deck.

3.16.2.3 Crash Lockers. Adjacent to main access stairs to the training deck should be two crash lockers with dimensions 3048 mm by 4572 mm each. These lockers should be constructed the same as repair lockers. They should be used to store hoses, proximity suits, porta saws, jaws of life, etc. These items should be procured by the using activity through collateral equipment. Ventilation is required in the crash lockers at a rate of 6 air changes per hour.

3.16.2.4 Instructor's Station

a) A two-story high instructor's station should be located 15 240 mm from a corner of the fireplace. Its siting should consider the prevailing wind. It should be upwind of the fireplace and the sun should not interfere with the view of the training deck.

b) The instructor's station and electrical room below should be 3048 mm by 4572 mm, have 2743 mm high ceilings and a computer floor. A computer floor is not required for the electrical room. Access to the second floor should be by exterior stairs. The instructor's station should have a 2438 mm by 762 mm high window overlooking the training deck mounted 610 mm off the computer floor.

c) The DTC is located in the electrical room.

d) The exterior wall and windows of the instructor's station facing the fireplace should be designed to be capable of withstanding a surface temperature of 74 degrees C.

3.16.2.5 Doors. Doors associated with the 19F4 structure should be 914 mm wide hollow metal doors. This structure is not an all weather trainer. The 19F4 structure is open to the

elements and has no provisions for removal of ice and snow; however, associated liquid systems should be freeze protected.

3.16.2.6 Structural Features

a) A device contractor supplied steel framing should support the mockups and grating in the fireplace opening and at the ground storage area. The foundation for this steel framing should be provided with the facility as follows:

(1) A reinforced concrete mat foundation should be provided in the crawl space at the 15 850 mm by 10 973 mm fireplace opening and should support concentrated loads from device support columns. The concrete mat should be pile or grade supported as required by the site soil conditions. The concrete mat should be designed for the following column reactions and spacings:

Location	Column Grid Spacing	Column Reaction
Center 4877 mm by 4877 mm area	1067 mm on center	3405 kg
Remaining fireplace area	1905 mm on center	4812 kg

(2) Column bearing area should be approximately 305 mm square and should be set in a grout bed and anchored directly to the mat foundation. Minimum column distance to edge of mat should be 610 mm. The mat should be designed to give the device contractor the flexibility to locate columns anywhere on the mat subject to minimum column grid spacing, maximum column reactions, and minimum edge distance.

(3) Minimum mat thickness should be 203 mm. Provide a 13 mm minimum expansion joint at the mat perimeter isolating the mat from the remainder of the crawl space slabs. Minimize the crack control joints in the mat foundation. Slope mat from center high point to drains. Refer to Appendix E.

b) The training deck should be designed as a standard training floor, 27 kg per square foot live load. There should be no wheeled vehicles on the deck of the 19F4 structure. Aircraft carriers use a forklift truck to aid in rescuing the

pilot. The 19F4 trainer should have a 91 kg mannequin strapped in a seat 2438 mm above the deck which should be rescued using a portable ladder.

c) Some of the larger ships use a P-16, self-propelled fire truck, to fight deck fires. Because the trainer deck should be above grade due to the propane fuel, resulting size limitations prohibit the use of the P-16. Another negative aspect of P-16 use with this structure is that it would require automotive type maintenance which is not normally associated with firefighting schools.

3.16.2.7 Miscellaneous. Ordnance mockups should weigh approximately 45 kg and be positioned manually by the trainees.

3.16.3 Mechanical

3.16.3.1 Use Rate. The 19F4 structure (see Table 12) has utilities designed to support three classes of 60 trainees each week. The class should be divided into four teams of 15 trainees each with two team leaders and one center leader. Two teams at a time should fight fires alternately at a rate of three fires per hour. The structure should be used for half a day each day of the week for two 2-day classes and one 1-day accelerated class. Each class should receive 5 hours of fire exposure time.

3.16.3.2 Firefighting Agents

a) Flush deck nozzles are used on the flight deck of a ship as a countermeasure to prevent accumulation of contaminants during a chemical biological radiation (CBR) attack and with foam to aid in fighting fires. On the 19F4 structure, use deck nozzles for demonstration purposes only and supply with water only. Nozzles must be installed in the fireplace grating by the device contractor. A 152 mm water line must terminate near the edge of and below the trainer deck with a motorized valve. The water line must have a manual shutoff valve and a pressure regulator valve prior to the motor operated valve. The water pressure for the flush deck nozzles should be the fire main pressure. The tie-in point for the device contractor should be the outlet of the motorized valve.

Table 12
19F4 and 19F4A Structures

CLASS SCHEDULE

	MON		TUE		WED		THU		FRI		
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
Classroom	X	X					Y	Y			Z
Structure			X	X					Y	Y	Z

Note: Classes are designated as X, Y, Z.

PROPANE USAGE

CLASS OF FIRE	NO. OF FIRES/ CLASS OF 63 MEN	FIRE TYPE	PROPANE DEMAND L/s		PROPANE USE PER FIRE L^3	TOTAL PROPANE/ CLASS
First Day PM	6	Fixed Wing	2549	5/	283 000	1 698 000
B						
Second Day PM	6	Helicopter	2549	5/	283 000	1 698 000
B						
B	3	Gas Tank	34		6198	18 593
	15 Fires/ Class					3 414 593 L/ class 12 496 L/ class

Notes:
1. Propane consumption and demand for the 1-day class are the same as those for the 2-day class.
2. The design propane demand for the bldg. is 2549 L/s.
3. Propane is based on a gas pressure at the burner of 14 kPa.
4. Propane supply pressure at the trainer entry (device contractor hookup) should be 69 kPa.
5. The average propane demand is 944 L/s.

Table 12 (Continued)
19F4 and 19F4A Structures

AGENT USAGE

CLASS OF FIRE	NO. OF FIRES/ CLASS	NO. OF HOSES	AFFF 3% L/s	WATER TIME min
First Day PM				
B	6	2 - 65 mm	16	5
Second Day PM				
B	6	2 - 65 mm	16	5
B	3	2 - 65 mm	16	3

Notes: 1. The design water demand should be 8 + 8 + 16 + 16 = 48 L/s for the occasional times when two 64 mm and two 38.1 mm cooling water hoses are used together. This is the total demand for the structure. Do not add in the water for foam.
2. The maximum 3 percent foam solution demand should be 16 + 16 = 32 L/s.

TOTAL UTILITIES

	CLASS	WEEKLY
Propane	3 414 593 L	10 243 779 L
Water	136 440 L	409 320 L
AFFF Concentrate (100%)	3923 L	15 160 L
PKP	None	

Notes: 1. The water category includes the water portion of the AFFF (97 percent water, 3 percent AFFF for design) and the flush deck nozzle water.
2. 46 percent of the water usage for a 2-day class occurs occurs on the first day of class. However, since the whole course is taught in one day to the accelerated students, the design daily water consumption equals the full class value.

b) The flush deck nozzles should be controlled from the instructor's station only, by activating the motorized valve. The water demand for the 19F4 structure should not be affected by these nozzles. Deck nozzles should not be used simultaneously with other agents.

c) Agents used to fight aircraft deck fires should come from the foam deck. Foam should be used exclusively to fight aircraft fires. Water should be used to cool ordnance after the fire is out and used to wash contaminate off the deck.

d) PKP should not be used as a firefighting agent with this structure.

3.16.3.3 Ventilation

a) The wind generator should not be used because of crosswind problems, safety, noise and power consumption. Natural wind should be used to provide the air movement required. In an effort to retain the advantage of training with a upwind or downwind approach to the fire, the device should be configured so the fire can be attacked from any one of its four sides with equal realism. Foam decks are also located so the fire can be approached from any side.

b) Wire mesh covered openings bordering the crawl space should be as large as the structure will allow to provide as much air under the fireplace as possible. Louvers and backdraft dampers for the 19F4 trainers are not required since neither artificial smoke nor PKP is used.

3.16.3.4 Air Conditioning. The electronic equipment in the instructor's station is expected to add 1000 W to the air conditioning load. There is no electronic equipment (device) cooling load for the electrical space below the instructor's station. This electrical space should be cooled and heated.

3.16.3.5 Miscellaneous

a) Artificial smoke should be used to help trainees determine wind direction and to indicate, along with the sound of an explosion, ordnance that has heated beyond its cook-off point.

b) The courses taught on the 19F4 and 19F4A trainers require exposure to the wild hose facility. The wild hose may be taught on the ground adjacent to the 19F4 structure. Only one wild hose facility should be required at a firefighting school.

c) The propane supply should terminate at the side of the structure as shown in Appendix E, Figure E-1.

3.16.3.6 Foam Proportioning

a) The foam for foam decks should be proportioned in the foam room with less than 3 percent AFFF solution being piped to each foam standpipe. Concentrate should be pumped to the mixing tank in the foam room. An industrial type proportioner should take 100 percent solution from the mixing tank and produce less than 3 percent solution. A balanced pressure system should be used as shown on Figure E-6 of Appendix E.

b) The high capacity fog foam generator (HCFF) or FP-1,000 are used aboard ship to proportion firefighting foam. There are aspects of this equipment which are not conducive to firefighting training. The HCFF or FP-1,000 should not be incorporated in the 19F4 or 19F4A for training purposes. This equipment type training should be accomplished aboard ship.

3.16.4 Electrical

3.16.4.1 Power

a) Power required for the device is 85 kVA. Provide 120/208 V, three-phase service.

b) Provide eight 50 mm spare conduits from the two-story instructor's station building to the 19F4 training structure. These conduits should be used only by the device contractor for both power and control. Power and control wiring should be run in separate conduits.

3.16.4.2 Lighting. The 19F4 structure should be lighted for nighttime operation. However, provide security lighting. The crawl space should be fully lighted with switches by doors.

3.17 19F5 and 19F5A Structures

3.17.1 General. The 19F5 and 19F5A structures should be used for initial exposure or indoctrination firefighting training. The structure is designed to train one class of 160 students and can train five classes each week operating on a single shift.

3.17.2 Architectural. Floor plans for the 19F5 and 19F5A structures are in Appendix F.

3.17.2.1 Layout. The 19F5 and 19F5A structures should consist of six fireplace compartments, three on either side of a large staging area. Students should line up in the staging area in front of each compartment and fight the fire through the doorway. Fireplaces should run simultaneously.

Two storage rooms should be located off of the staging area which should provide access to the burner room. Both of the storage rooms should be permanently heated to 10 degrees C.

3.17.2.2 Ceilings. Ceilings in the fireplace compartment should be 3658 mm high. The roof over the staging area should be high enough to provide line of sight between the second story instructor's station and the compartments. The roof over the compartments should allow 2438 mm clearance for maintenance of the exhaust system and smoke generation equipment. An equipment space over the burner room may also be required. The ceiling height in the egress chamber should be 2438 mm minimum.

3.17.2.3 Doors. Doors leading to fireplace compartments and associated with the egress chamber should be quick-acting watertight doors. Other doors should be hollow metal. A 1829 mm wide by 2134 mm high door should be located in the staging area to accommodate large equipment on hand trucks. The door should have ramp access. No forklift trucks should be used.

3.17.2.4 Fireplaces. Exact dimensions of burn areas are listed in the table below by fire type. Compartments are 3048 mm by 3048 mm clear in the plan.

Trash Can	1829 mm by 1829 mm (floor opening), located 305 mm from the back wall liner
Bilge	3048 mm by 3048 mm clear (floor opening)
Electrical Panel	406 mm (wall mounted)

Fireplace compartments should have refractory lined walls and ceilings. In addition, compartment walls should have steel plate liners to protect walls from the water hose stream and to maintain compartment temperature. The bilge fireplace compartment ceiling should also have steel plate liner. The electrical panel and trash can fireplaces should have grating floors. The bilge fireplace should have a chained doorway, floor, and a fireplace support as shown on Appendix A, Figure A-9. Required compartment dimensions should be clear dimensions from refractory wall coating to steel plate wall liner. Fireplace compartments should be thermally isolated from the facility structure to allow for thermal expansion.

Note: Facility to provide fireplace steel gratings. NAWCTSD will supply drawings and cost estimate to the facility architect during design phase.

3.17.2.5 Instructor's Station. The 19F5 and 19F5A structures should include two 3658 mm by 3658 mm instructor's stations. One for each set of fireplace compartments. The 19F5 and 19F5A structures should be separated by an electrical room measuring 3658 mm by 7925 mm. All three rooms should be located on the second floor along the side of the staging area and should have a 305 mm high raised floor. Access to the instructor's stations should be by stairway or through the electrical room. Each instructor's station should have a 3048 mm by 762 mm window overlooking the staging area. The lower edge of window should be 610 mm off of the computer floor.

3.17.2.6 Egress Chamber. An emergency egress chamber should be provided which should present the trainee with a loss of light and a high temperature, smoky environment. The trainee should enter and leave the chamber through smoke filled entryways. These entryways should be designed to block light from entering

the main chamber. Ventilation should be such that no smoke is allowed to enter the staging area. Smoke should not be introduced in the main chamber.

a) Once inside the dark chamber, the trainee should follow a rope lanyard which should eventually lead him to the smoke filled exit. The main chamber should be heated to 43.3 degrees C during the training scenario.

b) Provide a watertight door in the steel partition between side 1 and side 2 of the chamber and watertight openings without doors in the steel partitions making up the entryways, refer to Appendix F, Figure F-1, for details. Walls and the ceiling should be sealed with a coating chemically resistant to triphenyl phosphate.

3.17.2.7 Miscellaneous

a) No OBA's should be used by trainees, therefore a fixed OBA disposal area is not required.

b) Provide a hose drying rack capable of storing twelve 15 240 mm lengths of hose. Once loaded, the hose drying rack should be hoisted electrically to a mezzanine located 2743 mm above the floor. The mezzanine should be accessible from the second floor. Material for the hose drying rack should be lightweight. A heavy duty wrench-hoist system should be provided.

c) The P-250 portable, gasoline engine driven water pump should be demonstrated in front of the bleacher area. Refer to the requirements stated herein. No raised platform is required.

d) Provide bleachers for seating 250 students.

e) Provide a wild hose demonstration area. The space should be approximately 6096 mm by 6096 mm by 6096 mm high with an opening facing the bleachers to allow observation from the staging area. Means with unrestricted visibility should be provided to protect the bleachers from the wild hose water spray.

3.17.3 Mechanical

3.17.3.1 Use Rate. Utilities for the 19F5 and 19F5A structures are designed to support five classes of 160 students each week. A class should be divided into two groups (A, B) of 80 men. Group A should spend the morning fighting fires in the six fireplace locations while group B watches the demonstration, e.g., wild hose, P-250 pump, portable extinguishers, etc., and goes through the emergency egress chamber. In the afternoon the two groups switch. A typical schedule should consist of five classes per week, 800 trainees for 52 weeks or 40,000 students per year. For class schedule and utilities requirements, see Table 13.

3.17.3.2 Firefighting Agents. Firefighting water entering the structure should come through a motorized valve. This valve should be controlled from the DTC and act as an emergency shutoff valve in case of an uncontrollable hose.

a) Six standpipes, two foam stations, and two foam reels should be located in the center of the staging area. Only the reels and agents should be used for training purposes. The foam proportioning equipment which feeds the reels should be operated by instructors. Therefore, it can be standard commercial. The design should allow for any two reels to operate simultaneously, one for each bilge compartment.

b) Provide a 9 kg portable PKP extinguisher outside of each bilge compartment. Provide a 6.81 kg portable CO_2 extinguisher outside of each electrical panel compartment. Additional extinguishers which should be used as replacements should be purchased as collateral equipment.

c) Hose stations in the 19F5 structure do not require the instructor operated hose station disabling valve.

Table 13
19F5 and 19F5A Structures

CLASS SCHEDULE

A	Monday	AM	240 fires
B		PM	240 fires

Note: The 2-day course includes a classroom session before the fire training.

PROPANE USAGE

CLASS OF FIRES	TOTAL NO. OF FIRES/ CLASS	FIRE TYPE	PROPANE DEMAND L/s	AVERAGE FIRE DURATION min	PROPANE USE PER FIRE L	PROPANE/ CLASS FOR 1 DAY L
A	160	Trash Can	5	2	566	67 920
B	160	Bilge	31	2	4528	724 480
C	160	Electric Panel 480 fires/class	2	2	283	33 960 826 360/ class

Notes:
1. Each fireplace should have 10 fires/hour.
2. Maximum fires per shift is 480 fires. Classes larger than 160 students can be accommodated by reducing student fire exposure or extending the shift.
3. Great Lakes should train additional students with the same number of fires.
4. The propane demand is based on a gas pressure at the burner of 7 kPa except for the bilge fire which is 14 kPa.
5. The design propane demand for the structure is (5 + 31 + 2) x 2 = 76 L/s.

Table 13 (Continued)
19F5 and 19F5A Structures

AGENT USAGE

CLASS OF FIRE	NO. OF FIRES/ CLASS	NO. OF HOSES 40 mm FIRE	WATER L/s	AFFF 6% L/s	PKP/ FIRE kg	CO_2/ FIRE kg	WATER TIME min
A	160	2	6				2
B	160	1	6				2
		1		6	5		1
C	160	5					

Notes:
1. The design water demand is: ((6)2 + 6 + 6)2 = 48 L/s.
2. Portable PKP extinguishers should require 80 CO_2 charges per class.
3. No OBA's should be used.
4. Portable extinguishers should be used for fighting fires with PKP.

TOTAL UTILITIES

	CLASS 1 DAY	WEEKLY
Propane	820 700 L	4 103 500 L
Water	379 950 L	1 989 750 L
AFFF Concentrate (100%)	3456 L	17 282 L
PKP	73 kg	363 kg
CO_2	363 kg	1816 kg

Notes:
1. The water category includes the water portion of AFFF (94 percent water, 6 percent AFFF for design).
2. Continuous operation can be assumed for weekly and monthly consumption.

3.17.3.3 Ventilation

a) There should be an exhaust duct leading from each fireplace compartment with a separately operated motorized floating point damper. These ducts should come together above the compartment ceiling. The design capacity of exhaust fans for each side of the structure should be based on the simultaneous operation of fireplaces or 8686 L/s "air out." The minimum ventilation should be 472 L/s per fireplace or 1416 L/s for each side of the structure. For ventilation air per area, see Table 14.

b) Artificial smoke, butylated triphenyl phosphate, should be used in fireplaces and in the emergency egress chamber.

c) Each entryway of the egress chamber should be provided with 472 L/s of ventilation which should keep it under negative pressure so that the smoke should not migrate to the staging area. Exhaust grills should be located above the entry and exit on the inside and should draw air from the staging area through the doorway. Motorized dampers should be provided to allow remote adjustment of the entryway ventilation rate. A second fan should draw 472 L/s from each inner room of the egress chamber. The inner room fan should be used to clear stray smoke from inner rooms only after the exercise is complete. The inner room fan should not be on while trying to maintain 37.7 degrees C in the chamber. Interlock the fans to the entryway doors so they cannot run with the doors closed. The open door is the source of makeup air for the inner room exhaust fan. Heating of the egress chamber to 43.3 degrees C during training should be provided by the device contractor. Normal building heating should be provided.

3.17.3.4 Air Conditioning. Electronic equipment in each instructor's station is expected to add 1172 W to the air load. The air conditioning to the electric room adjacent to the instructor's station has an air conditioning load of 5860 W due to the equipment. The normal occupancy for each of the three rooms should be two people.

Table 14
19F5 and 19F5A Ventilation Air

COMPARTMENT	PROPANE DEMAND L/s	VENTILATION AIR OUT AT 316 degrees C L/s
Trash Can	5	2171
Bilge	31	5428
Electric Panel	2	1086

Notes:
1. The design ventilation for each side is 8685 L/s "air out." The minimum flushing ventilation should be as low as the fan can turn down but never lower than 1416 L/s "air in."
2. Fan static pressure should be determined by bringing 15.5 degrees C air through the louvers and exhausting 316 degrees C through the exhaust system.
3. Provide two 944 L/s fans for the egress chamber.

3.17.4 Electrical

3.17.4.1 Power. The power for the device is 50 kVA. Provide 120/208 V, three-phase service.

3.17.4.2 Lighting. The staging area should be lighted for training after dark. Fireplace compartments should be lighted for maintenance from underneath the grating. No shipboard type lighting is required in compartments of the 19F5 structure. Install guards on lights in staging area at the ceiling to protect lights from hose spray.

The egress chamber should have interior lighting for maintenance purposes only. The light switch should be exterior and away from the entry and exit doors.

Section 4: AGENTS AND APPARATUS

4.1 General. Substitute materials have been found to replace AFFF foam, PKP, and smoke. These substitutes were chosen to improve the trainee's environment, the treatability of the air and water effluents, and the economics of training. Equivalents other than brand names are acceptable as long as the substitute material meets the given chemical formula requirement.

Any reference to the use of the above agents in this document should be understood to mean the substitute mentioned below unless stated otherwise.

4.2 Aqueous Film-Forming Foam (AFFF)

a) AFFF is used extensively in the Navy for fighting fires aboard ship. Its main disadvantage in firefighting training is its toxicity to treatment plant bacteria and receiving stream oyster larva. The toxic characteristic did not respond to various treatment processes as measured by methylene-blue-active substance (MBAS). Therefore, the only two methods of disposal for AFFF contaminated waste water was hauling it away as a toxic waste or diluting it to under 200 ppm. The first option was prohibitively expensive and the latter alternative restricted the amount of foam to where it could only be used for demonstration purposes not for training.

b) Dilution is, however, the method of disposal of AFFF used by the fleet during the routine testing of shipboard firefighting equipment. When testing is done in harbor and coastal areas, the effluent is collected and stored until it can be transferred to shore. Once shoreside, it is metered into the municipal sanitary sewer system under permit.

4.2.1 Substitute

a) The substitute for AFFF is sodium dodecylbenzine sulfonate manufactured by Pilot Chemical Company of Avenel, New Jersey and marketed as Calsoft. It is also marketed by Whitco under the name Ultrawet K, by Textile Chemical Company under the name Calsoft, and by Stephan Chemical Company under the name

Nacconal 35SL. It is a common industrial surfactant. Of the many types of surfactants on the market, Calsoft was chosen because it was:

(1) Readily available in large quantities

(2) Nonflammable

(3) Disposable in effluent

(4) Biodegradable

(5) Acceptable for human health and safety

(6) Adequate in foaming action

(7) Stable at high temperature

(8) Minimally corrosive

(9) Cost effective for training

(10) Compatible with the flame control logic

b) Another substitute should not be attempted without thoroughly considering each of these characteristics.

c) Calsoft can be delivered in a wide variety of forms. The solid form comes in bags and drums. The liquid form comes in cans, drums, and by tank truck in varying concentrations. The liquid form is preferred for fire training.

d) Liquid Calsoft is sold in different concentrations because higher concentrations contain less water therefore less bulk for efficient shipping. However, 60 percent and higher concentrations of liquid Calsoft should increase handling problems for the user. In 60 percent concentrated form, Calsoft should be heated to be transferred. If 60 percent Calsoft ever cools below 10 degrees C, it should be heated and mechanically mixed before it can be used. Calsoft should be bought as a 40 percent concentrate which does not have to be kept heated except

for freeze protection. The concentrate is mixed half and half with water to make a 20 percent solution of surfactant which is referred to as 100 percent AFFF in this handbook.

e) Concentrates are diluted with water to the maximum extent practicable, consistent with maximizing realism, activating AFFF sensors, and minimizing cost. Foaming action should vary from site-to-site, based on water hardness. Experimentation at each site is required. The diluted AFFF surrogate is referred to as 100 percent AFFF in this handbook.

4.2.2 Handling System. The foam system for fire training should consist of bulk storage for concentrate, a mixing tank for preparing 20 percent solutions, a proportioning device (see hose stations), and suitable transfer means between each. Where usage rates are practical and tank truck deliveries are available, bulk tank storage may be the most economical method. The 40 percent concentration, used for the design delivery quantity should ensure that the concentrate remains pumpable without heating under possible ambient conditions. Provide spill prevention provisions around the bulk storage area. If the bulk storage tank is underground, ensure that the pump design includes a provision for pump priming.

a) If bulk tank storage is inappropriate, provisions should be made for 204 kg bulk 208 L drum storage and handling.

b) A solution tank should be provided in the utilities building for mixing the concentrate with water to make 100 percent solution (20 percent active surfactant, 80 percent inert). The tank should be sized to hold 120 percent of the maximum daily 100 percent AFFF usage. Supporting equipment should facilitate manual batch mixing. Each day the design amount of concentrate should be pumped into the solution tank from the bulk tank or from 208 L drums after which the calculated amount of water should be added.

c) The solution tank should have, but not be limited to, a graduated sight glass, a gage port, inlets and outlets, high level alarm, low level pump shutoff, drain, and a vent. Tank inlets should extend to the bottom of the tank and have expansion nozzles to reduce foaming. Aspects of the design

should consider the fluid's propensity to foam and the fluid's viscosity. Refer to Appendix A, Figures A-17 and A-18 for the AFFF viscosity characteristics curves.

d) Carbon steel cannot be used with the AFFF surrogate because the chemical picks up iron molecules. Tanks, pumps, piping, and appurtenances should not be carbon steel, irrespective of the solution concentration of the chemical. Copper piping or 316L stainless steel is an acceptable piping material.

e) From the solution tank the foam concentrate should be pumped in underground pipes to the hose station day tank. The flow rate should allow the day tank(s) to be filled in approximately 15 minutes. The concentrate distribution pump should be controlled by start-stop push-button stations at each hose station. The solution tank should include provisions for filling 19 L cans to be used with the portable foam proportioner.

f) The device sensors can distinguish between 3 percent AFFF and pure water. However, instructors feel that a 6 percent solution is more realistic in appearance. The proportioner is field adjustable. A 6 percent solution should be used for design purposes unless indicated otherwise. The 19F4 trainer uses 3 percent solution.

g) The 21C12A trainer requires a AFFF mixed solution for extinguishers of 59 ml. of 40 percent concentrate in 9 L of water.

4.2.3 Portable AFFF Fire Extinguishers. Portable AFFF fire extinguishers are only required on submarines, therefore, only used in the 21C12 and 21C12A trainers. These extinguishers are stainless steel cylinders that store 9 L of a premixed solution of AFFF concentrate and water. Cylinders are pressurized with air to 689 kPa at 21 degrees C. The AFFF is discharged from the bottom of the cylinder through the siphon tube, extinguisher valve, and discharge hose to the nozzle. The AFFF fire extinguisher weighs approximately 12 kg when fully charged and has a 55- to 65-second continuous discharge time. The AFFF

solution undergoes an expansion of 6.5 to 1 when passing through the nozzle, which produces around 61 L of expanded AFFF/water solution (foam) after discharge.

4.3 Potassium Bicarbonate. Potassium bicarbonate, PKP, is a dry chemical extinguishing agent. PKP has two main undesirable characteristics for use in fire training. It is extremely diffusive, that is it spreads in all directions like smoke and remains airborne, and it is corrosive to metal and painted surfaces.

a) Substitute. A substitute was identified as grade No. 2 sodium bicarbonate powder with an apparent density of approximately one g/cm^3. Sodium bicarbonate is similar to PKP in all respects. However, No. 2 grade powder is composed of large particles, i.e., 90 percent of the particles are larger than 44 microns whereas 90 percent of PKP particles are smaller than 44 microns. PKP has an apparent density of approximately 2 g/cm^3. Larger particles make sodium bicarbonate less diffusive. The substitute powder is coated with silicon and therefore not soluble in water. The silicon coating should breakdown in time and then the sodium bicarbonate should dissolve in the water. Sodium bicarbonate powder's chemical composition is:

COMPONENTS	WEIGHT/PERCENT
Sodium bicarbonate, No. 2 grade	93.4
Attaclay	4.0
Mica	2.0
Silicone fluid	0.6
	100.0

b) Sodium bicarbonate is available in a variety of dry containers. It should be delivered and stored in bulk quantities. Storage should be kept dry.

c) Sodium bicarbonate should then be transferred to the refill station where the proper weight is poured through a funnel into portable extinguishers. The same scales can be used for PKP and CO_2 refill. PKP cylinders come in 8 and 12 kg sizes

and are provided in accordance with MIL-E-24091, Extinguisher, Fire, Portable, Potassium Bicarbonate, Dry Chemical, Cartridge-Operated Type.

4.4 Carbon Dioxide (CO_2). CO_2 should be used for fire training in the form of portable 7 kg extinguishers. The portable 7 kg extinguishers should be in accordance with MIL-E-24269, Extinguisher, Fire, Carbon Dioxide, 15 Pound, Portable, Permanent Shutoff, Navy Shipboard Use. There are no fixed pipe CO_2 systems for training purposes. Extinguishers should be purchased as collateral equipment and stored in repair lockers for use by the trainees. As an exception to collateral equipment requirements, portable CO_2 extinguishers should be provided with the training facility for the electrical room and instructor's station.

a) The 19F5, 19F5A, 21C12, and 21C12A trainers should use a low pressure refrigerated, CO_2 bulk storage tank system. For other trainers, consideration should be given to using either a low pressure refrigerated, CO_2 bulk storage tank system or high pressure 23 kg storage cylinders for recharging the extinguishers.

b) The high pressure recharging system should consist of 23 kg cylinders which are 1295 mm long by 215.9 mm in diameter and weigh 72 kg when full. Cylinders contain CO_2 gas at 5857 kPa at 21.1 degrees C. The recharging station should consist of the following collateral equipment: tilt racks, a scale, 220 V, single-phase motor and pump, fill hose, and valves. For details, refer to Appendix A, Figure A-11. The 23 kg cylinders should be stored in a bulk storage area located near the recharging area. The bulk storage area should be suitable for storing 1 month's supply of cylinders plus 2 weeks of empty cylinders. Sufficient access should be provided in the bulk storage area for moving the cylinders.

c) The low pressure recharging system should consist of a low pressure refrigerated CO_2 storage tank, fixed supply and

return piping system, and a manual extinguisher fill pump capable of receiving CO_2 at 2067 kPa, and an oxygen monitor and alarm system.

d) The system should be in accordance with NFPA 12, Carbon Dioxide Extinguishing Systems. The storage tank should contain CO_2 at -17.7 degrees C and 2067 kPa and should be sized to provide a minimum of 30 days of CO_2. For details, refer to Appendix I, Figures I-1 through I-7.

> Caution: Extra care should be taken when recharging the extinguisher with low pressure liquid CO_2. Too much liquid CO_2 in an extinguisher will cause an explosion when the CO_2 changes state from a liquid to a gas due to expansion as the liquid heats up from -17.7 degrees C ambient temperature.

e) CO_2 is also used in cartridges for propelling PKP from portable extinguishers. These cartridges are not refillable.

f) Due to the potential for CO_2 gas leakage, provide an oxygen (O_2) monitoring and alarm system in enclosed spaces containing the CO_2 recharging system. The O_2 monitoring and alarm system should tie into the main propane alarm control panel so as to provide alarm and annunciation to the 24-hour duty desk, instructor's station, and to the DTC. Local alarm and flashing warning sign should also be provided. The warning sign should state "DANGER, CO_2 CONDITION."

g) At the closest outside entrance to the CO_2 recharging system, provide the following in weatherproof lockers with the appropriate labels:

(1) A portable CO_2 and O_2 detection kits.

(2) An emergency air breathing "SCOTPAK."

h) Doors for the spaces containing the CO_2 recharging system should be provided with panic hardware.

4.5 Halon. Halon is an invisible gas which is used in the Navy community. Where it is called for in the training structure it should be simulated and necessary equipment should be provided by the device contractor. No facility services are required. The Halon simulator should look like a shipboard installation but there should be no pressurized containers inside the structure. Halon is now limited by the Navy due to possible ozone depletion.

4.6 Aqueous Potassium Carbonate (APC). APC is a type of extinguishment that is used as a fixed range guard system on kitchen exhaust hoods. It should be simulated on the deep fat fryer fireplace by the use of a water spray.

4.7 Nozzles. Hose end nozzles used for firefighting training should be provided by the user as collateral equipment. The preferred water fog nozzle is NAVSHIPS Dwg. 805-860089.

4.8 Oxygen Breathing Apparatus (OBA). OBA are used by the Navy to protect firefighters from the toxicity of the products of combustion. They contain a replaceable cartridge. Oxygen is produced by chemical reaction in the cartridge. The OBA's should be stored in repair lockers associated with each structure. Chemicals in the spent cartridge should be completely finished producing oxygen prior to disposal. This is done by letting them set in the air a minimum of one hour, then recapping them and wrapping them in double poly bags. Wrapped cartridges are then stored in drums to be hauled away as hazardous waste.

4.9 Hose Stations. In the 80 mm service pipe supplying each hose station, provide a shutoff valve so the instructor can disable the station. The valve should be out of sight of the trainee where possible but in a location convenient to the instructor. The instructor's shutoff valve should be a 80 mm commercial ball valve with a locking handle.

a) Consult the using activity and when requested, provide a hose drying rack. Where the climate allows, the hose drying rack should be out in the open for maximum use of natural air movement.

b) The word "faked" in faked hose station refers to the method used to store the hose. See Appendix A, Figure A-4 for an example of a faked hose.

c) The following types of hose stations have been identified for the 19F series trainers.

4.9.1 Hose Station 1 (HS1). A 40 mm hose station, supplied with water. Refer to Appendix A, Figure A-4.

a) A 40 mm hose globe valve with one end flanged and one end threaded, NAVSHIPS Dwg. 803-1385712.

b) A marine strainer and valve with connection coupling on one end and threaded on the other end is no longer required.

c) A 15 240 mm steel hose rack with strap, NAVSHIPS Dwg. 805-860089.

d) A 40 mm hose, 15 240 mm long, Fed. Spec. ZZ-H-451, Hose, Fire, Woven-Jacketed Rubber or Latex or Rubber-Coated Fabric-Lined With Couplings.

e) A 1219 mm applicator.

f) Spanner wrench.

4.9.2 Hose Station 2 (HS2). A 65 mm hose station, supplied with water. Refer to Appendix A, Figure A-5.

a) A 65 mm hose angle valve with one end flanged and the other end threaded, NAVSHIPS Dwg. 803-1385712.

b) A marine strainer and valve with connection coupling on one end and a threaded connection on the other end is no longer required.

c) A 65 mm by (2) 40 mm wye gate.

d) Two 30 480 mm steel hose racks with strap, NAVSHIPS Dwg. 805-860089.

e) Four 40 mm hose, 12 240 mm long Fed. Spec. ZZ-H-451.

f) Two 1219 mm applicators.

g) Spanner wrench.

4.9.3 Foam Station (FS). Foam hose station, supplied with water. Refer to foam station diagram Appendix A, Figure A-21.

a) Single agent hose reel

b) A 40 mm hose, 38 100 mm long, MIL-H-24580, Hose Assemblies, Synthetic Rubber, Noncollapsible, Firefighting

c) Foam nozzle

d) Concentrate tank

(1) 19F1A - 303 L

(2) 19F3-B1 - 303 L

(3) 19F3-B3, 19F3-B4, and 19F5 - 379 L

e) Electric foam proportioning pump (Blackmer pump Model BXL - 1-1/4, Manufacturer Dwg. E-4638)

f) Controls as found on damage control deck

The 100 percent AFFF concentrate line should have a valved bypass before it enters the concentrate tank arranged so 19 L AFFF cans can be filled at that location.

4.9.4 Foam Reel (FR). Foam reel station, supplied with foam. Refer to Appendix A, Figure A-21.

a) Single agent hose reel, Appendix A, Figure A-6.

b) A 40 mm hose, 38 100 mm long, MIL-H-24580

c) Foam nozzle

d) Manual control valve

e) Ball valve

f) Controls

The foam reel is supplied with 6 percent foam from the nearest FS type hose station.

4.9.5 Stand Pipe (SP). A 65 mm stand pipe, supplied with water.

a) A 65 mm hose angle valve with one end flanged and the other end threaded, NAVSHIPS Dwg. 803-1385712.

b) A marine strainer and valve with connection coupling on one end and a threaded connection on the other end is no longer required.

c) A 65 mm by (2) 40 mm wye gate.

4.9.6 Submarine Hose Station 1 (SHS1). Hose station is supplied with water and is wall mounted.

a) A 40 mm angle globe valve with one end flanged and the other end threaded, NAVSHIPS Dwg. 803-1385712. The valve should be located 457 mm above the floor next to the hose station. The valve should be perpendicular to the wall and should be served by piping routed in or through the wall.

b) A 40 mm hose, 7620 mm long, MIL-H-24580.

c) Wall mounted fire hose locker in accordance with Appendix G, Figure G-8. The hose is rolled up and stored in the locker.

d) No strainer, wye gate, or applicator is required.

4.9.7 Submarine Hose Station 2 (SHS2). Hose station is supplied with water and is floor mounted.

a) A 40 mm angle globe valve. Refer to SHS1 above.

b) A 40 mm hose, 15 240 mm long, MIL-H-24606, Hose Assemblies, Chlorosulfonated Polyethylene Impregnated, Double Synthetic Jacket, With Couplings, Firefighting and Other Water Service

c) Floor mounted hose cabinet in accordance with Appendix G, Figure G-9. The hose is rolled up and stored in the locker.

4.9.8 Submarine Hose Station 3 (SHS3). Hose station is supplied with water and is recessed into the wall. Hose station should consist of the following as shown on NAVSEA Dwg. 608-4674414: (SHS3 is part of the combined submarine hose station.)

a) A 40 mm hose, 15 240 mm long, MIL-H-24606

b) Fire hose rack per NAVSEA Dwg. 608-4674414

c) One applicator per BUSHIPS Dwg. 810-1385834

d) Two spanner wretches per NAVSHIPS Dwg. 810-4444647

Spanner wrenches and the applicator should be clamped in the recessed area of the station. Clamps should be per NAVSEA Dwg. 608-4674414. SHS3 should be recessed into a space of the wall with dimensions of 1270 mm height from the floor to top of the opening by 762 mm wide by 203 mm deep.

4.9.9 Combined Submarine Hose Station (CSHS). Hose station is supplied with water and consists of SHS3 recessed into the wall with SHS1 on a metal plate mounted to cover SHS3. The metal plate should be removable and should be provided over SHS3 to hide SHS3. The plate should be designed to be removed by one or two men. Clips or other methods of attachment should be provided for attaching the plate over SHS3. SHS1 should be

permanently attached to the metal plate. A 40 mm angle globe valve normally furnished with SHS1 should be provided next to the combined hose station.

4.9.10 PKP Fire Extinguisher (PFE). A 12 kg portable PFE should be provided with single AFFF foam reels, as shown on appendixes floor plans, and should be in accordance with MIL-E-24091.

4.9.11 Twin Agent Reels (TAR). The TAR and system have been replaced by a single AFFF FR and a 12 kg portable PFE which should provide a similar function to the TAR system.

Section 5: PROTECTION OF THE ENVIRONMENT

5.1 Permits

a) OPNAVINST 5090.1, Environmental and Natural Resources Protection Manual, Chapter 6, Air Pollution Abatement states the firefighting schools should comply with state open burning regulations or have prior Chief of Naval Operations (CNO) approval for a delayed compliance request.

b) Discharge permits for air and water should be negotiated with the state for each site. This should be done early in the project so the scope of monitoring and treatment can be determined. It is important to have discharge information adequately prepared and use a positive approach. Water usage permits may also be required depending on locality, municipal, or State regulations. For typical air emissions, see Table 15; for wastewater characteristics, see Table 16.

5.2 Air. The 19F series trainers use propane for fuel, dramatically reducing criteria (PM1O/TSP, VOCs, CO, SOX, etc.) and other hazardous air pollutants. However, benzene as a combustion by-product is still emitted in sufficient concentrations to require emission control devices under some circumstances. In addition, the surrogate PKP and artificial smoke training agents generate regulated emissions as discussed below. Continuous monitoring of the air effluent may be required to determine code compliance. This should be negotiated with local air pollution control authorities.

5.2.1 PKP. One of the parameters used to choose the PKP surrogate was particle size. Grade No. 2 sodium bicarbonate was chosen. Ninety percent of its particles are larger than 44 microns with an average particle size of 100 microns. Ninety percent of normal PKP particles are smaller than 44 microns with an average particle size of 20 microns. For comparison, a human hair is approximately 100 microns in diameter. The large particle PKP substitute is less diffusive than PKP with most particulate falling out before the effluent leaves the training compartment. For maximum particulate emission rates see Appendix A, Figure A-10.

Table 15
Typical Air Emissions

EMISSION	MAXIMUM EMISSION RATE	TYPICAL EFFLUENT
CO	(1)	negligible
VOCs	(1)	negligible
SOX	(1)	none
NOX	(1)	negligible
TSP/PM1O	(1)	see Figure A-10, Appendix A
Lead	(1)	none
Ozone	(1)	negligible
Benzene	(2) 0.325 mg/cu. m (0.1 mg/kg)	(3)
Tear Gas	(2) 0.3 mg/cu. m (0.05 mg/kg)	19.5 gm (4)
Triphenyl Phosphate	(2) 3 mg/cu. m	(5)

Notes: (1) Emission rates of criteria pollutants vary by locality, primarily due to each locality's compliance with National Ambient Air Quality Standards established by the Clean Air Act Amendments of 1990.

(2) Values listed are threshold limit values (TLVs) as established by the National Institute for Occupational Safety and Health (NIOSH), American Conference of Governmental Industrial Hygienists (ACGIH), or Occupational Safety and Health Administration (OSHA).

(3) Source emissions testing/monitoring for the 21C12 trainer at STF Norfolk were conducted in the Fall of 1993. This data will be promulgated as an amendment to this handbook as soon as data is available. Such information may be useful for local EFD's in projecting air permit application data and generating cost certification/concept design cost estimates for necessary control devices required by local authorities for other types of trainer devices.

(4) Tear gas chambers are normally only included in 19F5 recruit training facilities.

(5) TPP emission data is largely dependent on local training requirements for each facility.

Table 16
Wastewater Characteristics

Trainer Structure	19F1A/ 19F1B	19F4/ 19F4A	19F5/ 19F5A	19F3A/ 19F3C	21C12/ 21C12A	19F3/ 19F3B	Composite
Date of Test	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	7/19/89
Test No.	B8917164	B8917162	B8917163	B8917167	B8917165	B8917166	B898356
BOD, mg/1	23	10	219	62	44	<127	104
COD, mg/1	120000	33000	3900	780	290	8300	4800
TSS, mg/1	77	5	700	250	5146	58	57
TDS, mg/1	69088	15810	9508	2625	132461	4003	2330
MBAS, mg/1	3000	6000	400	100	100	N/A	300
Oil & Grease, mg/1	24	30	19	15	6	N/A	14
PH	not tested	not tested	not tested	not tested	not tested	not tested	not tested
PRIORITY POLLUTANTS (TEST RESULTS)							
VOLATILES, ug/1							
Acrolein	not tested	not tested	not tested	not tested	not tested	not tested	not tested
Acrylonitrile	not tested	not tested	not tested	not tested	not tested	not tested	not tested
Benzene	<0.10	<1	<0.10	<0.10	<0.10	<10	<0.10
Bis (chloromethyl) ether	not tested	not tested	not tested	not tested	not tested	not tested	not tested
Bromoform (Tribromomethane)	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Carbon tetrachloride	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Chlorobenzene	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Chlorodibromomethane (Dibromochloromethane)	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Chloroethane	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
2-Chloroethylvinyl ether	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10

Table 16 (Continued)
Wastewater Characteristics

Trainer Structure	19F1A/ 19F1B	19F4/ 19F4A	19F5/ 19F5A	19F3A/ 19F3C	21C12/ 21C12A	19F3/ 19F3B	Composite
Date of Test	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	7/19/89
Test No.	B8917164	B8917162	B8917163	B8917167	B8917165	B8917166	B898356
Chloroform (Trichloromethane)	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Dichlorobromomethane (Bromodichloromethane)	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Dichlorodifluoromethane (Fluorocarbon-12) (Diflurodichloromethane)	not tested	not tested	not tested	not tested	not tested	not tested	not tested
1,1-Dichloroethane	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
1,2-Dichloroethane	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
1,1-Dichloroethyene (1,1-Dichloroethene)	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
1,2-Dichloropropane	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
1,3-Dichloropropylene (cis-1,3-Dichloropropene)	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
(trans-1,3-dichloropropene)	<1	<0.10	<0.10	<0.10	<0.10	<0.10	
Ethylbenzene	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Methyl chloride (Chloromethane)	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Methylene chloride	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Milligrams per liter							
Micrograms per liter (Dichloromethane)		<1					
1,1,2,2-Tetrachloroethane	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Tetrachloroethylene (Tetrachloroethene)							

Table 16 (Continued)
Wastewater Characteristics

Trainer Structure	19F1A/ 19F1B	19F4/ 19F4A	19F5/ 19F5A	19F3A/ 19F3C	21C12/ 21C12A	19F3/ 19F3B	Composite
Date of Test	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	7/19/89
Test No.	B8917164	B8917162	B8917163	B8917167	B8917165	B8917166	B898356
Toluene	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
1,2 trans-dichloro-ethylene (trans 1,2-dichloroethene)	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
1,1,1-Trichloroethane	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
1,1,2-Trichloroethane	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Trichloroethylene	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Trichlorofluoromethane	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Vinyl chloride (Chloroethylene)	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<0.10
Xylenes	not tested	not tested	not tested	not tested	not tested	not tested	not tested
ACIDS, ug/1							
2-Chlorophenol	*	<1	<1	<1	<1	<1	<10
2,4-Dichlorophenol	*	<1	<1	<1	<1	<1	<10
2.,4-Dimethylphenol	*	<1	<1	<1	<1	<1	<10
4,6-Dinitro-o-cresol (4,6-Dinitro-othro-cresol) (4,6-Dinitro-2-methylphenol)	*	<2	<2	<2	<2	<2	<10
2,4-Dinitropheno1	*	<4	<4	<4	<4	<4	<10
2-Nitrophenol	*	<2	<2	<2	<2	<2	<10
4-Nitrophenol	*	<2	<2	<2	<2	<2	<10
P-chloro-m-cresol (Para-chloro-meta-cresol) (4-chloro-3-methylphenol)	*	<1	<1	<1	<1	<1	<10
Pentachlorophenol	*	<2	<2	<2	<2	<2	<10

Table 16 (Continued)
Wastewater Characteristics

Trainer Structure	19F1A/ 19F1B	19F4/ 19F4A	19F5/ 19F5A	19F3A/ 19F3C	21C12/ 21C12A	19F3/ 19F3B	Composite
Date of Test	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	7/19/89
Test No.	B8917164	B8917162	B8917163	B8917167	B8917165	B8917166	B898356
Phenol	*	<1	<1	<1	<1	<1	<10
2,4,6-Trichlorophenol	*	<2	<2	<2	<2	<2	<10
BASE/NEUTRALS, ug/l							
Acenapthene	*	<1	<1	<1	<1	<1	<10
Acenapthylene	*	<1	<1	<1	<1	<1	<10
Anthracene	*	<1	<1	<1	<1	<1	<10
Benzidine	*	<10	<10	<10	<10	<10	<50
Benzo(a)anthracene (1,2-benzanthracene)	*	<1	<1	<1	<1	<1	<10
Benzo(a)pyrene (3,4-benzopyrene)	*	<1	<1	<1	<1	<1	<10
3,4-Benzofluoranthene (Benzo-(B) fluoranthene)	*	<1	<1	<1	<1	<1	<10
Bis (2-chloroethoxy) methane	*	<1	<1	<1	<1	<1	<10
Bis (2-chloroethyl) ether (Dichloroethyl ether)	*	<1	<1	<1	<1	<1	<10
Bis (2-chloroisopropyl) ether	*	<1	<1	<1	<1	<1	<10
Bis (2-ethylhexyl) phthalate	*	<1	<1	<1	<1	<1	<21
4-Bromphenyl phenyl ether	*	<1	<1	<1	<1	<1	<10
2-chloronaphthalene	*	not tested	not tested	not tested	not tested	not tested	<10
4-chlorophenyl phenyl ether	*	<1	<1	<1	<1	<1	<10
Chrysene	*	<1	<1	<1	<1	<1	<10
Dibenzo (a,h) anthracene	*	<1	<1	<1	<1	<1	<10

Table 16 (Continued)
Wastewater Characteristics

Trainer Structure	19F1A/ 19F1B	19F4/ 19F4A	19F5/ 19F5A	19F3A/ 19F3C	21C12/ 21C12A	19F3/ 19F3B	Composite
Date of Test	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	7/19/89
Test No.	B8917164	B8917162	B8917163	B8917167	B8917165	B8917166	B898356
(1,2,5,6-dibenzanthracene)							
1,2-Dichlorobenzene	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<10
1,3-Dichlorobenzene	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<10
1,4-Dichlorobenzene	<0.10	<1	<0.10	<0.10	<0.10	<0.10	<10
3,3-Dichlorobenzidine	*	<2	<1	<1	<2	<2	<20
Diethyl phthalate	*	<1	<1	<1	<1	<1	<10
Dimethyl phthalate	*	<1	<1	<1	<1	<1	<10
Di-n-butyl phthalate	*	<10	<10	<10	<10	<10	<50
2,4-Dintrotoluene	*	<1	<1	<1	<1	<1	<10
2,6-Dinitrotoluene	*	<1	<1	<1	<1	<1	<10
Di-n-octyl phthalate	*	<1	<1	<1	<1	<1	<10
1,2-Diphenylhydranzine	*	not tested	not tested	not tested	not tested	not tested	not tested
Fluoranthene	*	<1	<1	<1	<1	<1	<10
Fluorene	*	<1	<1	<1	<1	<1	<10
Hexachlorobenzene	*	<1	<1	<1	<1	<1	<10
Hexachlorobutadiene	*	<1	<1	<1	<1	<1	<10
Hexachlorocyclopentadiene	*	<1	<1	<1	<1	<1	<10
Hexachloroethane	*	<1	<1	<1	<1	<1	<10
Indeno (1,2,3-cd) pyrene	*	<1	<1	<1	<1	<1	<10
Isophrone	*	<1	<1	<1	<1	<1	<10
Napthalane	*	<1	<1	<1	<1	<1	<10
Nitrobenzene	*	<1	<1	<1	<1	<1	<21
N-nitrosodimethylamine (Dimethyl nitrosamine)	*	<1	<1	<1	<1	<1	<10
N-nitroso-di-n-propylamine	*	<1	<1	<1	<1	<1	<10
N-nitrosodiphenylamine	*	<1	<1	<1	<1	<1	<10

Table 16 (Continued)
Wastewater Characteristics

Trainer Structure	19F1A/ 19F1B	19F4/ 19F4A	19F5/ 19F5A	19F3A/ 19F3C	21C12/ 21C12A	19F3/ 19F3B	Composite
Date of Test	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	7/19/89
Test No.	B8917164	B8917162	B8917163	B8917167	B8917165	B8917166	B898356
Phenanthrene	*	<2	<1	<1	<2	<2	<20
Pyrene	*	<1	<1	<1	<1	<1	<10
1,2,4-Trichlorobenzene	*	<1	<1	<1	<1	<1	<10
PESTICIDES, ug/l							
Aldrin	* not tested		<0.2	<0.1	0.07	<0.01	<0.03
Alpha-BHC	* not tested		0.09	0.04	0.04	<0.07	<0.03
Beta-BHC	* not tested		<1	<0.50	<0.10	<0.10	0.86
Gamma-BHC (Lindane)	* not tested		0.15	0.06	0.06	0.08	not tested
Delta-BHC	* not tested		<0.3	<0.7	0.07	<0.15	<0.04
Chlordane	* not tested		<5	<2.5	<2.5	<2.5	not tested
4,4'DDT	* not tested		<1	<0.50	<0.15	0.15	not tested
4,4'DDE	* not tested		<0.3	<0.15	<2.5	<2.5	not tested
4,4'DDD	* not tested		<0.6	<0.30	<0.30	<3	not tested
Dieldrin	* not tested		<0.2	<0.10	<0.10	<0.10	not tested
a-endosulfan	* not tested		<0.3	<0.15	<0.15	<0.15	not tested
b-endosulfan	* not tested		<0.4	<0.12	<0.20	<0.20	not tested
Endosulfan sulfate	* not tested		<0.8	<0.40	<0.40	<0.40	<0.11
Endrin	* not tested		<0.8	<0.40	<0.40	<0.40	<0.11
Endrin aldehyde	* not tested		<0.6	<0.13	<0.30	<0.30	<0.08
Heptachlor	* not tested		<0.2	<0.10	<0.10	<0.16	<0.03
Heptachlor epoxide	* not tested		<0.2	0.08	<0.10	<0.10	<0.03
PCB-1242 (AROCLOR 1242)	* not tested		<25	<12.5	<12.5	<12.5	<3.5
PCB-1254 (AROCLOR 1254)	* not tested		<25	<12.5	<12.5	<12.5	<3.5
PCB-1221 (AROCLOR 1221)	* not tested		<50	<25	<25	<25	<3.5

Table 16 (Continued)
Wastewater Characteristics

Trainer Structure	19F1A/ 19F1B	19F4/ 19F4A	19F5/ 19F5A	19F3A/ 19F3C	21C12/ 21C12A	19F3/ 19F3B	Composite
Date of Test	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	7/19/89
Test No.	B8917164	B8917162	B8917163	B8917167	B8917165	B8917166	B898356
PCB-1232 (AROCLOR 1232)	* not tested		<50	<25	<25	<25	<3.5
PCB-1248 (AROCLOR 1248)	* not tested		<25	<12.5	<12.5	<12.5	not tested
PCB-1260 (AROCLOR 1260)	* not tested		<10	<5	<5	<5	<1.4
PCB-1016	* not tested			not tested	not tested	not tested	<3.5
Toxaphene	* not tested		<20	<10	<10	<10	not tested
METALS, mg/1 (all reported as total metals)							
Antimony (Sb)	<0.1	not tested	not tested	<0.1	<0.1	<0.1	<0.2
Arsenic (AS)	0.01	not tested	not tested	0.003	0.018	0.002	0.001
Beryllium (Be)	<0.003	not tested	not tested	<0.003	<0.003	<0.003	<0.005
Cadmium (Cd)	<.003	not tested	not tested	<.003	0.004	<.003	<.0002
Chromium (Cr)	0.17	not tested	not tested	<.003	0.1	<0.03	<0.05
Copper (Cu)	0.09	not tested	not tested	0.06	0.15	0.05	0.01
Lead (Pb)	<0.03	not tested	not tested	<0.03	<0.03	0.03	<0.001
Mercury (Hg)	<0.002	not tested	not tested	<0.002	<0.002	<0.002	<0.002
Nickel (Ni)	<0.02	not tested	not tested	<0.02	0.05	<0.02	<0.04
Selenium (Se)	<0.02	not tested	not tested	0.004	0.002	<0.002	<0.002
Silver (Ag)	<0.01	not tested	not tested	0.02	<0.01	<0.01	<0.01
Thallium (T1)	not tested	not tested	not tested	not tested	not tested	not tested	<0.1
Zinc (Zn)	0.09	not tested	not tested	0.07	0.21	0.07	0.06

Table 16 (Continued)
Wastewater Characteristics

Trainer Structure	19F1A/ 19F1B	19F4/ 19F4A	19F5/ 19F5A	19F3A/ 19F3C	21C12/ 21C12A	19F3/ 19F3B	Composite
Date of Test	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	11/14/89	7/19/89
Test No.	B8917164	B8917162	B8917163	B8917167	B8917165	B8917166	B898356
Cyanide, mg/l	not tested	not tested	not tested	not tested	not tested	<0.01	<0.01
Phenol, mg/l	not tested	<1	<1	<1	<1	<0.01	<0.01
Asbestos, fibrous	not tested	not tested	not tested	not tested	not tested	not tested	not tested

*Upon extraction for Acids, Base Neutrals, and Pesticides, and sample solidified.

NOTES:

1. These tests were performed by LANTNAVFACENGCOM Code 1812. These bench tests were performed on mixed solutions containing the required constituents at concentrations given in this handbook.

2. The 19F3 test is the combination of the B1, B2, B3, and B4 trainers.

3. The composite test is for the combination of 19F1A, 19F3 (B1, B3, B4), and 19F4 trainers.

5.2.2 Artificial Smoke. Artificial smoke agent is butylated triphenyl phosphate ester hydraulic fluid which contains varied amounts of the toxic substance triphenyl phosphate (TPP). Several states regulate the emission of this substance as a hazardous air pollutant. Artificial smoke as generated is a hot air or aerosol mixture which produces a negligible residue.

Visible emission from a training structure consists of artificial smoke (a white colored hot air or aerosol mixture) and water vapor both of which evaporate to a colorless gas with no particulates. Where visible emission is not permissible, treatment should consist of allowing the effluent to evaporate prior to discharge.

5.2.3 Benzene. Although propane fuel eliminates most emissions of criteria pollutants, benzene is still emitted in trace amounts and concentrations. In some installations, additional stacks have been required by local air pollution authorities to lower ground level plume concentrations of benzene. Emissions testing of 21C12 facilities at STF Norfolk and 19F5 facilities at RTC San Diego were conducted in Fall of 1993. Test results will be published as an amendment to this handbook as soon as results are available.

5.3 Wastewater

5.3.1 General. The water effluent from training structures contains two major contaminants in varying degrees depending on the training being given. Sodium bicarbonate and excessive concentrations of biodegradable surfactant are the contaminants. Wastewater is channeled to a collection tank for pretreatment. Surface runoff from fire training facility pavement can go directly to the storm drain since firefighting agents used outside each structure are also collected and sent to pretreatment.

a) Wastewater effluent characteristics are as noted below in Table 16. These wastewater characteristics are based on actual bench tests performed by LANTNAVFACENGCOM. Limitations for each of these characteristics may vary on a local or state level. Typical wastewater surcharge limits are provided in Table 17. It should be the responsibility of the local EFD's to:

(1) Determine the required level of wastewater treatment.

(2) Determine applicable regulations necessary to obtain the wastewater permit.

(3) Determine the necessity of additional environmental studies of the projected wastewater (if required) to identify:

(a) BOD - biological oxygen demand

(b) COD - chemical oxygen demand

(c) pH

(d) TSS - total suspended solids

(e) TDS - total dissolved solids

(f) Priority pollutant scans

(g) EPA priority pollutant scans

b) The effluent is not toxic as the high COD could imply and is completely biodegradable when combined with acclimated bacteria. Surfactant quantities in excess of 200 mg/kg should require the addition of an anti-foaming agent to suppress foaming. A typical anti-foaming agent is Betz No. 300 defoamer.

c) Firefighting trainer wastewater should always require secondary treatment before being discharged to the environment because of high BOD and COD.

d) Provisions for onsite biological treatment should be provided where the receiving stream does not include secondary treatment. At those sites where Navy owned secondary treatment will be required, the design should consider the effect of precipitate on the treatment process. High surfactant effluent generates a precipitate so it may be desirable to reduce the precipitate in the biological section by flocculating and sedimentation prior to treatment.

e) Alternative AFFF surrogate agents may be available to reduce or eliminate local effluent discharge problems. Although discharge limits will vary at each trainer location, LANTNAVFACENGCOM Code 1811 has conducted a study of several agents to determine amounts of each which can be discharged as part of the effluent stream for the Fleet Training Center (FTC) Norfolk facilities. This information is available upon request from Mr. Ken Clark, Mr. Steve Azar, or Mr. Jim Bailey at (804) 322-4736 or DSN 262-4736.

f) Modifications to the pretreatment process described below may be required to comply with local discharge limitations. If pretreatment is not required by local authorities, it may be deleted.

Table 17
Wastewater Surcharge Limits

	TYPICAL LIMITS (Based on domestic sewage) (maximum)
BOD - Biological Oxygen Demand	230 mg/kg*
COD - Chemical Oxygen Demand	550 - 700 mg/kg*
pH - measure of acidity or alkalinity of a solution	6.5 - 8.5*
Oil and Grease	100 mg/kg
TSS - Total Suspended Solids (consists mostly of siliconized sodium bicarbonate particles)	250 mg/kg*
MBAS - measure of surfactant quantity	200 mg/kg

*Note: These are typical surcharge limits, not compliance limits.

5.3.2 Separation Chamber. The large particle siliconized sodium bicarbonate is partially soluble in water; however, its density is so close to that of water it should stay in suspension with the slightest agitation. Grit and sludge from other sources should accumulate in tanks associated with the wastewater stream and a method for its removal should be included in the tank design. Training wastewater from the fire training structure should be piped to a separation chamber to remove the propane. For details refer to par. 3.2.9 and Appendix A, Figure A-15.

5.3.3 Pretreatment. Fire training wastewater should be collected in an equalization tank sized to hold 125 percent of the largest one day's effluent. This should allow various firefighting agent concentrations to mix and dilute each other. It should also allow a homogeneous batch of wastewater to be monitored and then discharged to the sanitary sewer system at a controlled rate. There should be two equal size equalization tanks so that one can be discharging while the second is receiving. During maintenance periods the active tank can discharge at night. Each of the equalization tanks should have draft marks in increments sufficient for operators to estimate tank contents to the nearest 1900 L.

a) Piping and valves associated with equalization tanks should be designed for flexibility of use. Tanks should overflow to each other. Each tank should have provisions for mechanical agitation and sludge removal. The agitation should be a high volume low head pumped recirculation system with a 90-degree elbow and length of pipe at the discharge so the operator can manually adjust between submerged or open discharge. The open discharge would afford some aeration. Sludge handling provisions may consist of a sump or trough to which the grit can be hosed for removal by shovel and bucket. The sump should have a drain piped directly to the exterior of the tank for future addition of a pumped system if it becomes practical. Provide permanent personnel access to the bottom of tanks and a standpipe, SP, so tanks can be hosed down with a 40 mm fire hose.

b) Consideration should be given to the option of using a covered reservoir. The trade-offs are the cost of disposing of collected precipitation and freeze protection.

c) A chemical addition system should be provided for addition of acid, caustic, and defoaming agent. These three chemicals should be separately pumped at an adjustable rate to either equalization tank. The injection rate should be determined manually. Prior to discharging the wastewater to a secondary treatment plant, the operator should determine the pH of the effluent and make adjustments as necessary. Automatic pH adjustment with manual override can also be used. Provide a separate containment for each of the three chemicals used for the pretreatment. The containment basin should be designed to keep chemicals from mixing and to control chemicals in the event of spillage. A drain should not be provided. The containment should be designed to hold 125 percent of the amount of chemical drum storage intended for the area. Provide local exhaust in the chemical containment area. The exhaust system should manually operate from the local area.

d) When the pH is adjusted, the wastewater is ready for discharge. If monitoring is required by local authorities, it should be done at this time. A daily log of sampling data and chemical additions should be maintained by the user. Discharge to the sewer system should be controllable and verifiable because the rate should be used for billing purposes. The preferred system is dual sump pumps designed to evacuate the tank in 8 to 10 hours.

e) Local municipal treatment plants will periodically want a chemical analysis of the effluent being discharged to it. The reporting period may be short at first but then lengthened as confidence in the pretreatment process is gained. A sampling should best be done by a contract laboratory since its purpose is to determine permit compliance and its final frequency should not justify funding "in-house" capability. An automatic sample taking machine should be provided at fire training sites to facilitate the sample taking process. The controls for sump and recirculation pumps should include level controls, lead-log capability, alarm conditions for high-high and pump failure. Alarm conditions should be sent to the central annunciator panel in the utility building and to the 24-hour duty desk.

f) The inlet to the discharge and recirculation pumps should be provided with readily cleanable strainer to catch leaves and frogs, etc., which have been a problem in the past.

g) Pumps which take suction from the equalization tank should be protected by a low level shutoff switch.

5.3.4 Recovery. Wastewater recovery normally cost more than purchase, treatment, and disposal of potable water. In some instances, however, water use may be restricted and the more expensive route will be necessary. Recycled water should not cause a health hazard and should be compatible with device sensors. To avoid a health hazard, organic materials added during firefighting should be removed and the water should then be made clear since the device sensors use opacity to differentiate between foam and water. A carbon absorption procedure would be required to remove the organic material followed by a reverse osmosis system to remove the remaining dissolved solids and clear up the water. Since there are chemical compounds which are not removed by the above processes, the addition of new water and blow down would still be required. If recycling water is a serious consideration, more study would be required by the cognizant EFD to derive an acceptable system.

a) Wastewater associated with firefighting structures have low suspended solids, high dissolved solids (DS), high BOD, high COD, high pH, and high total toxic organics (TTO) levels. Recycling will arithmetically escalate the untreated portions of the wastewater (DS, BOD, COD, pH, and TTO), after each training scenario, to such high levels that device sensors and training personnel's health could be effected. Also, high levels of TDS, BOD, COD, pH, and TTS may prevent direct discharge into a sanitary sewer. The recycling system should consider each of the portions. The device sensor water requirements are given in the chart below:

pH Range	7.5 (max) - 6.5 (max)
Particle Size	40 microns
Color	None
Refoaming	Should not foam when sprayed
Safety	Not harmful to personnel

b) Recycling of water does not effect the storage requirement for potable water. The EFD environmental quality division should determine the required wastewater treatment, applicable regulations necessary to obtain the wastewater permit, and the necessity of required environmental studies of

the projected wastewater to identify: BOD, COD, pH, TSS, TDS, priority pollutant scans, Environmental Protection Agency (EPA) priority pollutant scans as required; water reclaim.

APPENDIX A
GENERAL

19F1A, 19F3, 19F3A, 19F1B, 19F3B, and 19F3C Bilge Fireplace Structure	A-1A
19F5, 19F5A Bilge Fireplace	A-1B
19F1A, 19F1B, 19F3, 19F3A, 19F3C Oil Spray/Bilge Fireplace	A-1C
Typical Deep Fat Fryer Fireplace	A-2
Typical Mattress/Locker Fireplace	A-3
Hose Station Detail HS1 - 40 mm	A-4
HS2 - 65 mm Hose Station Detail	A-5
FR - AFFF Hose Reel Detail	A-6
Quick Acting Watertight Door	A-7
Ellison Type Door	A-8
Fireplace Support	A-9
Particulate Compliance	A-10
Recharging Tilt Rack and Fill Equipment	A-11
Watertight Hatch for Emergency Escape Trunk	A-12
Wild Hose Demonstration Facility	A-13A
Wild Hose Post Detail	A-13B
Portable Pump P-250 Demonstration Facility	A-14
Separation Chamber, 21C12 and 19F Series Devices	A-15
Calsoft L-40 Viscosity Characteristic Curve	A-16
Calsoft L-40/Water Viscosity Characteristic Curve	A-17
Two Position Control Interface	A-18
Floating Point Control Interface	A-19
Exhaust Fan/Crawl Space Power Controls and Interlock	A-20A-D
AFFF Station	A-21A-J
Luminaire, Types 1 and 2	A-22

APPENDIX A (Continued)

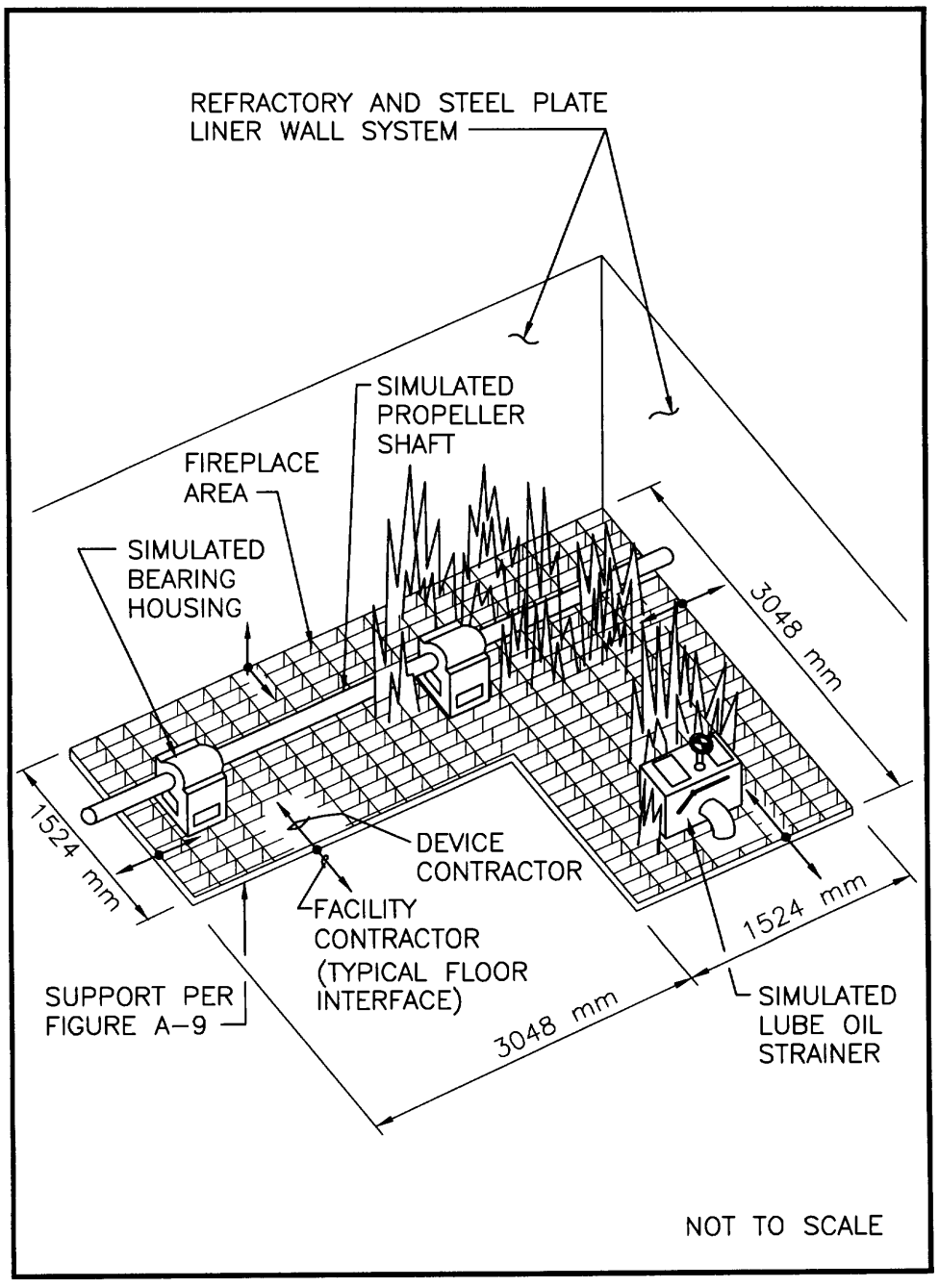


Figure A-1A

19F1A, 19F3, 19F3A, 19F1B, 19F3B, 19F3C
BILGE FIREPLACE STRUCTURE

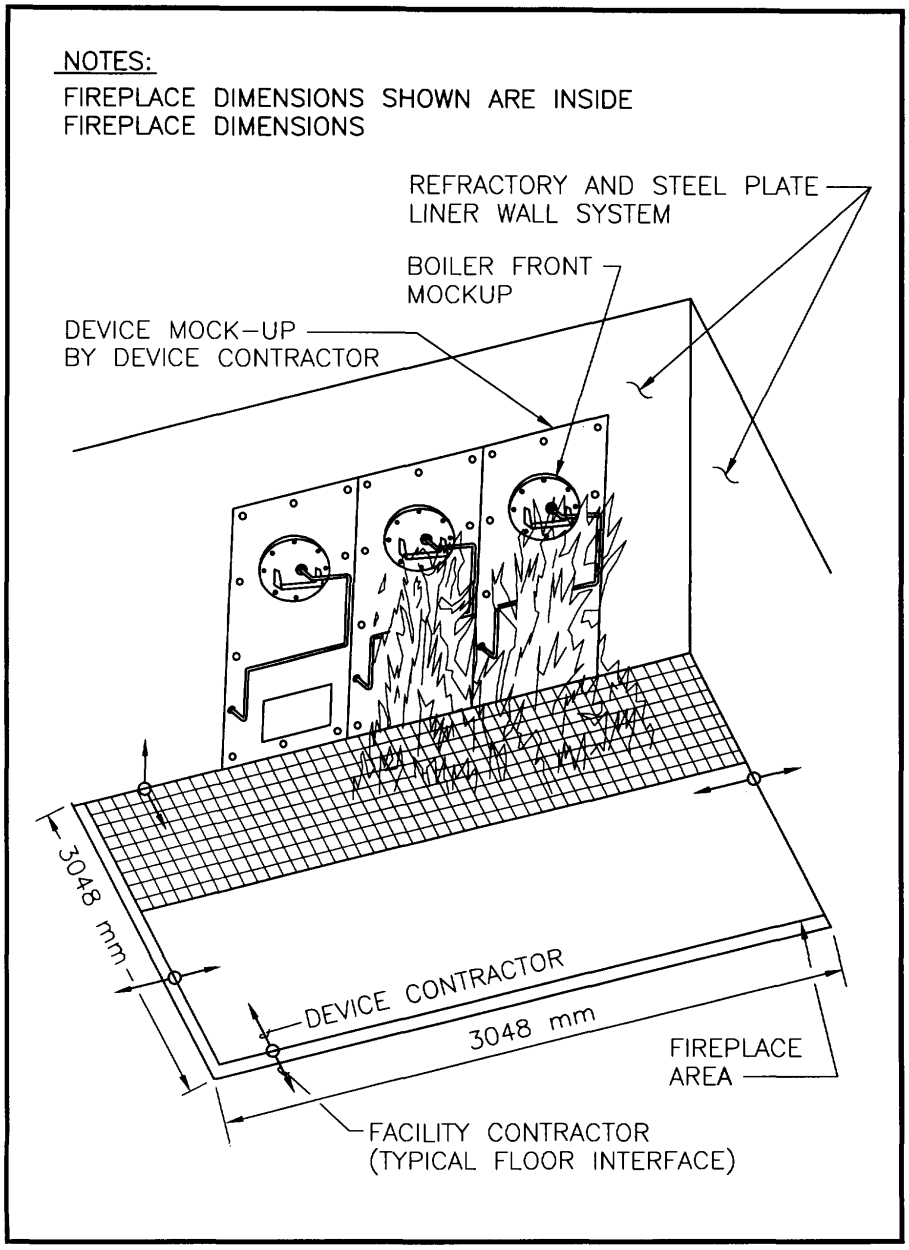


Figure A-1B

19F5, 19F5A Bilge Fireplace

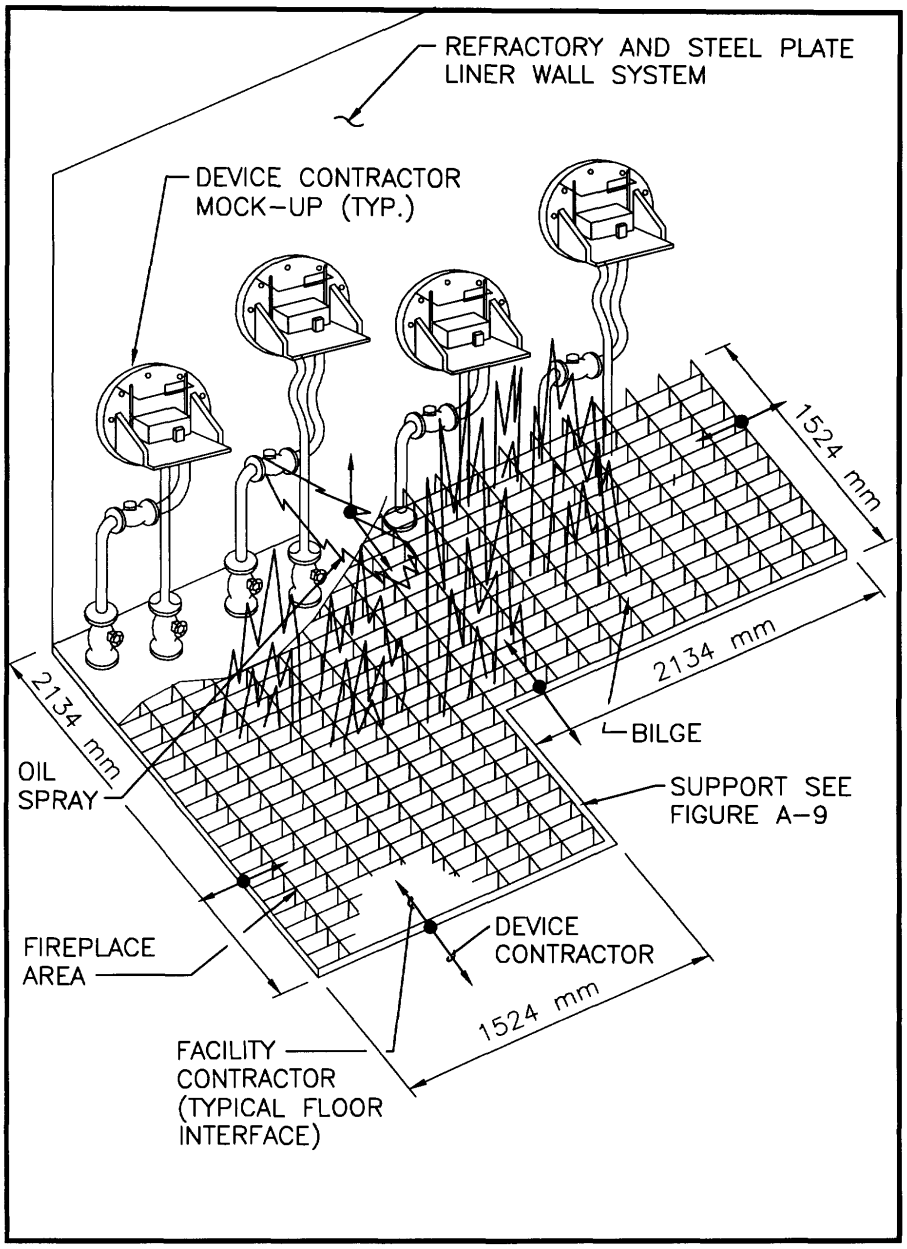


Figure A-1C

19F1A, 19F1B, 19F3, 19F3A, 19F3C
Oil Spray/Bilge Fireplace

APPENDIX A (Continued)

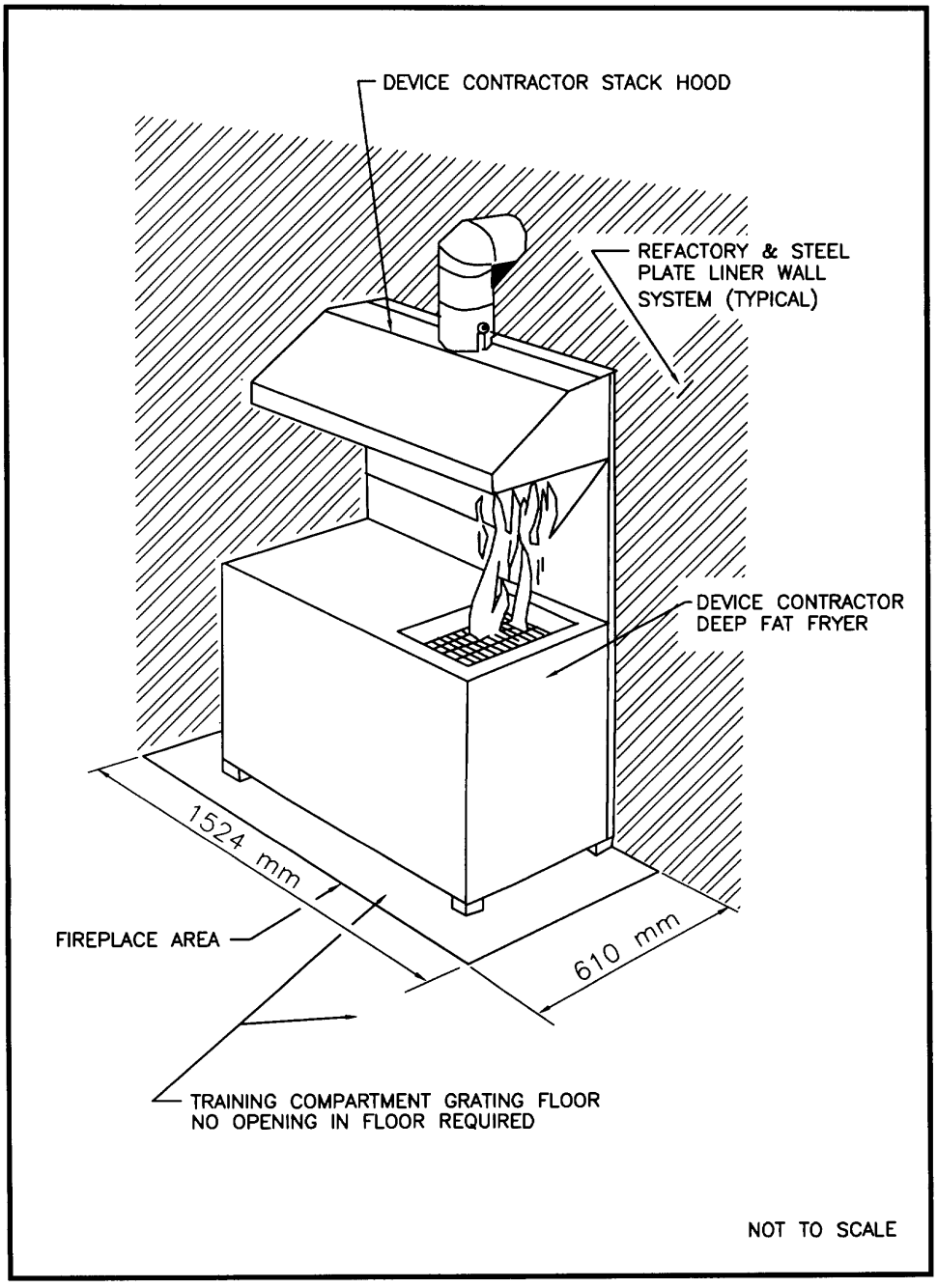


Figure A–2
Typical Deep Fat Fryer Fireplace

APPENDIX A (Continued)

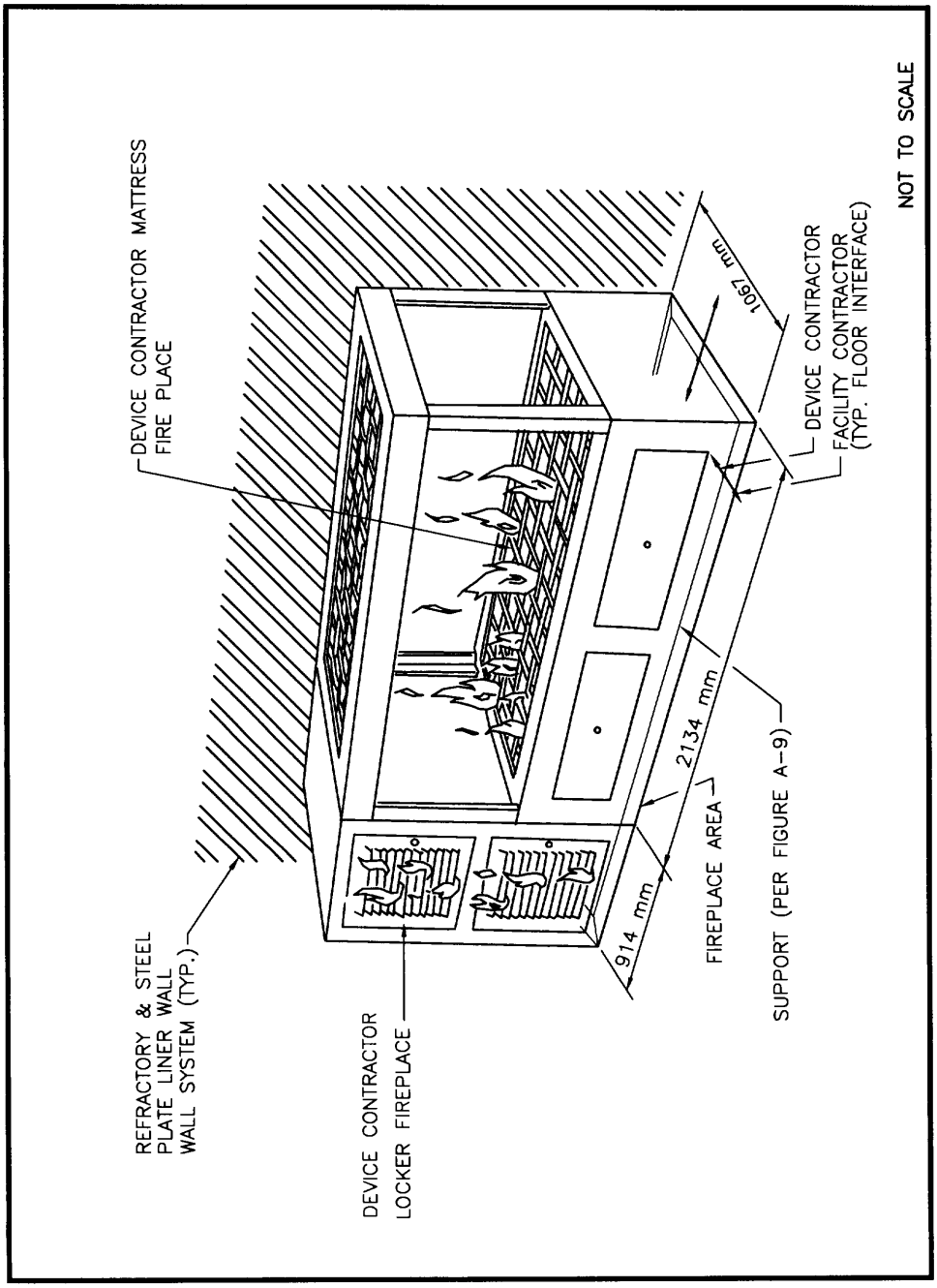


Figure A–3
Typical Mattress/Locker Fireplace

APPENDIX A (Continued)

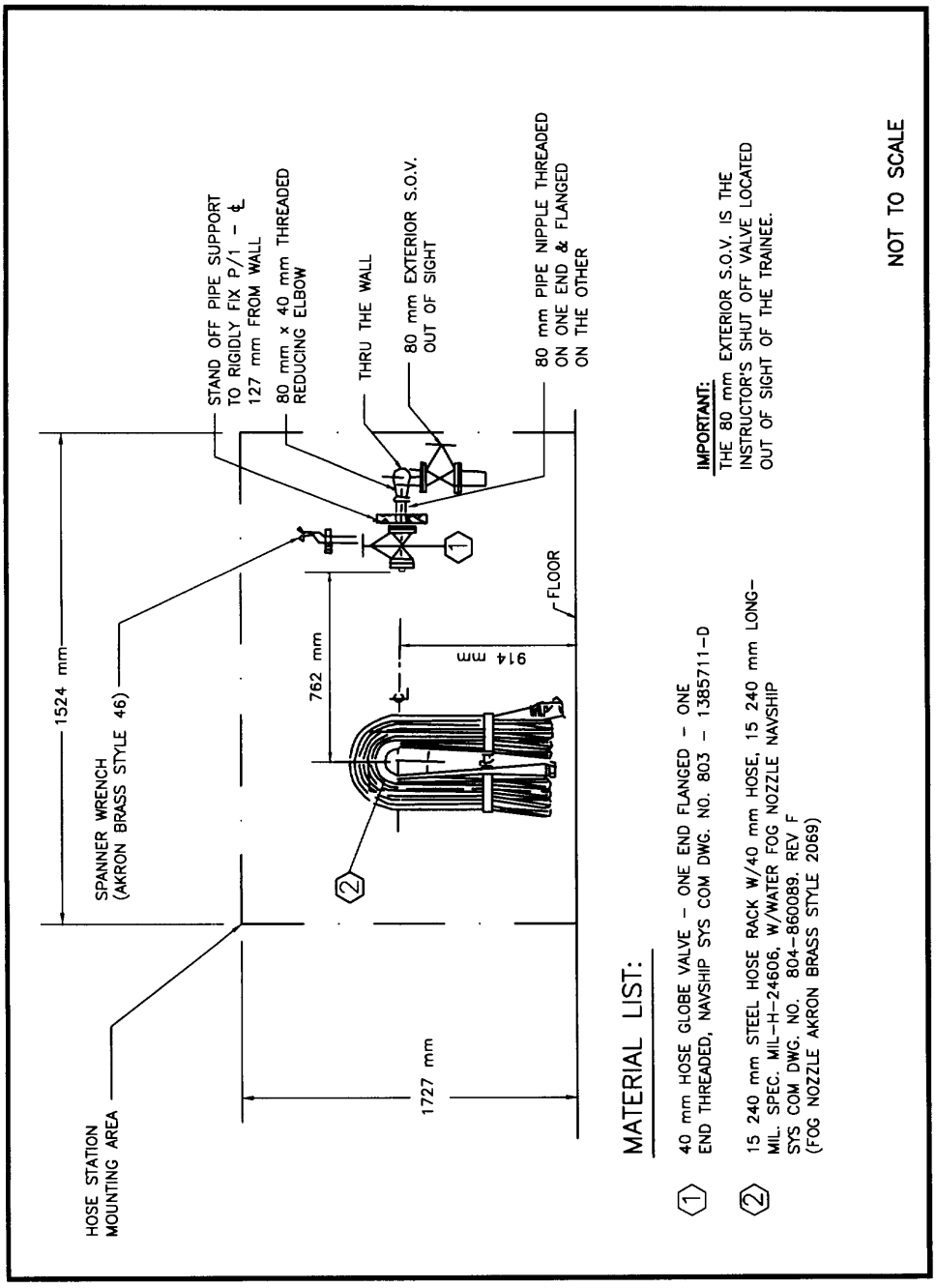


Figure A-4
Hose Station Detail HS1- 40 mm

APPENDIX A (Continued)

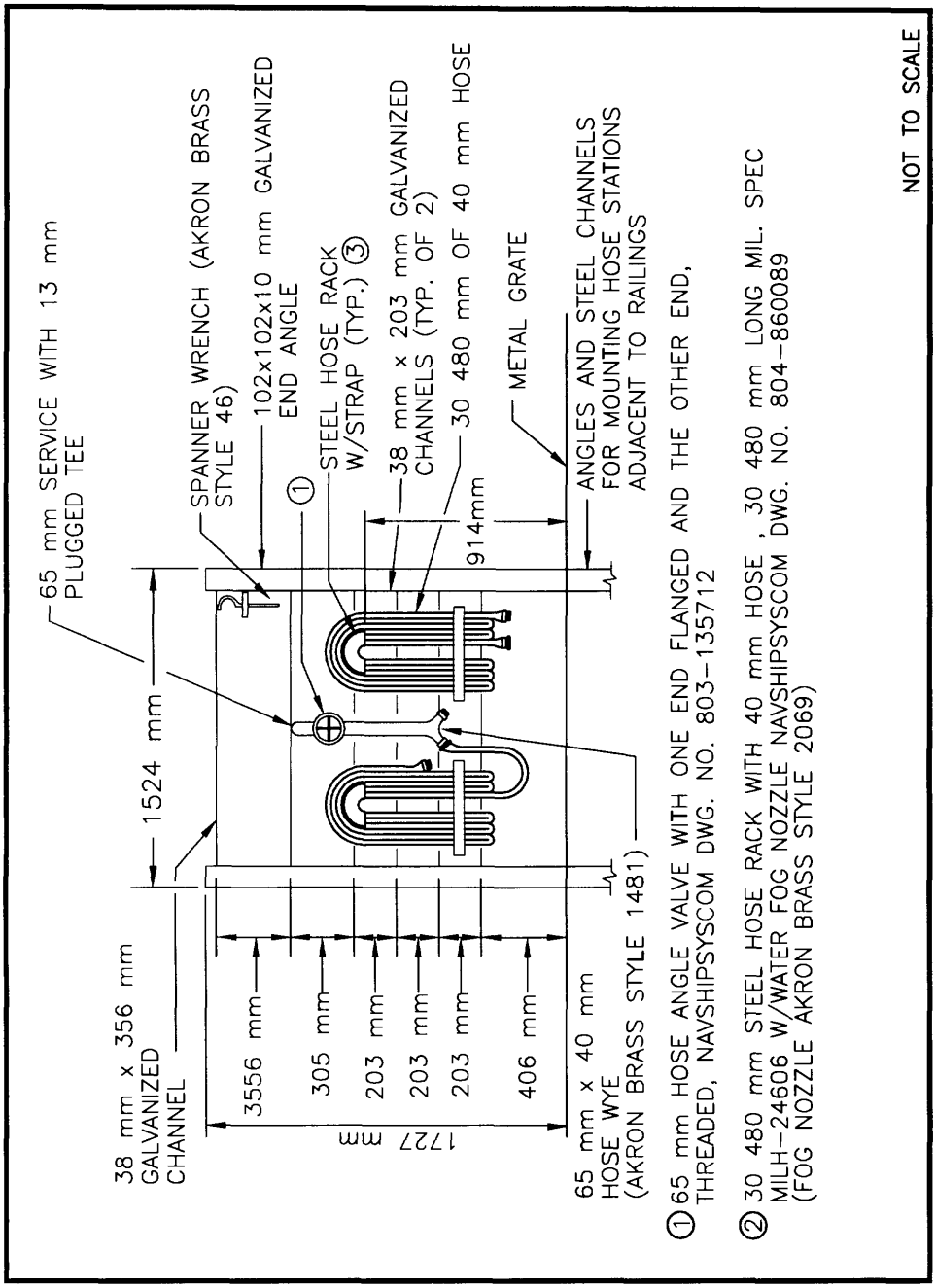


Figure A–5

HS2 – 65 mm Hose Station Detail

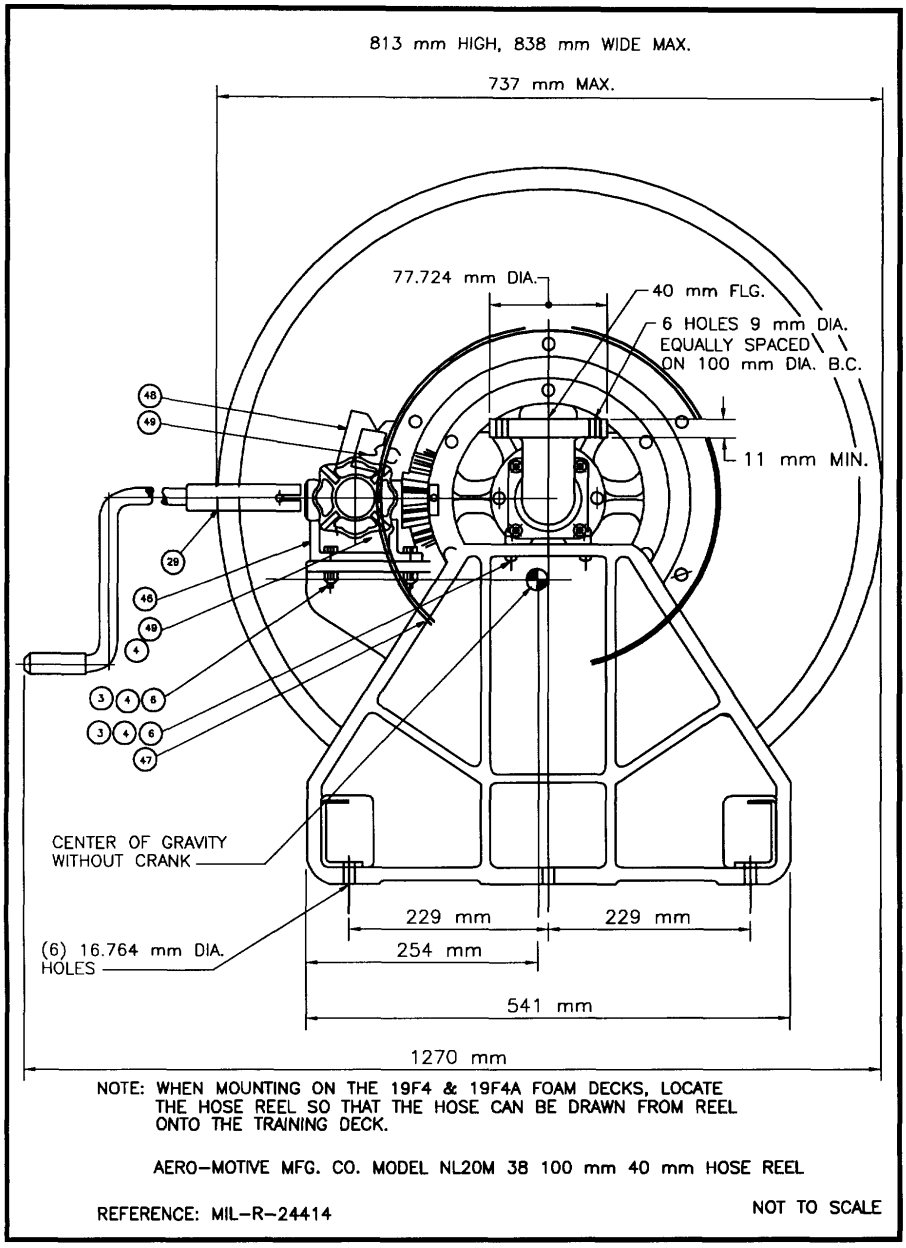


Figure A-6
FR – AFFF Hose Reel Detail

APPENDIX A (Continued)

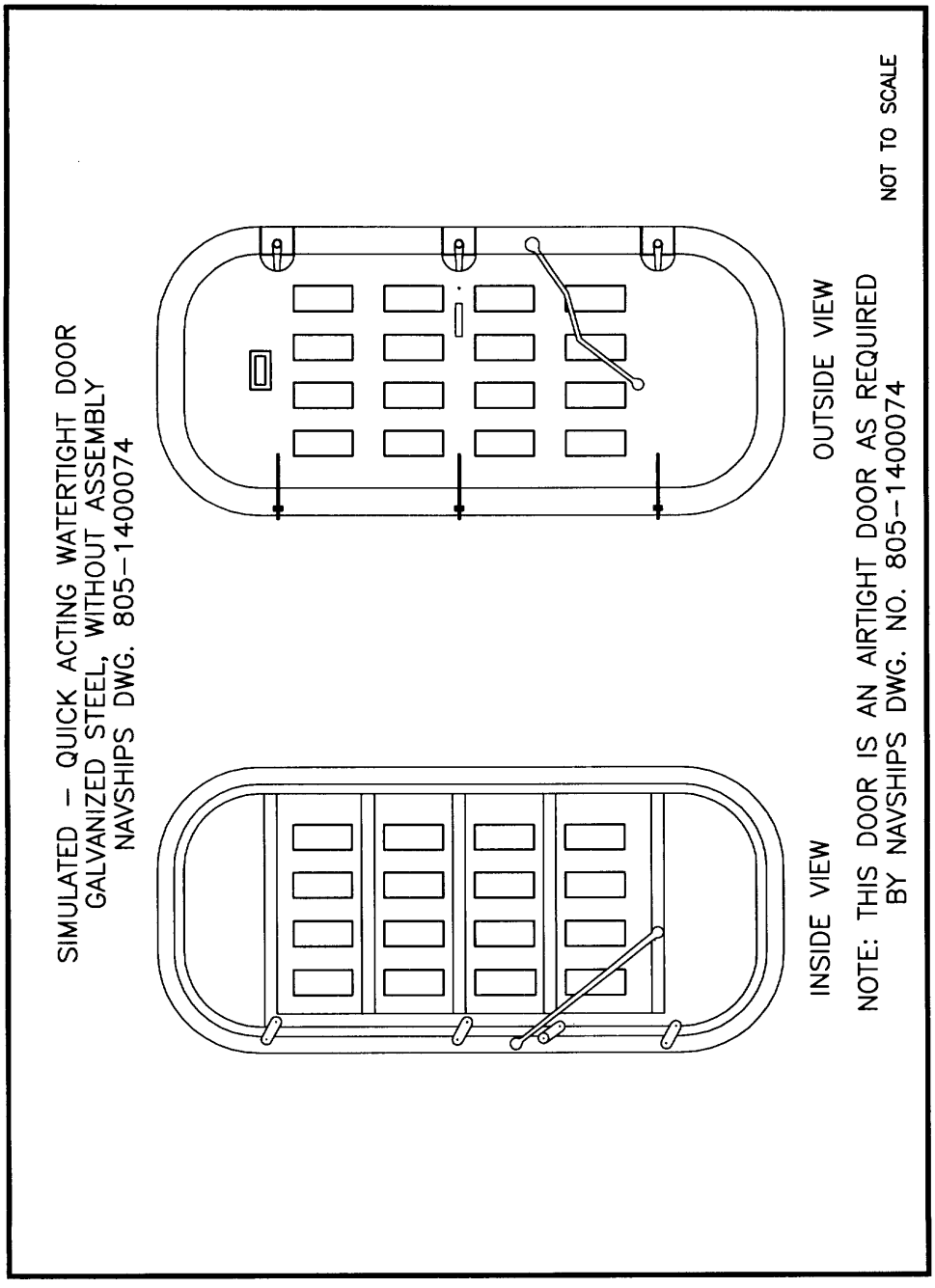
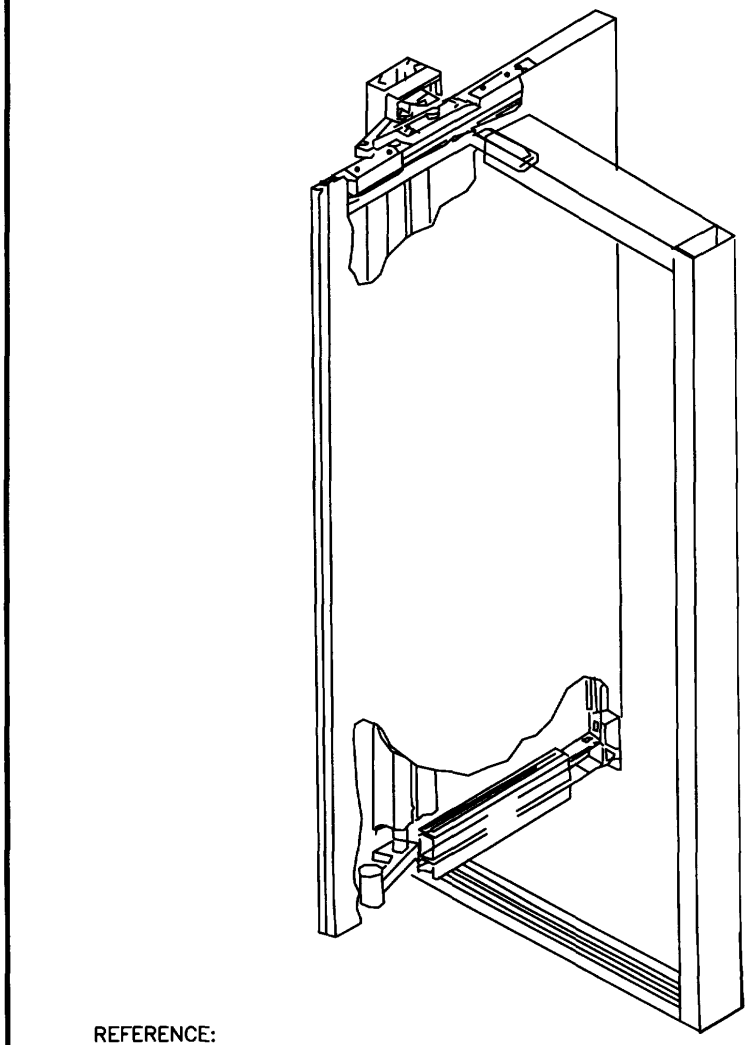


Figure A–7
Quick Acting Watertight Door

APPENDIX A (Continued)



REFERENCE:
NAVSEA DWG. NO. 803-5184129:
DOOR, STEEL, BALANCED.
ELLISON BRONZE CO. INC.

NOT TO SCALE

Figure A-8
Ellison Type Door

APPENDIX A (Continued)

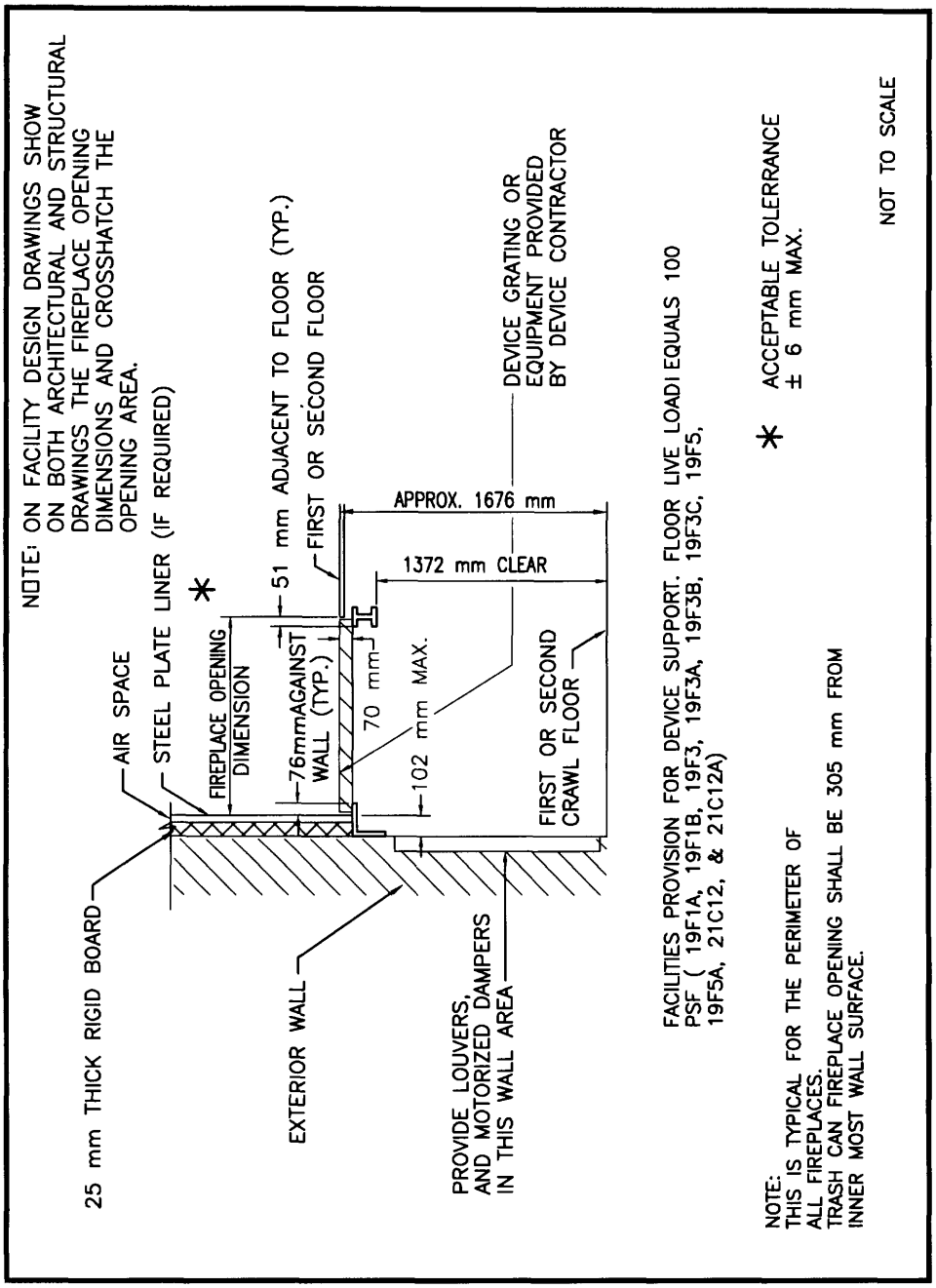


Figure A–9A
Fireplace Support

APPENDIX A (Continued)

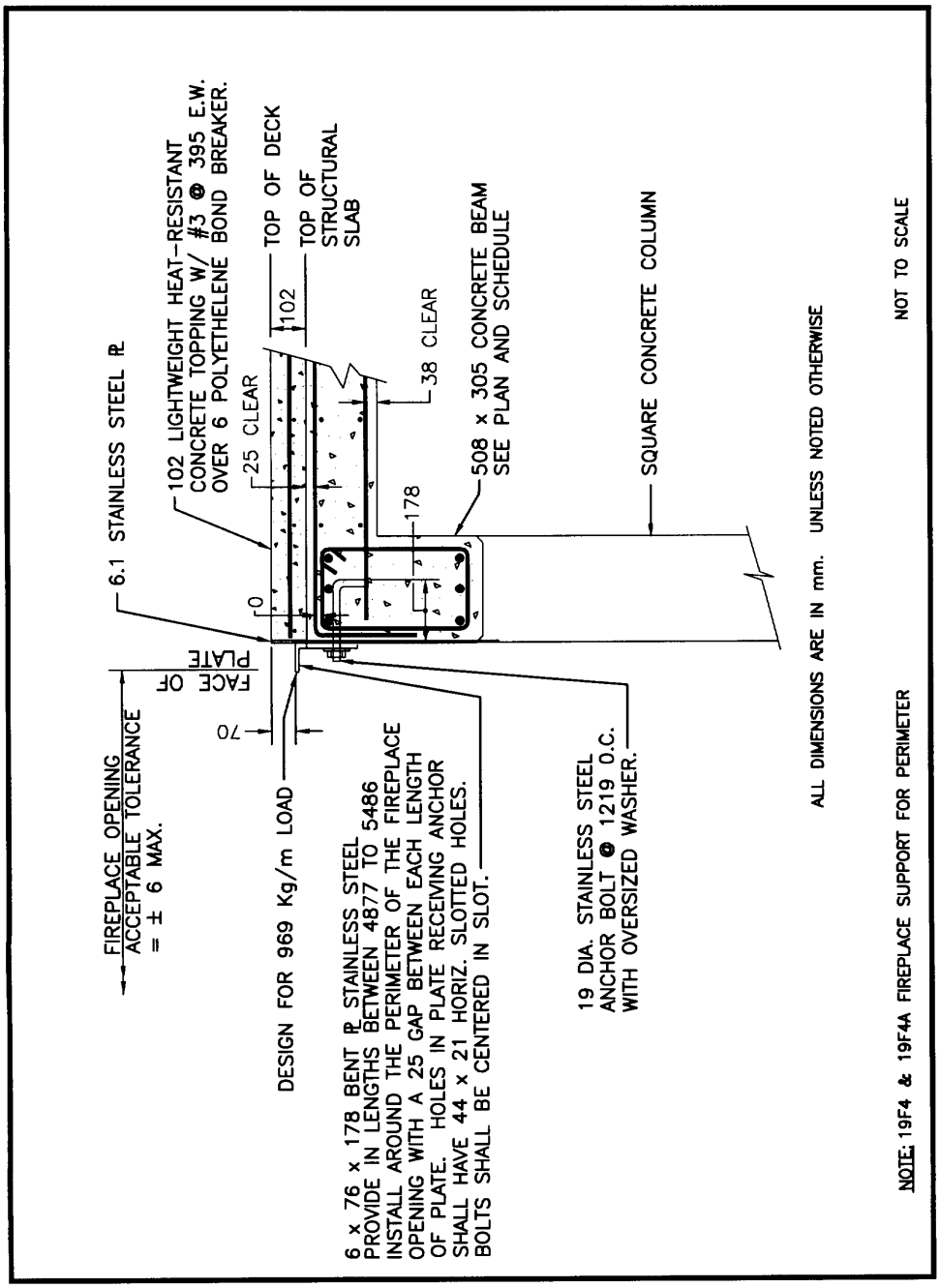


Figure A-9B

FIREPLACE SUPPORT

APPENDIX A (Continued)

DEEP FAT FIRE

PKP emission 0.0690 kg in 6 runs during test
0.011 kg E/run
PKP discharge 2 kg D/run during test
PKP emission rate 0.011 ÷ 2 = 0.005 kg E/kg D

3 Deep fat fires + 4 discretionary fires = 7 fires/class
*2 classes running together x 7 = 14 fires/day
9 kg discharge/fire x 3 fires/hr = 27 kg D/hr
x 14 fires/day = 127 kg D/day
27 kg D/hr x 0.005 kg E/kg D = 0.14 kg E/hr
127 kg D/day x 0.005 kg E/kg D = 0.64 kg E/day

BILGE FIRE

PKP emission 0.011 kg in 6 runs during test
0.002 kg E/run

PKP discharge rate 0.002 ÷ 7 = 0.0003 kg E/kg D
8 bilge fires/class x 2 classes = 16 fires
**9 kg discharge/fire x 6 fires/hr = 54 kg D/hr
x 16 fires/day = 144 kg D/day

54 kg D/hr x 0.0003 kg E/kg D = 0.016 kg E/hr
145 kg D/day x 0.0003 kg E/kg D = 0.048 kg E/day

TOTAL Maximum

***0.14 kg E/hr + 0.016 kg E/hr = 0.156 kg E/hr
27 kg D/hr + 54 kg D/hr = 81 kg D/hr

*0.64 kg E/day + 0.043 kg E/day = 0.684 kg E/day
127 kg D/day + 145 kg D/day = 272 kg D/day

*This represents the worst day where PKP fires for 2 classes were run in 1 day. This is very unlikely.

**7 kg D/run was used during test but figure 9 kg D/run for training purposes.

***Three 20 minute exercises per hour on the deep fat fire and the bilge fire for a total of 6 fires is the maximum training rate.

Figure A-12
Particulate Compliance

APPENDIX A (Continued)

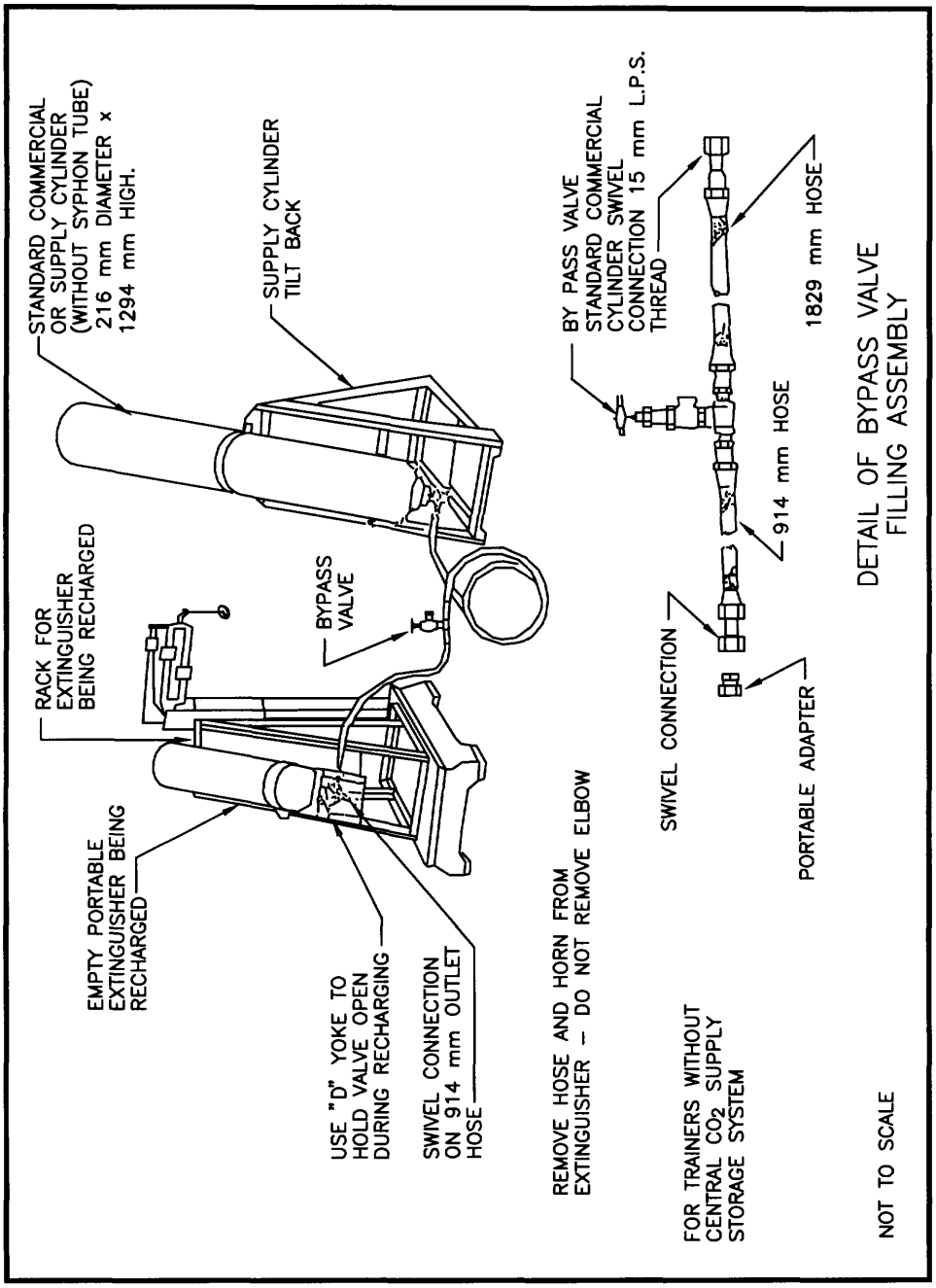


Figure A–11
Recharging Tilt Rack and Fill Equipment

APPENDIX A (Continued)

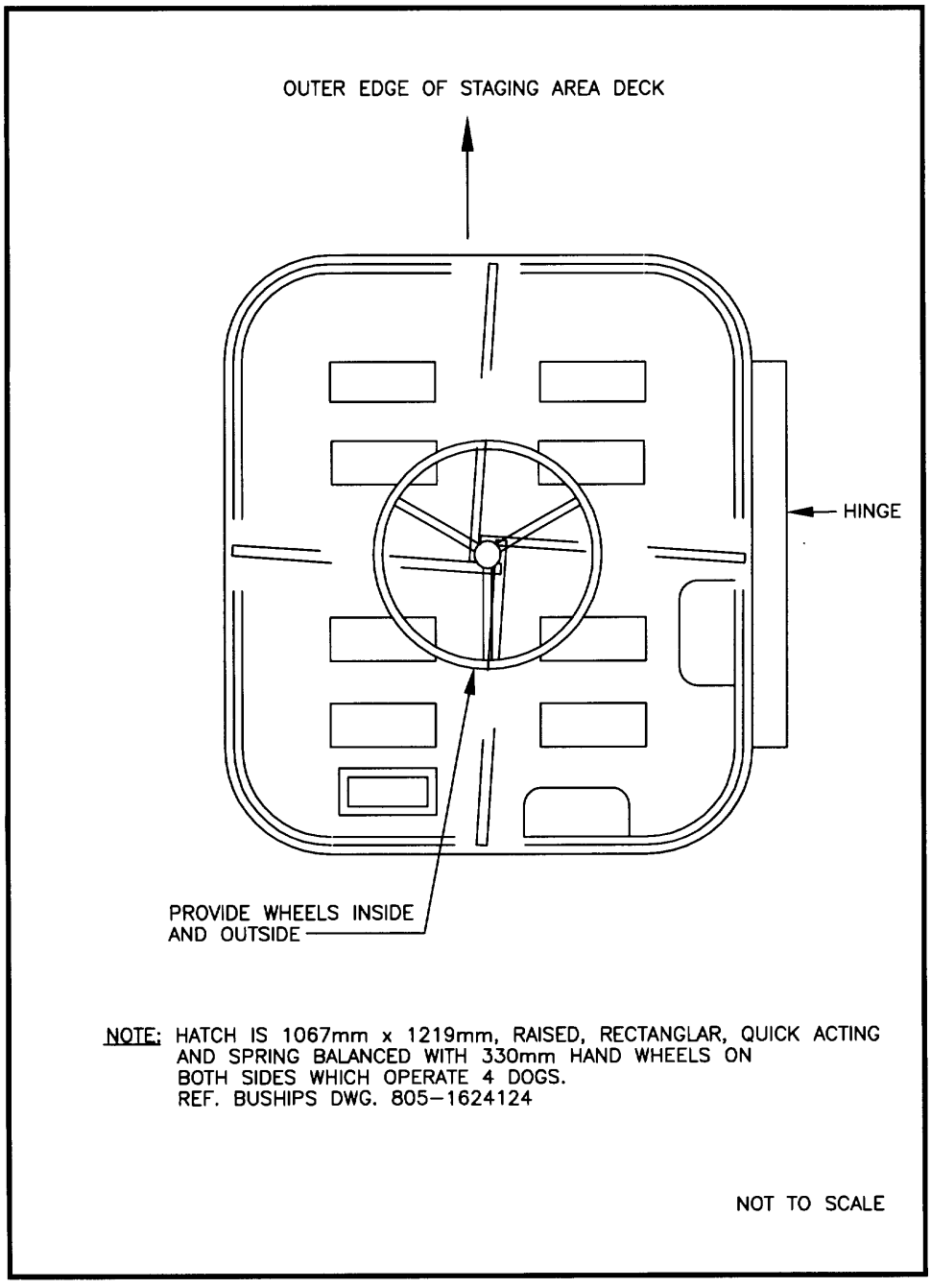


Figure A-12
Watertight Hatch For Emergency Escape Trunk

APPENDIX A (Continued)

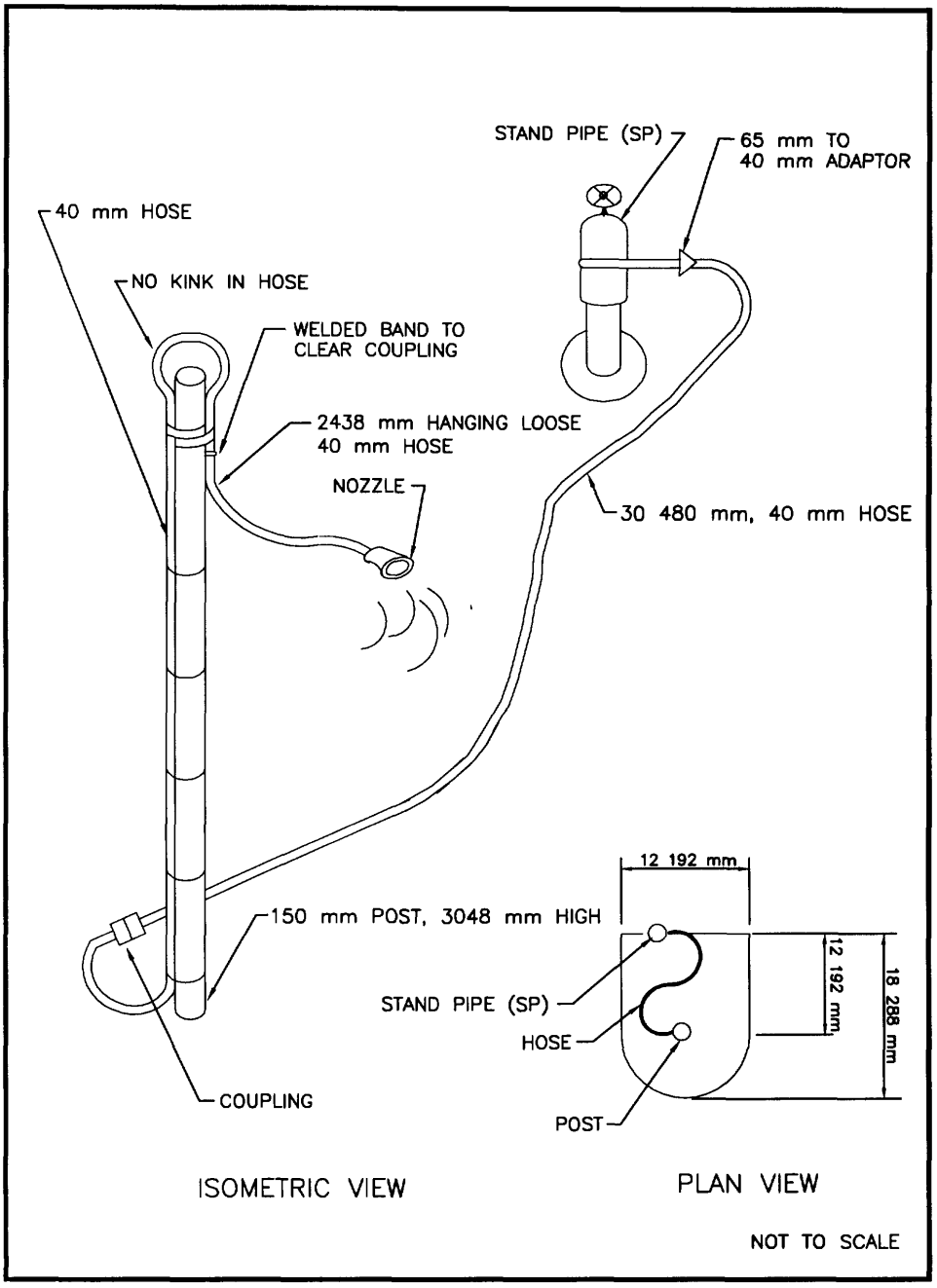


Figure A–13A
Wild Hose Demonstration Facility

APPENDIX A (Continued)

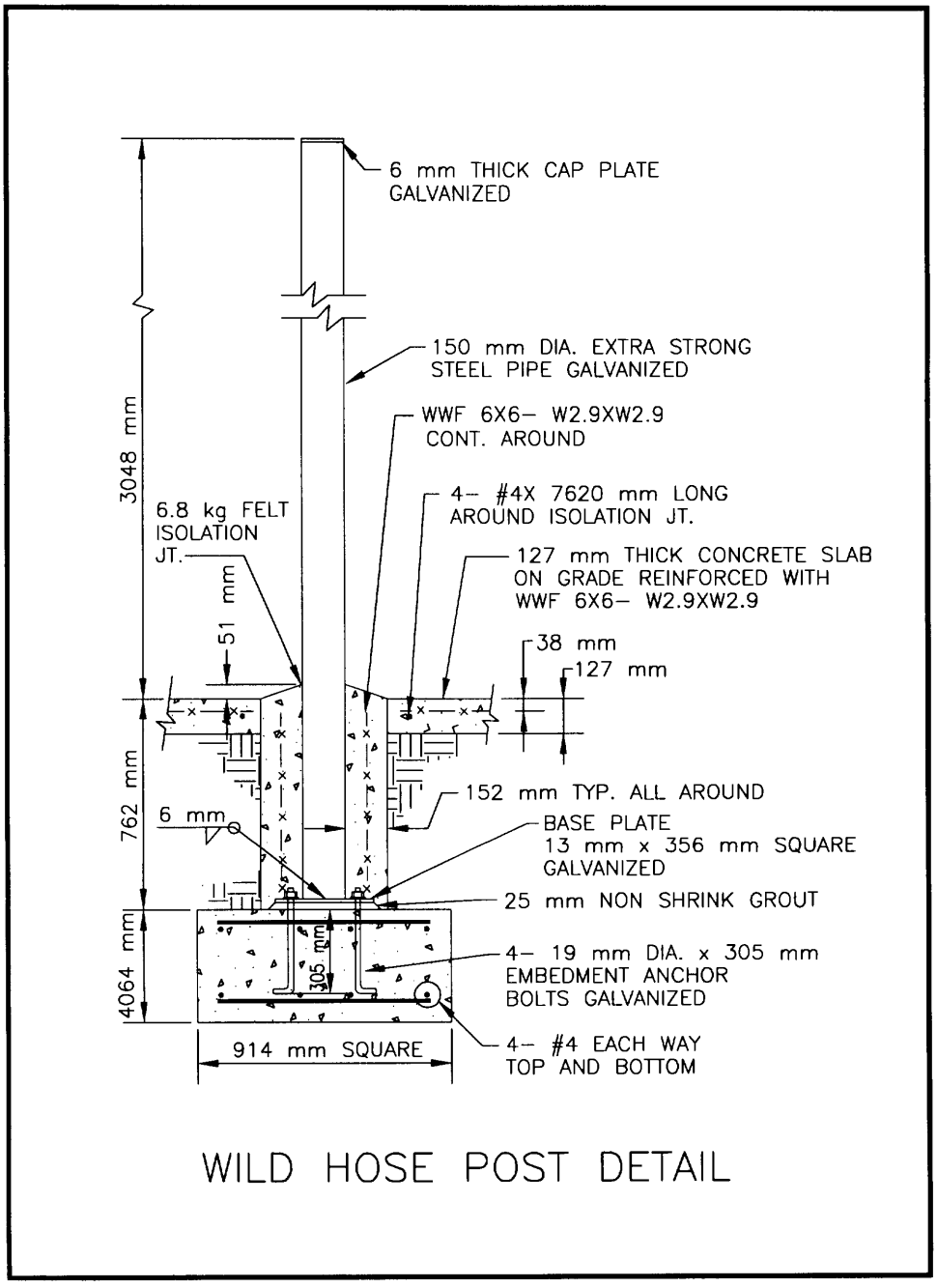


Figure A–13B
WILD HOSE POST DETAIL

APPENDIX A (Continued)

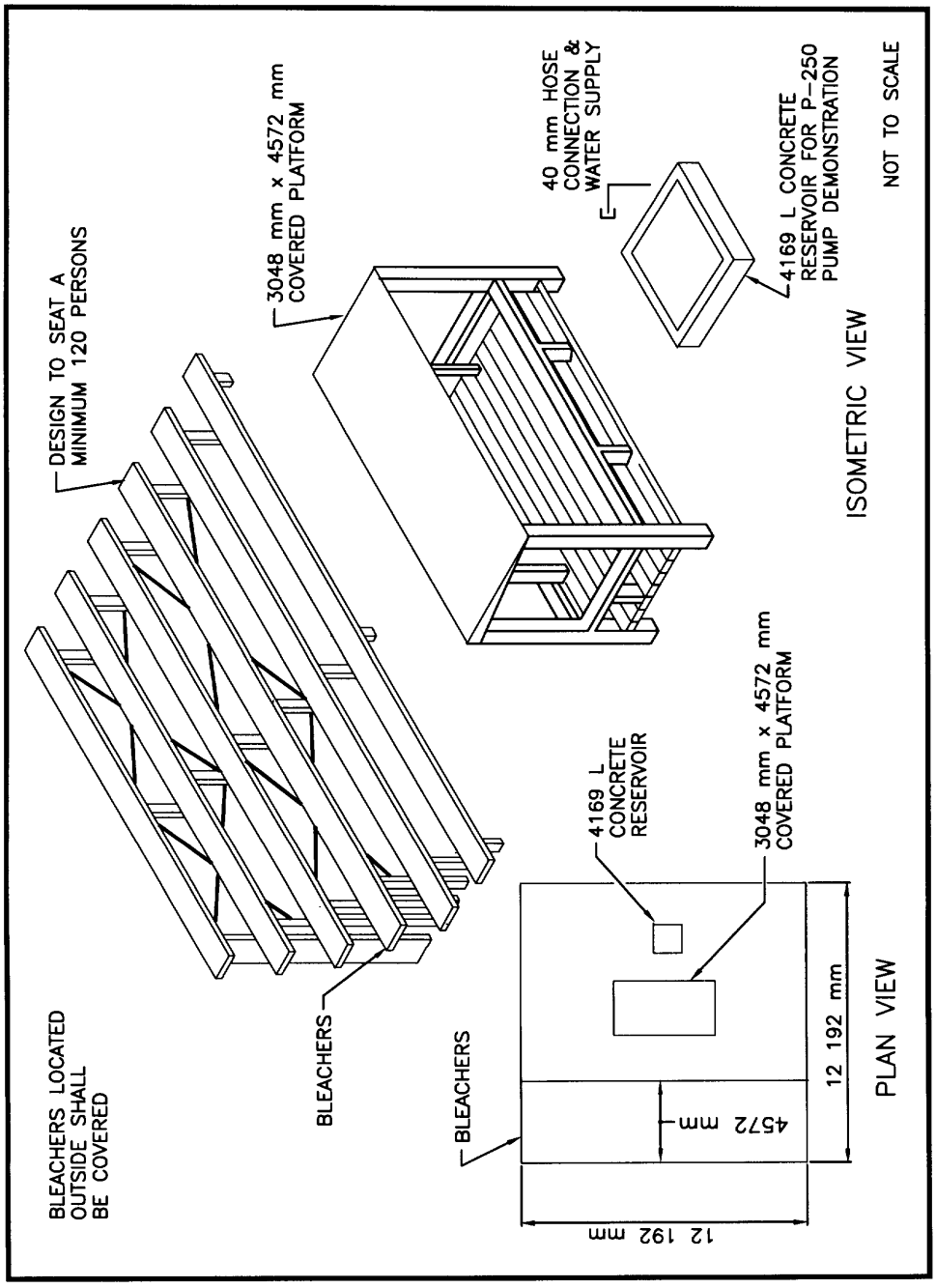


Figure A-14
Portable Pump P-250 Demonstration Facility

APPENDIX A (Continued)

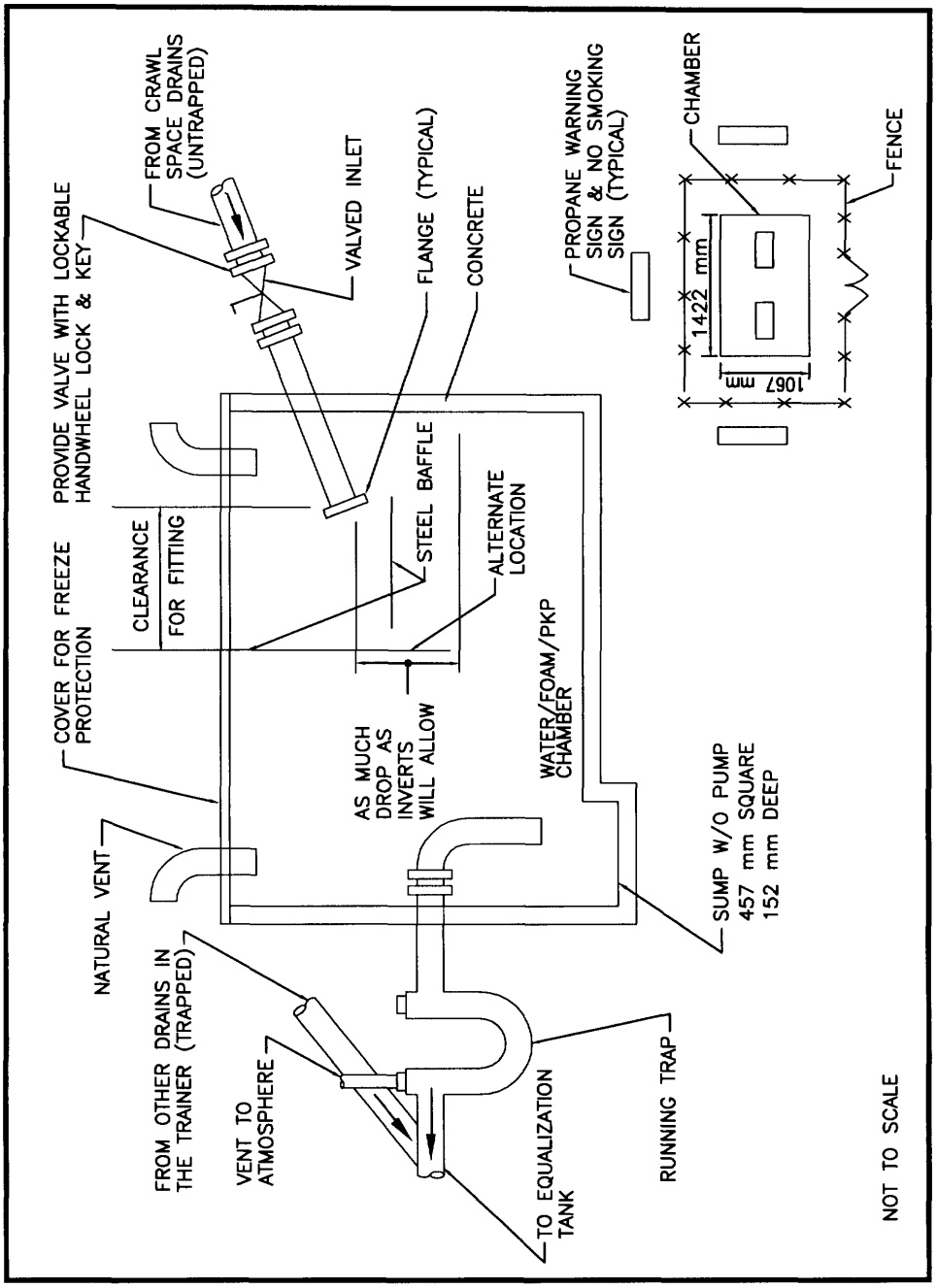


Figure A–15
Separation Chamber, 21C12 and 19F Series Devices

APPENDIX A (Continued)

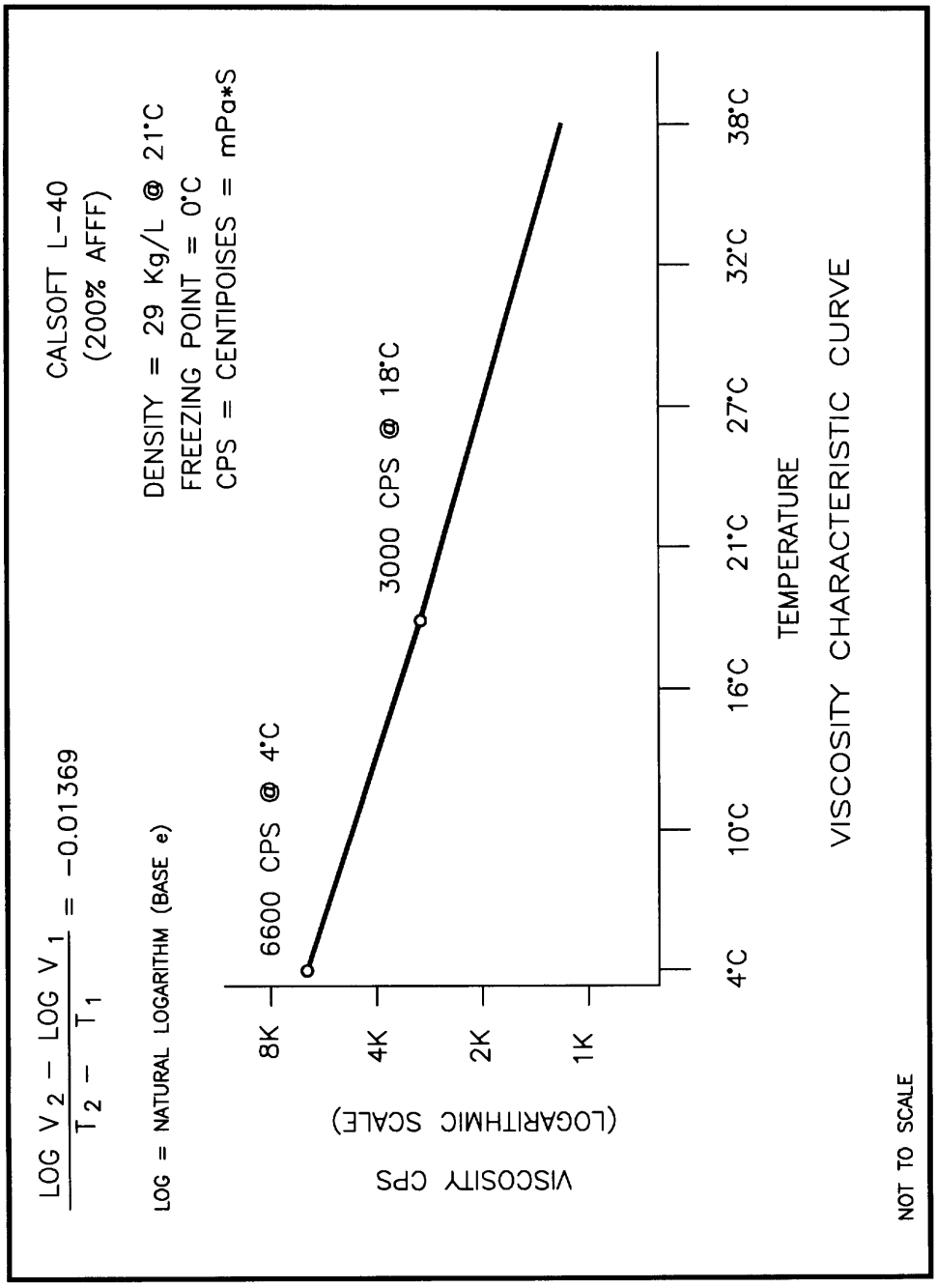


Figure A-16
Calsoft L-40 Viscosity Characteristic Curve

APPENDIX A (Continued)

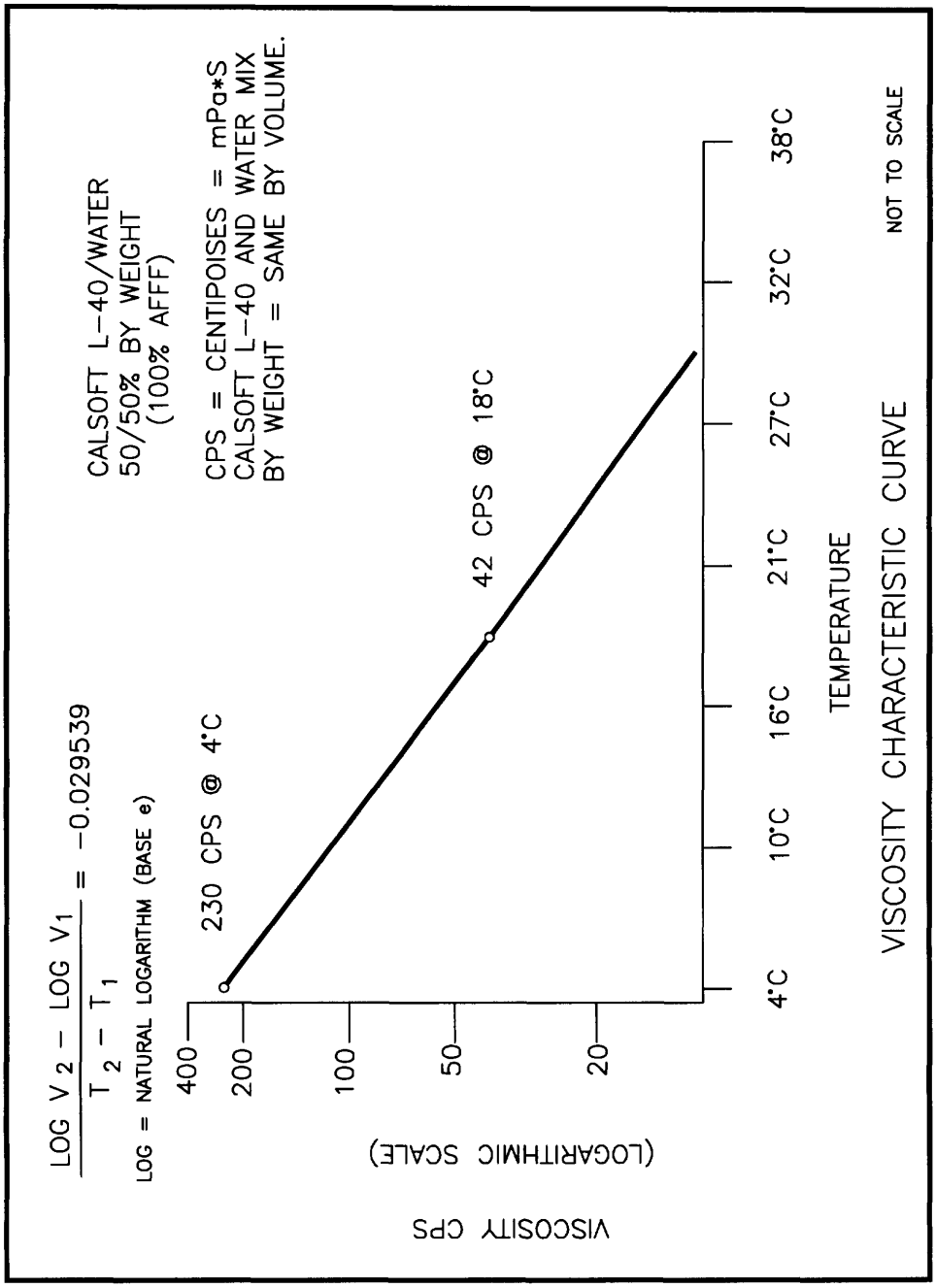


Figure A-17
Calsoft L-40/Water Viscosity Characteristic Curve

APPENDIX A (Continued)

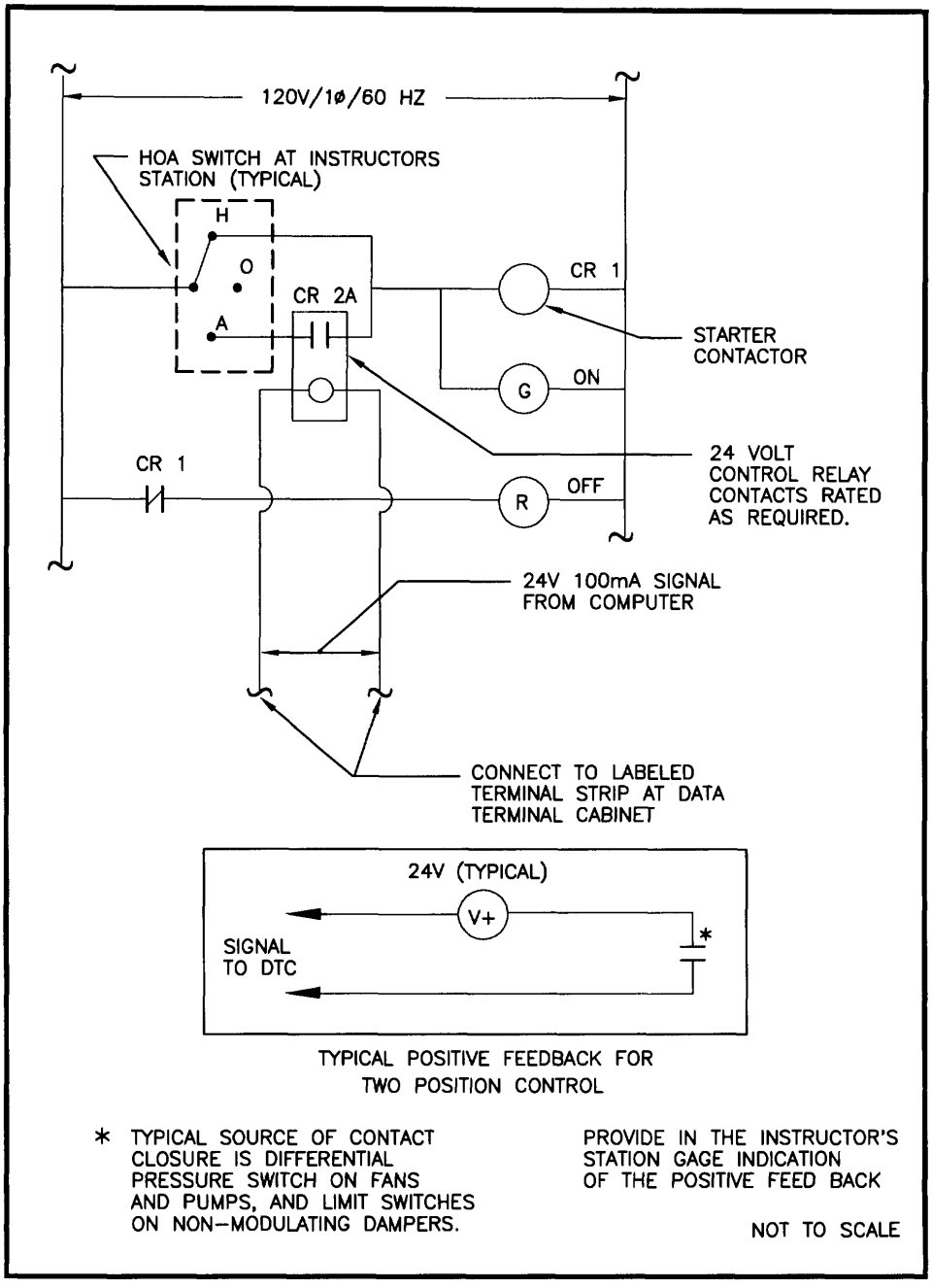


Figure A-18
Two Position Control Interface

APPENDIX A (Continued)

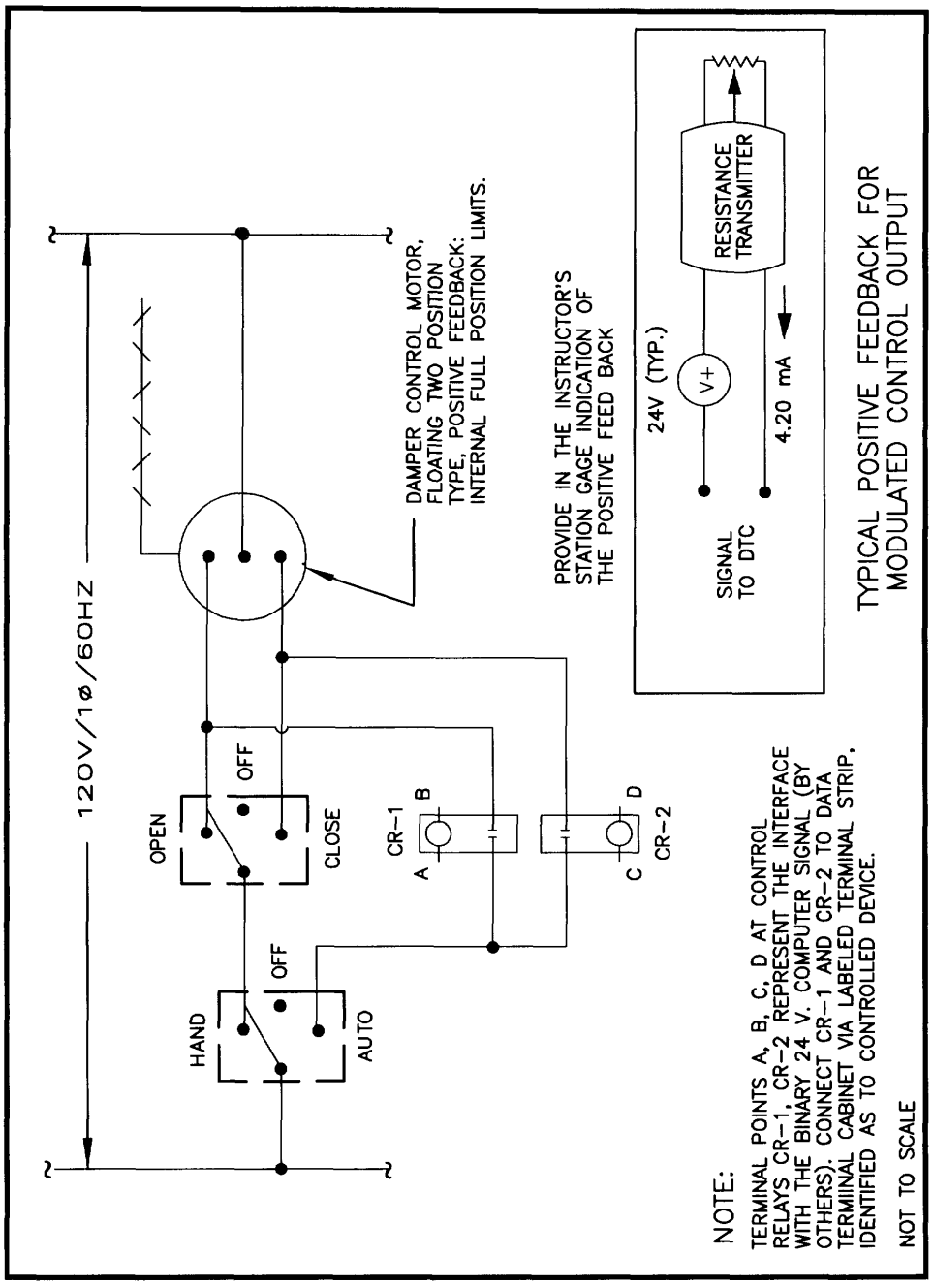


Figure A-19
Floating Point Control Interface

APPENDIX A (Continued)

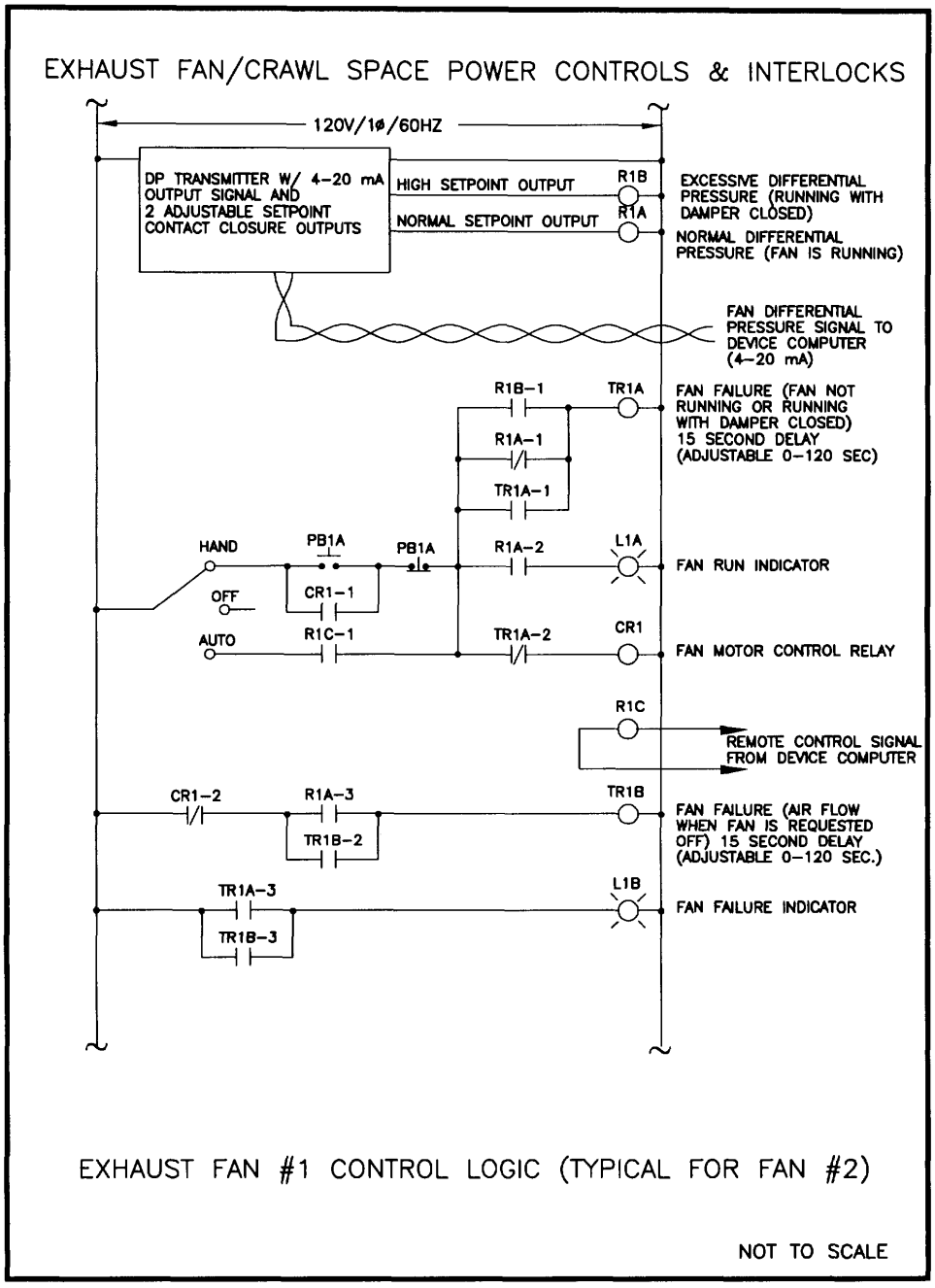


Figure A-20A
EXHAUST FAN/CRAWL SPACE
POWER CONTROLS & INTERLOCKS

APPENDIX A (Continued)

EXHAUST FAN SEQUENCE OF OPERATION:

HAND MODE: WHEN THE START PUSHBUTTON, PB1A, IS PRESSED, THE FAN CONTROL RELAY, CR1, ENERGIZES AND LATCHES IN THE CIRCUIT. AS THE FAN COMES UP TO SPEED, MINIMUM AIRFLOW DIFFERENTIAL PRESSURE IS GENERATED, ACTIVATING R1A. THIS CAUSES THE RUN INDICATOR, L1A, TO LIGHT. PRESSING THE STOP BUTTON, PB1B, UNLATCHES THE CIRCUIT WHICH DEENERGIZES THE FAN CONTROL RELAY AND RUN INDICATOR.

AUTO MODE: WHEN THE REMOTE CONTROL RELAY, R1C, IS ENERGIZED, THE FAN CONTROL RELAY, CR1, IS ALSO ENERGIZED. AS THE FAN COMES UP TO SPEED, MINIMUM AIRFLOW DIFFERENTIAL PRESSURE IS GENERATED, ACTIVATING R1A. THIS CAUSES THE RUN INDICATOR, L1A, TO LIGHT. DEENERGIZING THE DEVICE COMPUTER CONTROL RELAY RELEASES THE FAN CONTROL RELAY AND TURNS OFF THE RUN INDICATOR.

INTERLOCKS AND ALARMS (HAND AND AUTO MODES): IF NORMAL DIFFERENTIAL PRESSURE IS SENSED (FAN IS RUNNING), RELAY R1A IS ENERGIZED. EXCESSIVE DIFFERENTIAL PRESSURE (FAN RUNNING WITH DAMPER CLOSED) CAUSES R1B TO ENERGIZE. WHEN THE FAN IS COMMANDED ON AND EITHER INSUFFICIENT OR EXCESSIVE DIFFERENTIAL PRESSURE IS SENSED FOR 15 SECONDS, RELAY TR1A (TR2A) ENERGIZES AND LATCHES IN. THIS DEENERGIZES THE FAN CONTROL RELAY, CR1 AND LIGHTS THE FAN FAILURE INDICATOR, L1B. WHEN THE FAN IS COMMANDED OFF AND NORMAL DIFFERENTIAL PRESSURE IS SENSED FOR 15 SECONDS, RELAY TR1B ENERGIZES AND LATCHES IN. THIS ALSO CAUSES INDICATOR L1B TO LIGHT.

NOTES: 1. CONTROL LOGIC MAY BE IMPLEMENTED IN DISCRETE HARDWARE OR IN A SMALL PROGRAMMABLE LOGIC CONTROLLER.
2. TIMER RELAYS PROVIDE A DELAY AS NOTED AFTER POWER IS APPLIED. WHEN POWER IS REMOVED THE CONTACTS RESET IMMEDIATELY.

Figure A-20B
Exhaust Fan/Crawl Space Power Controls and Interlocks

APPENDIX A (Continued)

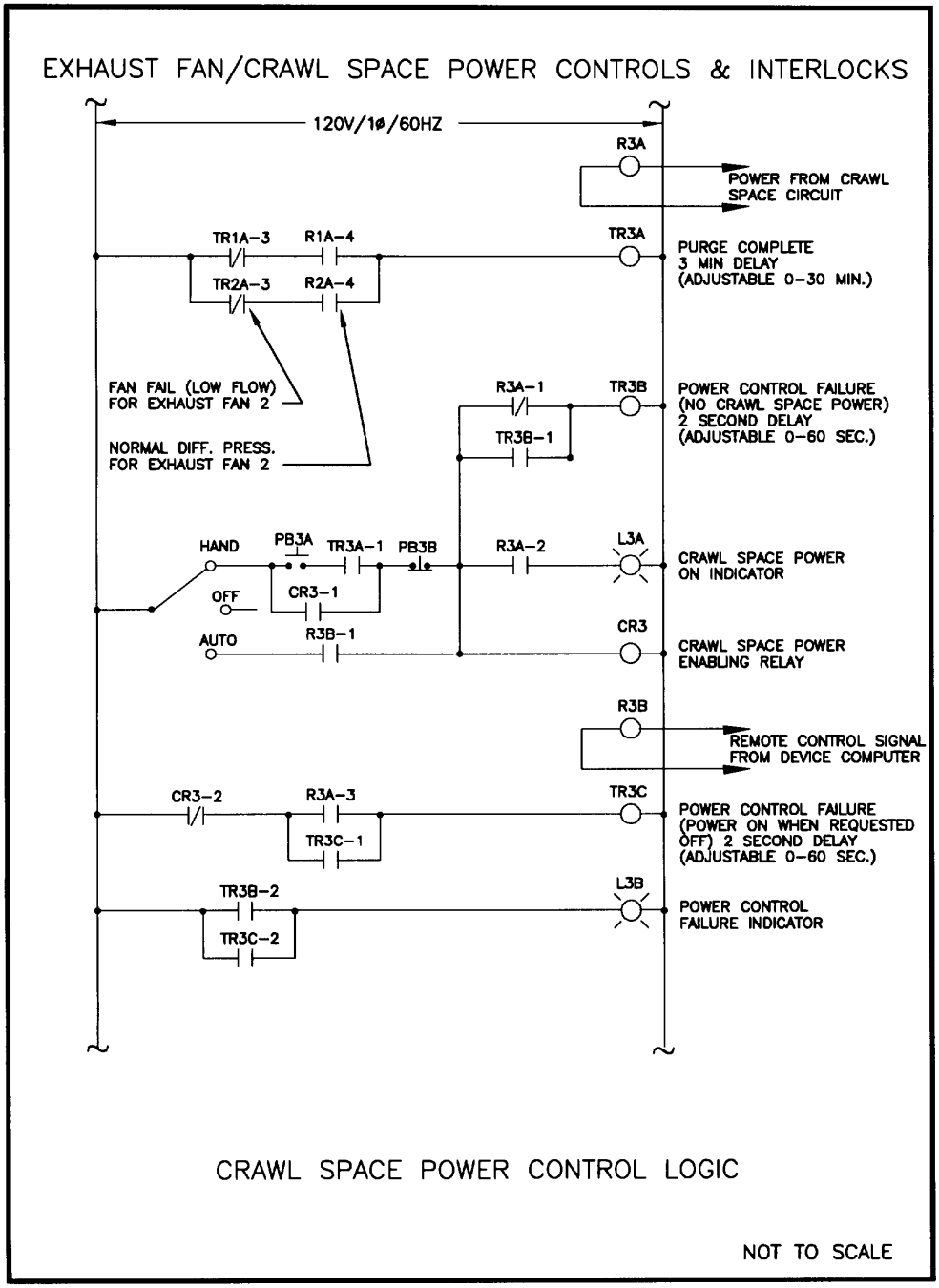


Figure A-20C
EXHAUST FAN/CRAWL SPACE
POWER CONTROLS & INTERLOCKS

APPENDIX A (Continued)

CRAWL SPACE POWER SEQUENCE OF OPERATION:

HAND MODE: WHEN EITHER FAN IS ON FOR 10 MINUTES WITHOUT A DETECTED FAILURE, THE PURGE COMPLETE RELAY, TR3A, IS ENERGIZED. WHEN THE ON PUSHBUTTON, PB3B, IS PRESSED AND TR3A IS ENERGIZED, THE CRAWL SPACE POWER RELAY, CR3, ENERGIZES AND LATCHES IN THE CIRCUIT. THIS PROVIDES POWER TO THE CRAWL SPACE, ENERGIZING RELAY R3A AND LIGHTING THE POWER INDICATOR, L3A. PRESSING THE OFF PUSHBUTTON, PB3B, UNLATCHES THE CIRCUIT WHICH DEENERGIZES THE POWER CONTROL RELAY AND POWER INDICATOR.

AUTO MODE: WHEN THE REMOTE CONTROL RELAY, R3B, IS ENERGIZED, THE FAN CONTROL RELAY, CR3, IS ALSO ENERGIZED. THIS PROVIDES POWER TO THE CRAWL SPACE, ENERGIZING RELAY R3A AND LIGHTING THE POWER INDICATOR, L3A. WHEN THE DEVICE COMPUTER CONTROL RELAY RELEASES, THE CRAWL SPACE POWER RELAY AND INDICATOR DEENERGIZE.

ALARMS (HAND AND AUTO): IF RELAY R3A DOES NOT ENERGIZE WITHIN 2 SECONDS AFTER POWER IS COMMANDED ON, POWER FAILURE RELAY TR3B ENERGIZES AND LATCHES ON. IF RELAY R3A DOES NOT DEENERGIZE WITHING 2 SECONDS AFTER POWER IS COMMANDED OFF, POWER FAILURE RELAY TR3C ENERGIZES AND LATCHES ON. WHENEVER EITHER POWER FAILURE RELAY IS COMMANDED THE POWER CONTROL FAILURE INDICATOR, L3B, LIGHTS.

NOTES: 1. CONTROL LOGIC MAY BE IMPLEMENTED IN DISCRETE HARDWARE OR IN A SMALL PROGRAMMABLE LOGIC CONTROLLER.
2. TIMER RELAYS PROVIDE A DELAY AS NOTED AFTER POWER IS APPLIED. WHEN POWER IS REMOVED THE CONTACTS RESET IMMEDIATELY.

Figure A-20D
Exhaust Fan/Crawl Space Power Controls and Interlocks

APPENDIX A (Continued)

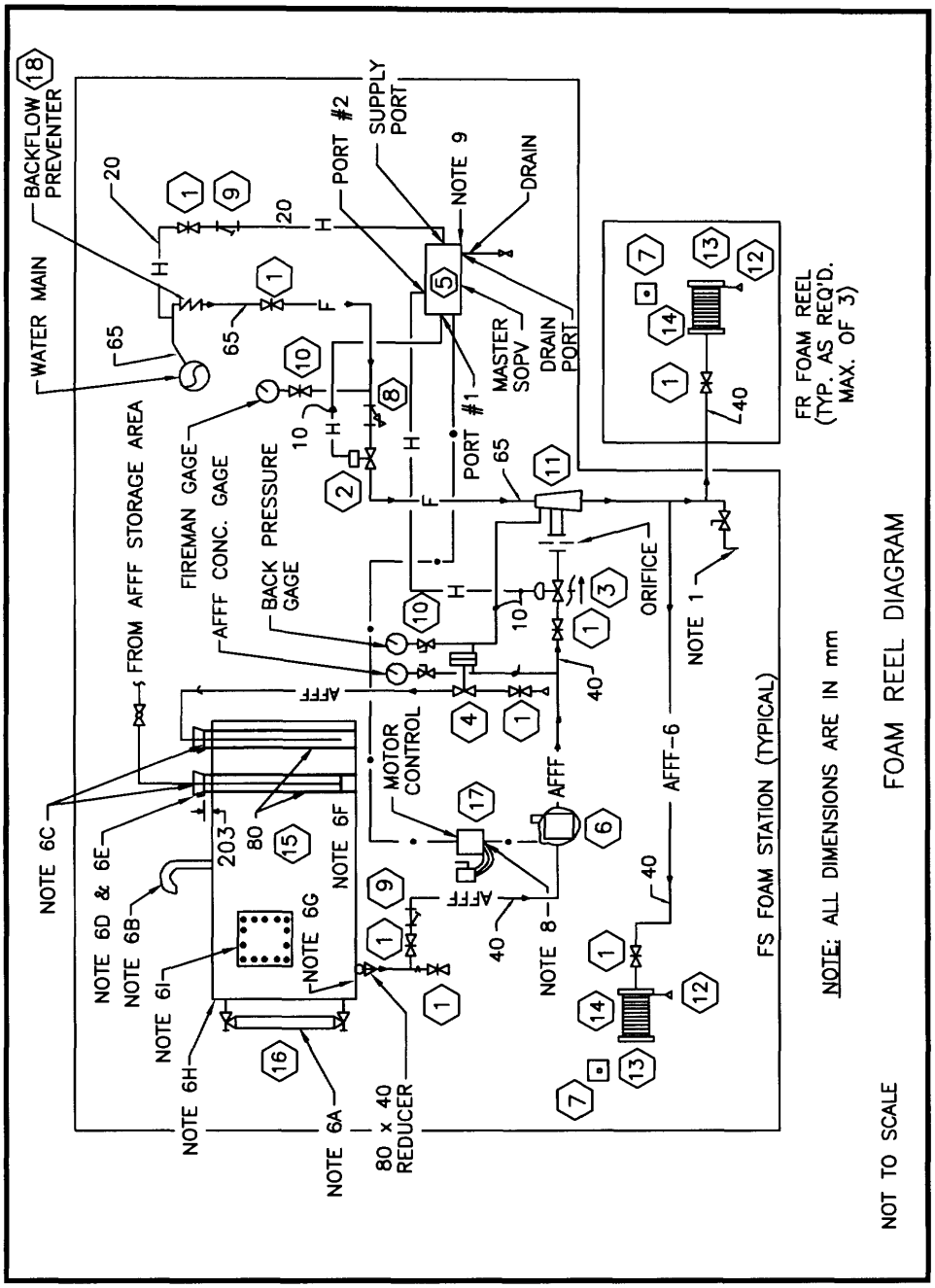


Figure A–21A
AFFF Station

AFFF STATION

EQUIPMENT IDENTIFICATION			
NO	DESCRIPTION	REFERENCE	SOURCE OF SUPPLY
1	GATE VALVE		STANDARD COMM.–2067 kPa WOG
2	WATER MAIN CONT. VALVE TO STATION (HYCHECK)	MIL–F–20042	CLAVAL MOD. 18M–EP/181M–EPKH
3	AFFF CONCENTRATE DISCHARGE CONT. VALVE (POWER CHECK)	MIL–F–20042	CLAVAL MOD. 181PM–EP
4	BACK PRESS. REGULATING VALVE	MIL– ~~V–18030~~ ~~P–24339~~	FEECON PART 00875040
5	MASTER SOPV (SOL OPERATED PILOT VALVE)	MIL–V–15508	CLAVAL MODEL CSM5M–3A
6	PUMP (2.2 L/s @ 1378 kPa HEAD)	MIL–P–19131	BLACKMER PUMP MODEL BXL–11/4
7	PUSHBOTTON STATION		STANDARD COMM.(RAINTIGHT)
8	MARINE FIRE MAIN STRAINER		STANDARD COMM.–2067 kPa WOG
9	STRAINER		STANDARD COMM.–2–67 kPa WOG
10	PRESSURE GAUGE (0–2067 kPa)		STANDARD COMM.
11	FLOW PROPORTIONER	MIL–P–24589	FEECON PART 00897750
12	FOAM NOZZLE SINGLE AGENT 6 L/s	MIL–N–24480 TYPE1	AKRON BRASS STYLE 3019
13	HOSE REEL SINGLE AGENT	MIL–R–24414	AERO–MOTIVE MFG CO. MODEL NL20M
14	HOSE SOFT HARD RUBBER	MIL–H–24580	STANDARD COMM.
15	AFFF CONCENTRATE TANK		SEE NOTE 3 & 6
16	SIGHT GLASS W/GLASS GUARD		STANDARD COMM.–2067 kPa WOG
17	MOTOR CONTROLLER		CONTRACTOR FIELD FABRICATED
18	BACKFLOW PREVENTER		STANDARD COMM.

SYMBOL	DESCRIPTION
F	1206 kPa WATER MAIN
H	HYDRAULIC CONTROL SYSTEM
AFFF	AFFF CONCENTRATE
AFFF–6	6% FOAM–WATER SOLUTION
	GATE VALVE W/LOCKING PIN
	STRAINER
	PET COCK.
	POWER/CONTROL WIRING
	REMOTE CONTROL VALVE HYDRAULIC OPER. DIAPHRAM TYPE. CONTROL LINE PRESS. TO CLOSE. WITH (NYCECK CONF.)
	PRESSURE GAUGE W/GAUGE COCK
	MARINE FIRE MAIN STRAINER
	GLOBE VALVE

NOT TO SCALE

Figure A–21B
AFFF Station

APPENDIX A (Continued)

NOTES:

1. LOCATE SAMPLE COCK SO IT CAN FILL A 19 L AFFF CAN.

2. ALL PIPES SHOULD BE PIPED TO ALLOW DRAINING FOR FREEZE PROTECTION. PROVIDE DRAINS AT LOW POINTS.

3. TANK SIZE: 19F1A-303 L
19F3-B1-303 L
19F3-B3-379 L
19F3-B4-379 L
19F3A -379 L
19F5 -379 L

4. SOURCE OF SUPPLY IS THE REQUIRED SOURCE OF SUPPLY.

5. PAINT WATER PIPING RED AFFF CONCENTRATE PIPING GREEN, 6% AFFF PIPING RED AND GREEN STRIPED, EXCEPT AT FOAM STATION WHERE ONLY THE VALVE HANDLES SHOULD BE COLOR CODED.

6. THE TANK SHOULD HAVE:

(A) AN EXTERNALLY MOUNTED LIQUID LEVEL INDICATOR ASSEMBLY PROTECTED FROM BREAKAGE BY AN EXPANDED METAL CASE.

(B) A GOOSENECK PIPE VENT 25 MM IN DIAMETER.

(C) TWO 200 MM INSIDE DIAMETER TANK FILL FUNNEL TAPERING TO 80 MM DIAMETER WITH A FLANGED TOP RIM BOLTED INTO A 80 MM TALL BOSS ON THE TANK TOP. PROVIDE 80 MM STAINLESS STEEL PIPE SCREENS, RUN PIPING TO 80 MM ABOVE TANK BOTTOM.

(D) A FUNNEL TOP THREADED TO RECEIVE A SCREW-IN FUNNEL COVER REQUIRING NO MORE THAN THREE TURNS TO REMOVE/REPLACE.

(E) A FUNNEL COVER FITTED WITH 102 MM WIDE U-SHAPED HANDLE TO FACILITATE USE.

(F) A 80 MM PIPE EXTENDING FROM THE FUNNEL BOTTOM TO WITHIN 51 MM OF THE TANK BOTTOM.

Figure A-21C
AFFF Station

APPENDIX A (Continued)

NOTES (Continued):

(G) A PUMP SUCTION CONNECTION WITH A WELDING REDUCER HAVING ITS LARGER END WELDED FLUSH WITH THE BOTTOM OF THE TANK. THE INLET AREA HAVING NOTES APPROXIMATELY FOUR TIMES THE FLOW AREA OF THE SUCTION PIPING.

(H) TANK SHOULD BE CONSTRUCTED OF STAINLESS STEEL (SS 316).

(I) A BOLTED ACCESS PLATE WITH GASKET IN THE TANK SIDE TO ALLOW A MINIMUM OF 305 MM CLEARANCE FOR CLEANING.

7. TRAINER REQUIREMENTS:

19F1A HAS 1 FOAM STATION SERVING 2 FOAM REELS
19F3-B1 HAS 1 FOAM STATION SERVING 2 FOAM REELS
19F3-B3 HAS 1 FOAM STATION SERVING 1 FOAM REEL
19F3-B4 HAS 1 FOAM STATION SERVING 1 FOAM REEL 19F3A HAS 1 FOAM STATION SERVING 3 FOAM REELS (USE OF STD. COMM. FOAM PROPORTIONING EQUIPMENT WITH 4 FOAM REELS IS APPROVED).

8. MOTOR CONTROLLER: (NEMA 4 ENCLOSURE)

(A) SEE SHEET 4 FOR PHYSICAL REQUIREMENTS

(B) SWITCHES SHOULD BE APPROVED FOR WET LOCATIONS

9. MASTER SOPV

(A) USE 480 V SOLENOIDS

10. AFFF PIPING, VALVES AND FITTINGS SHOULD BE STAINLESS STEEL OR COPPER.

11. PUMP IS BLACKMER PUMP MODEL BXL-1-1/4 (MFG. DWG. NO. E-4638) WITH STD. ELECTRIC MOTOR (7-1/2 HP, TOTAL ENCLOSED FAN COOLED).

12. PROVIDE VIBRATION ISOLATORS FOR AFFF STATION SUPPORTS.

Figure A-21D
AFFF Station

APPENDIX A (Continued)

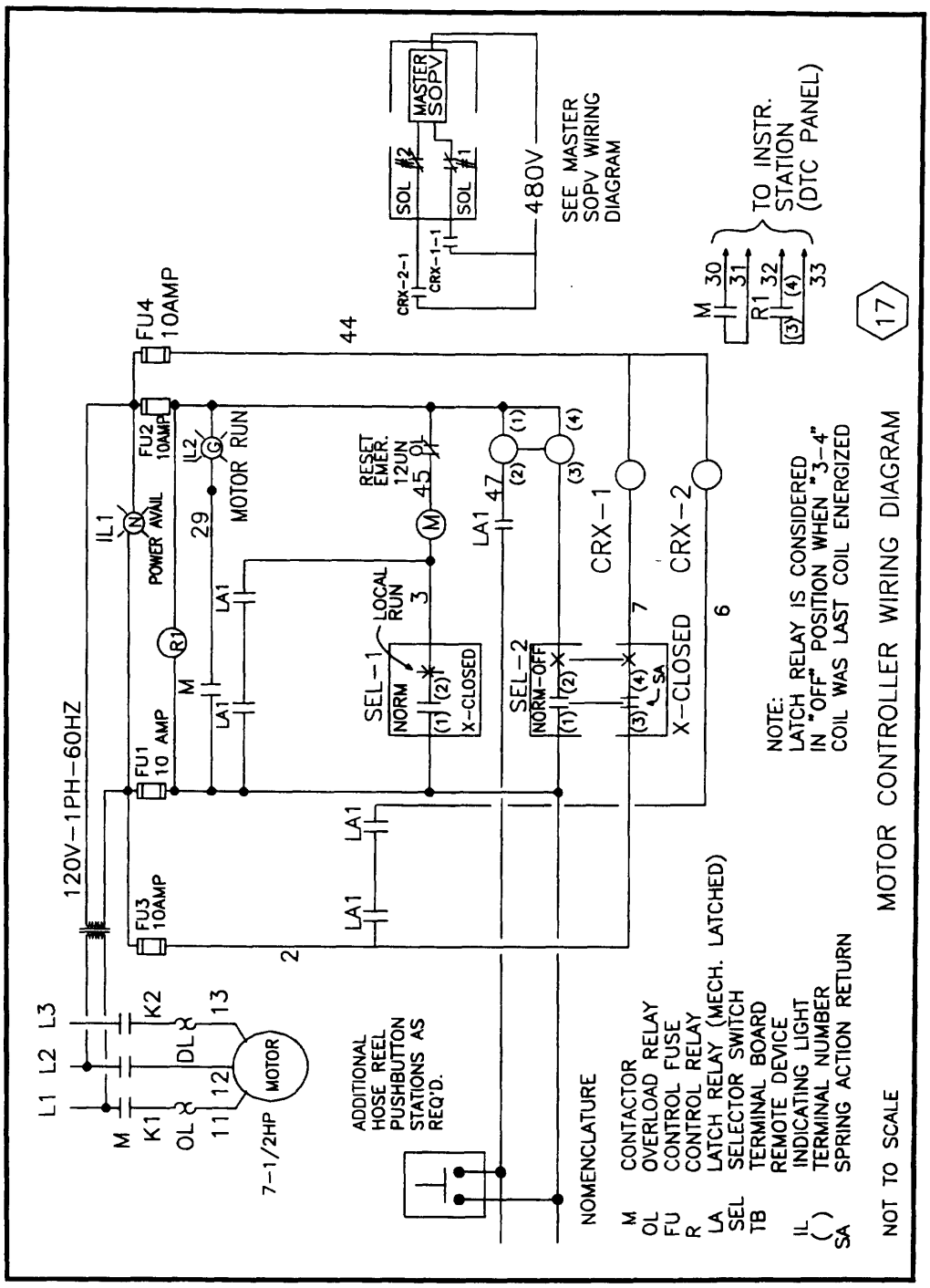


Figure A-21E
AFFF Station

APPENDIX A (Continued)

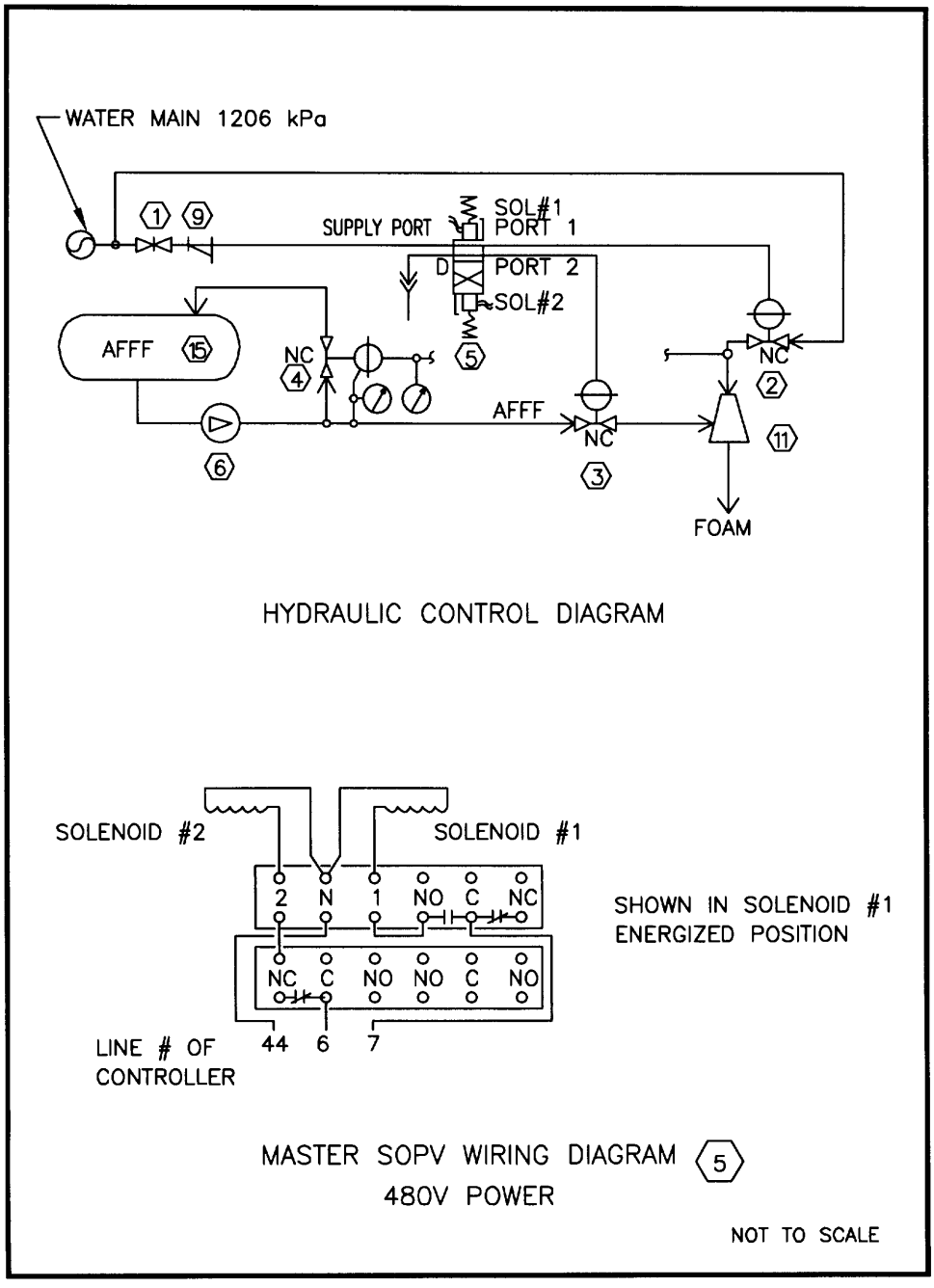


Figure A–21F
AFFF Station

APPENDIX A (Continued)

SEQUENCE OF OPERATION:

1. SUPPLY POWER TO MOTOR CONTROLLER CONTROL TRANSFORMER. THE WHITE POWER AVAILABLE LIGHT (IL 1) IS LIT. BOTH SELECTOR SWITCH ONE (SEL 1) AND SELECTOR SWITCH TWO (SEL 2) ARE IN "NORMAL" POSITION AND BOTH AFFF CONCENTRATE AND BACK PRESSURE GAGES SHOW NO PRESSURE.

2. IN NORMAL MODE BOTH SEL 1 AND SEL 2 SHOULD BE IN "NORMAL" POSITION, MASTER SOPV CONNECTS SUPPLY PORT TO PORT #2 WHICH SUPPLIES PRESSURE TO (2) WATER CONTROL VALVE (PRESSURE TO CLOSE) AND CONNECTS DRAIN PORT TO PORT #1 WHICH RELIEVES PRESSURE TO (3) AFFF CONCENTRATE DISCHARGE CONTROL VALVE (RELIEF TO CLOSE). (4) BACK PRESSURE REGULATING VALVE IS IN FULL RECIRCULATING MODE TO AFFF TANK.

3. TO START PUMP

A. LOCAL OPERATING MODE: PLACE "NORMAL/LOCAL RUN" SWITCH (SEL 1) IN THE LOCAL RUN POSITION THE PUMP WILL START AND GREEN MOTOR RUN LIGHT (IL 2) ON THE CONTROLLER IS LIT.

B. REMOTE OPERATING MODE ((7) HOSE STATION PUSHBUTTON): MOMENTARILY PUSH HOSE REEL PUSHBUTTON. THE PUMP WILL START AND GREEN MOTOR RUN LIGHT (IL 2) ON THE CONTROLLER IS LIT. IN ORDER TO ENERGIZE SOLENOID #2, MOMENTARILY PRESS THE PUSHBUTTON. THE PURPOSE OF THE LOCAL MODE IS TO ALLOW THE AFFF PUMPS TO RUN, READY FOR ACTION, WITHOUT INJECTING FOAM INTO THE WATER MAIN. WHEN THE FOAM REEL STATIONS ARE READY FOR FOAM, THE TRAINEE PRESSES THE REMOTE PUSHBUTTON.

4. WHEN PUMP IS RUNNING, THE MOTOR CONTROLLER ENERGIZES SOLENOID #2 OF THE (5) MASTER SOPV, WHICH CONNECTS SUPPLY PORT TO PORT #1 WHICH SUPPLIES PRESSURE TO (3) AFFF CONCENTRATE CONTROL VALVE WHICH GOES TO FULL OPEN POSITION AND CONNECTS DRAIN PORT TO PORT #2 WHICH RELIEVES PRESSURE TO (2) WATER CONTROL VALVE WHICH GOES TO FULL OPEN POSITION. SOLENOID #2 IS DEENERGIZED AT THE END OF ITS STROKE.

5. THE (4) BACK PRESSURE REGULATING VALVE SHOULD SELF REGULATE SO THAT THE PRESSURE OF THE AFFF CONCENTRATE IS EQUAL TO THE WATER AT THE FLOW PROPORTIONER.

Figure A-21G
AFFF Station

APPENDIX A (Continued)

SEQUENCE OF OPERATION (CONTINUED):

6. TO STOP PUMP

A. LOCAL OPERATING MODE:

(1) PLACE "NORMAL/LOCAL RUN" SWITCH (SEL 1) TO "NORMAL" POSITION.

(2) MOMENTARILY PLACE "NORMAL/OFF" SWITCH (SEL 2) TO "OFF" POSITION. TO ENERGIZE SOLENOID #1 TO CLOSE (3) AFFF CONCENTRATE VALVE AND (2) WATER CONTROL VALVE, AND RESET LATCH RELAY.

B. REMOTE OPERATING MODE:

(1) MOMENTARILY PLACE "NORMAL/OFF" SWITCH TO "OFF" POSITION TO ENERGIZE SOLENOID #1 TO CLOSE (3) AFFF CONCENTRATE VALVE AND (2) WATER CONTROL VALVE AND RESET LATCH RELAY.

Figure A-21H
AFFF Station

APPENDIX A (Continued)

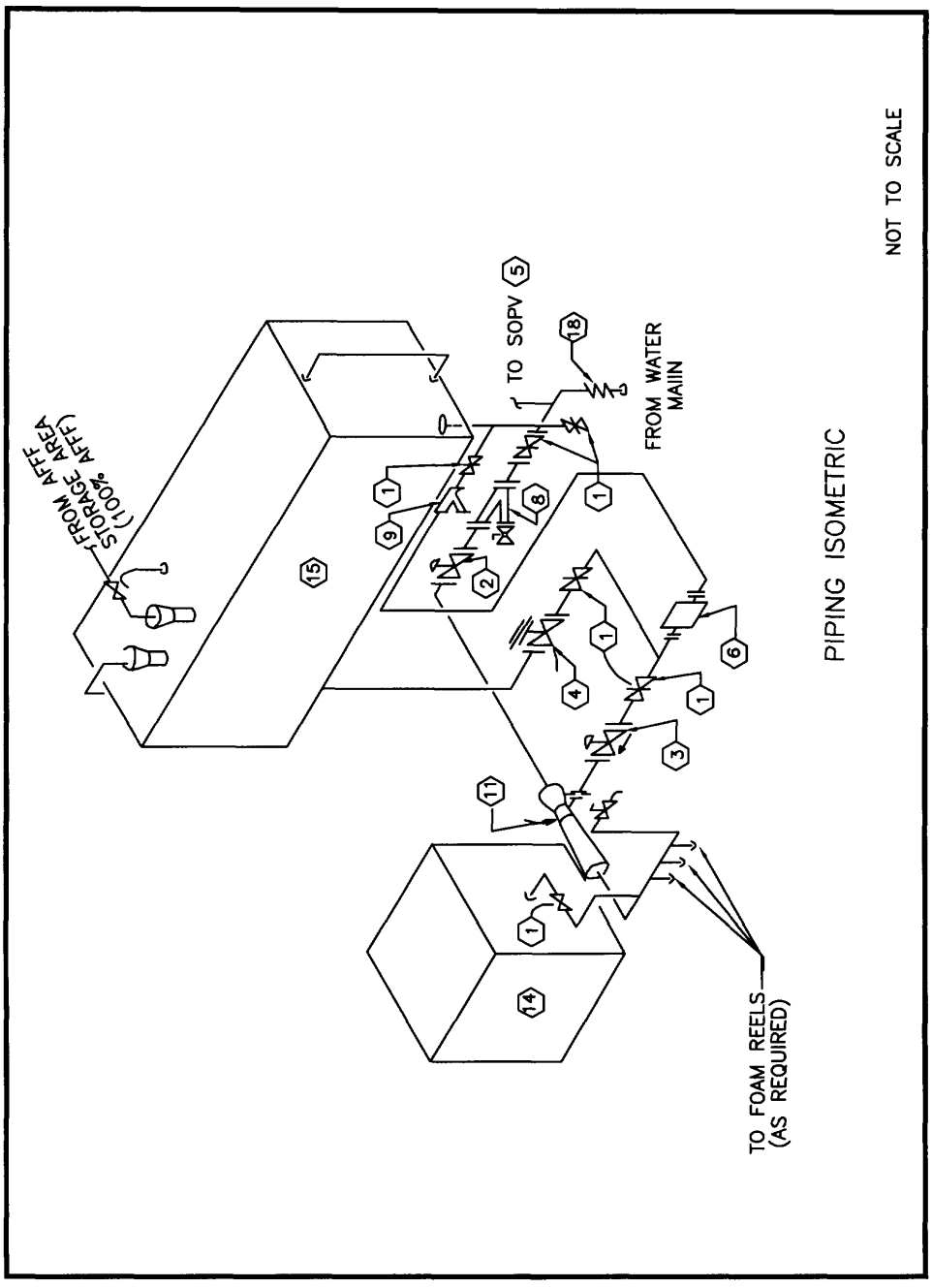


Figure A-21I
AFFF Station

APPENDIX A (Continued)

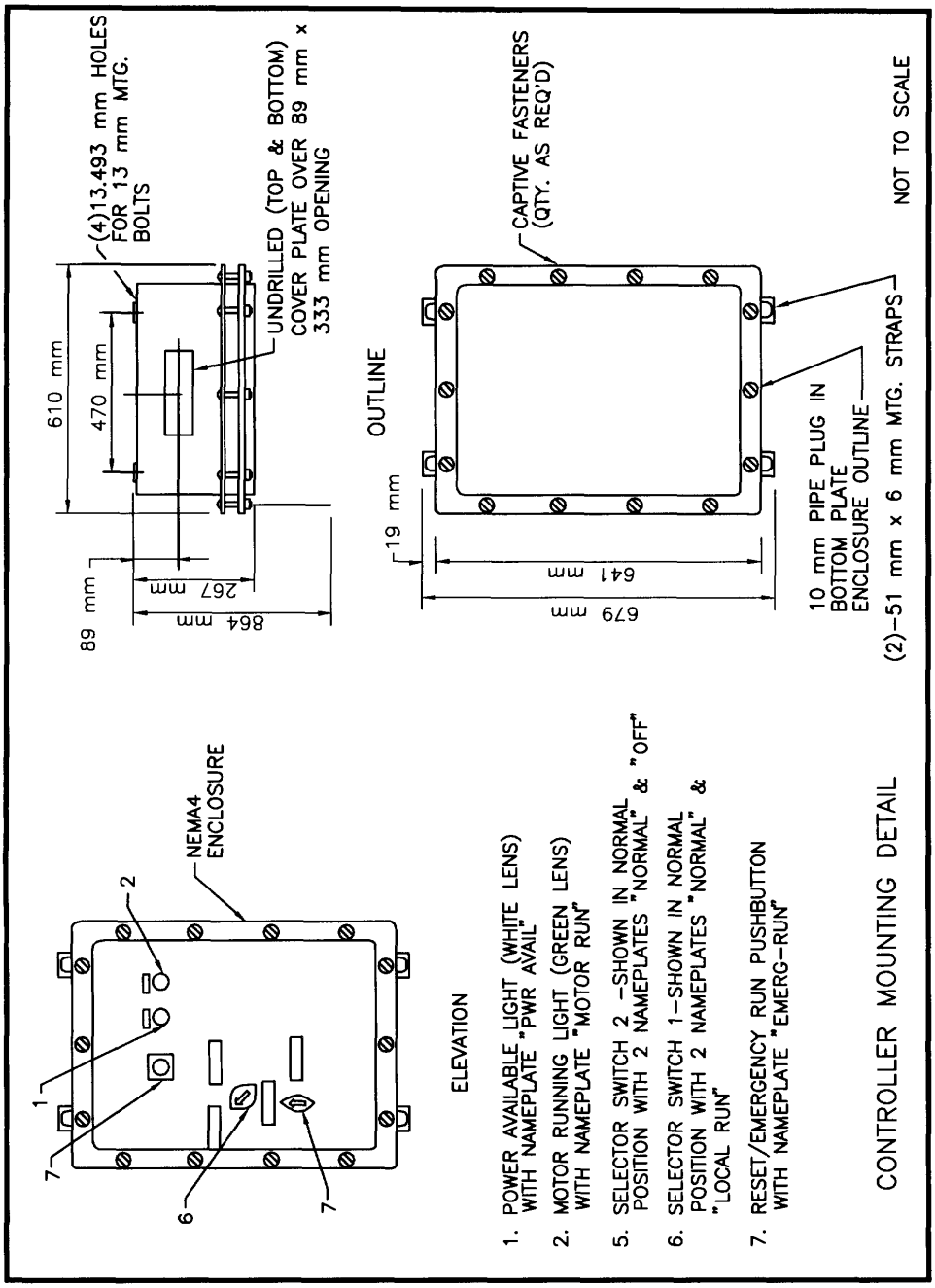
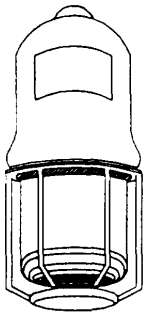


Figure A–21J
AFFF Station

APPENDIX A (Continued)



TYPE 1 & 2

LUMINAIRE REQUIREMENTS

1. LUMINAIRE SHALL MEET U.L. 844 OR FACTORY MUTUAL (FM) STANDARD FOR HAZARDOUS LOCATIONS.

2. LUMINAIRE SHALL MEET U.L. 595 FOR MARINE LOCATIONS.

3. HOUSING SHALL BE COPPER FREE CAST ALUMINUM WITH LACQUER OR EPOXY FINISH.

4. ALL JOINTS SHALL BE OF THE THREADED TYPE.

5. HEAT AND IMPACT RESISTANT PRESTRESSED GLASS GLOBE.

6. PROVIDE GLOBE GUARD INDICATED.

7. PROVIDE LAMPS AS INDICATED.

8. MOUNTING AS INDICATED.

9. PROVIDE INTERNAL GREEN GROUNDING SCREW.

TYPE 1 TWO 9 WATT COMPACT FLURESCENT LUMINIRES RATED FOR CLASS 1 DIVISION 2 GRUOP D ATOSHPHERE.

TYPE 2 70-250WATT HPS OR 175-400 WATT MET. HALIDE LUMINAIRE RATED FOR CLASS 1 DIVISON 2 GROUP D ATOSHPHERE.

Figure A-22

Luminaire, Type 1 & 2

APPENDIX B
19F1A AND 19F1B STRUCTURES

19F1A/19F1B	Isometric	B-1
19F1A/19F1B	Staging Area Plan	B-2
19F1A/19F1B	Second Floor Plan	B-3
19F1A/19F1B	First Floor Plan	B-4
19F1A/19F1B	Sections	B-5

APPENDIX B (Continued)

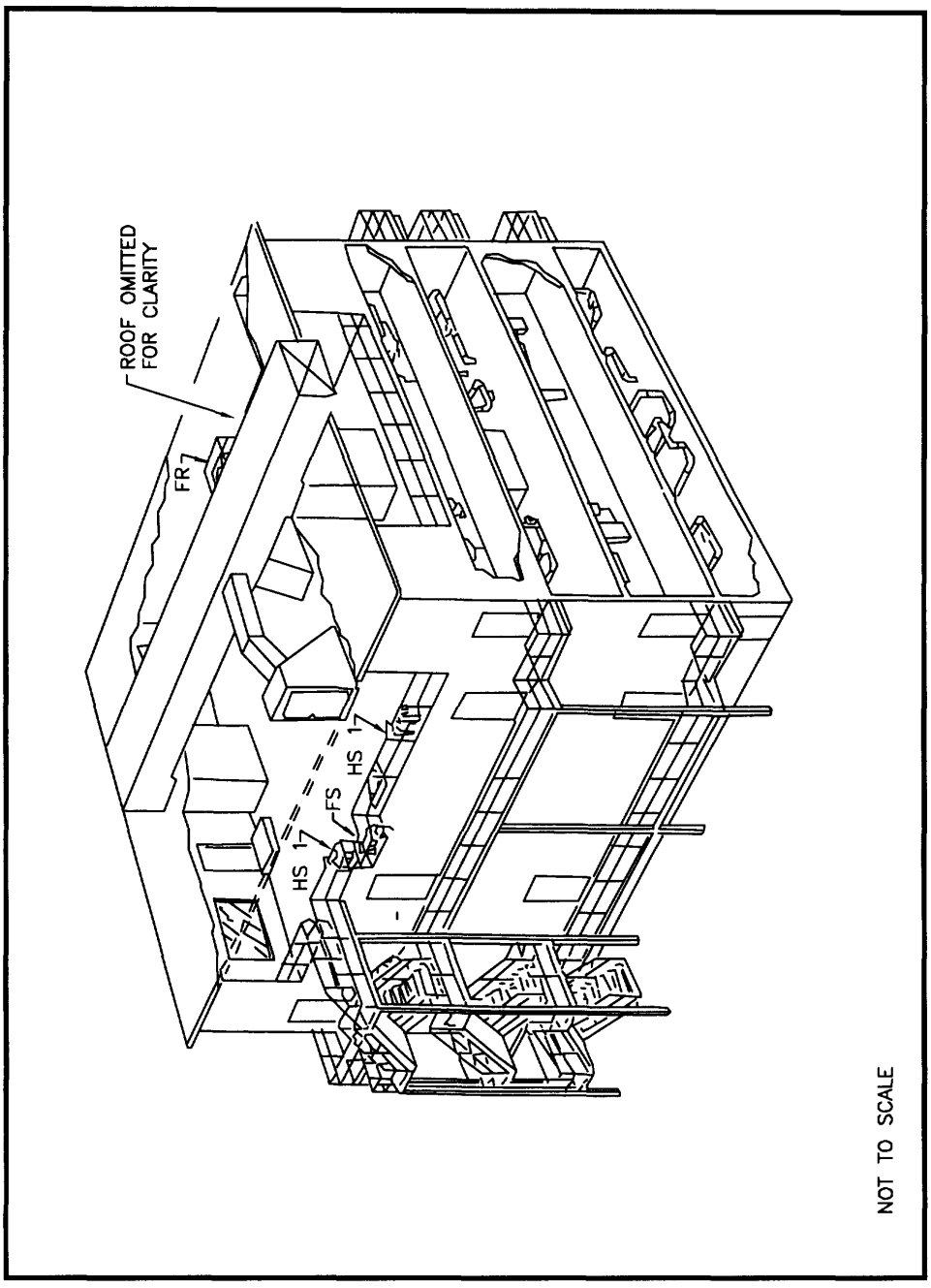


Figure B-1
19F1A/19F1B Isometric

APPENDIX B (Continued)

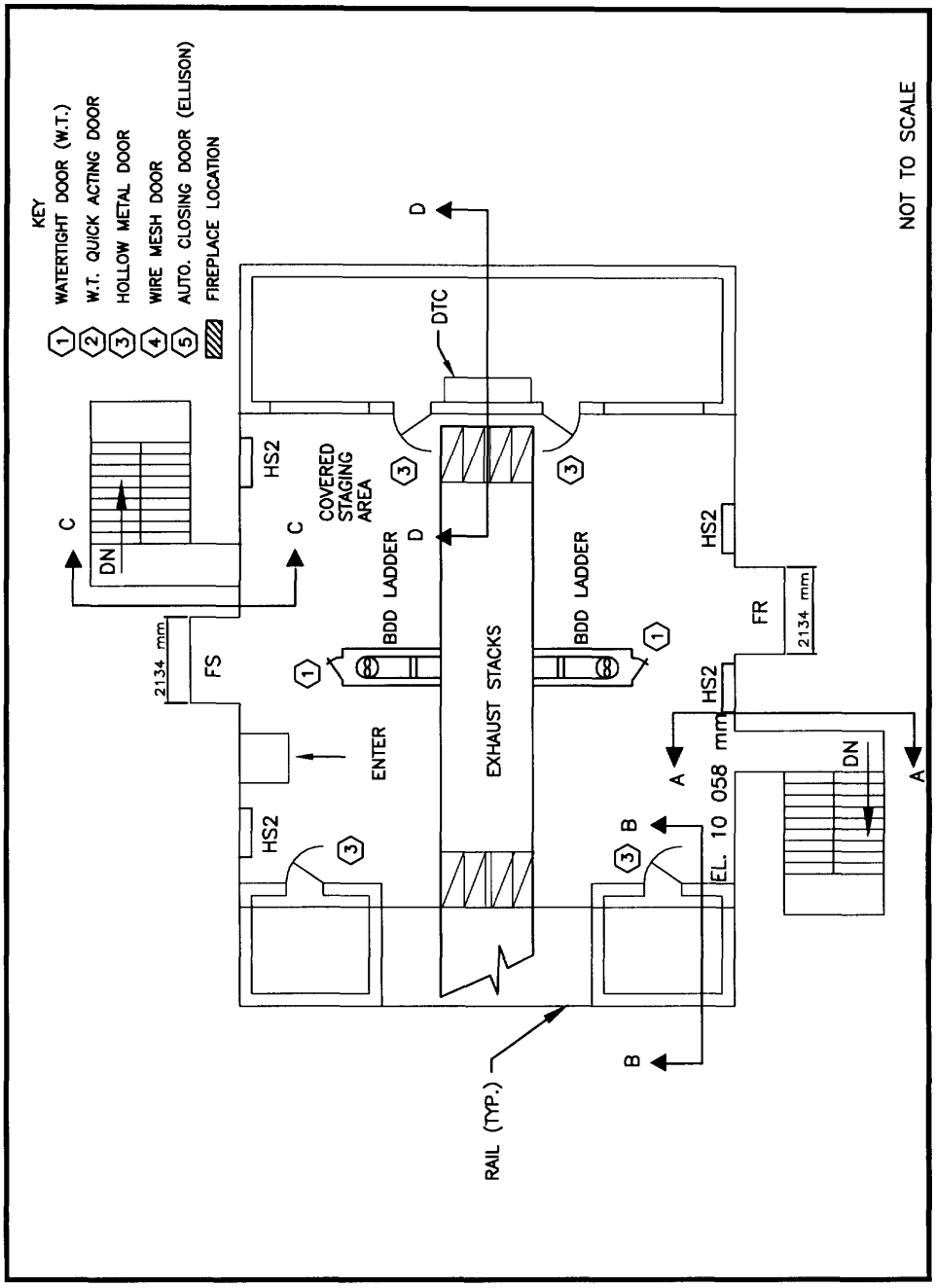


Figure B–2
19F1A/19F1B Staging Area Plan

APPENDIX B (Continued)

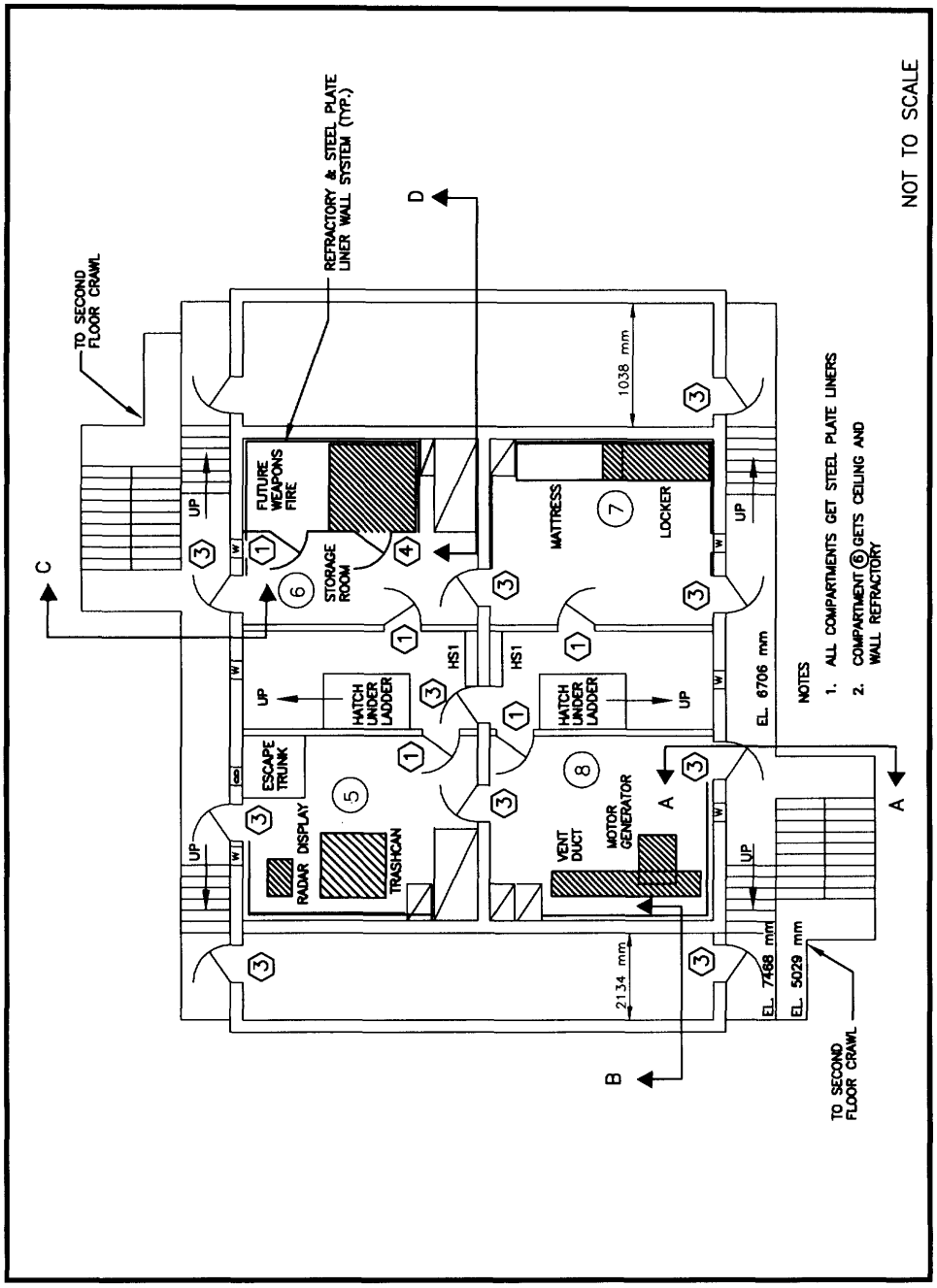


Figure B–3
19F1A/19F1B Second Floor Plan

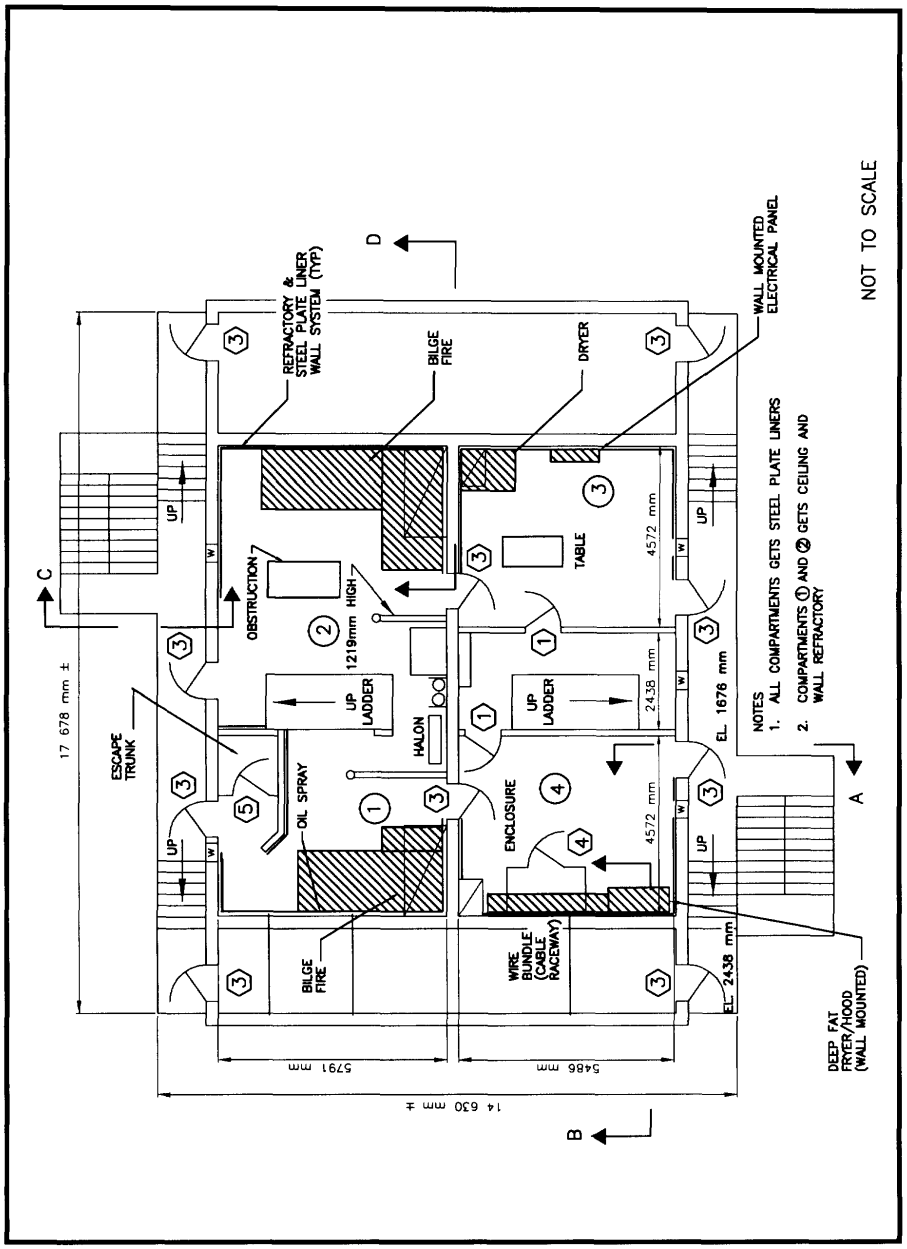


Figure B–4
19F1A/19F1B First Floor Plan

APPENDIX B (Continued)

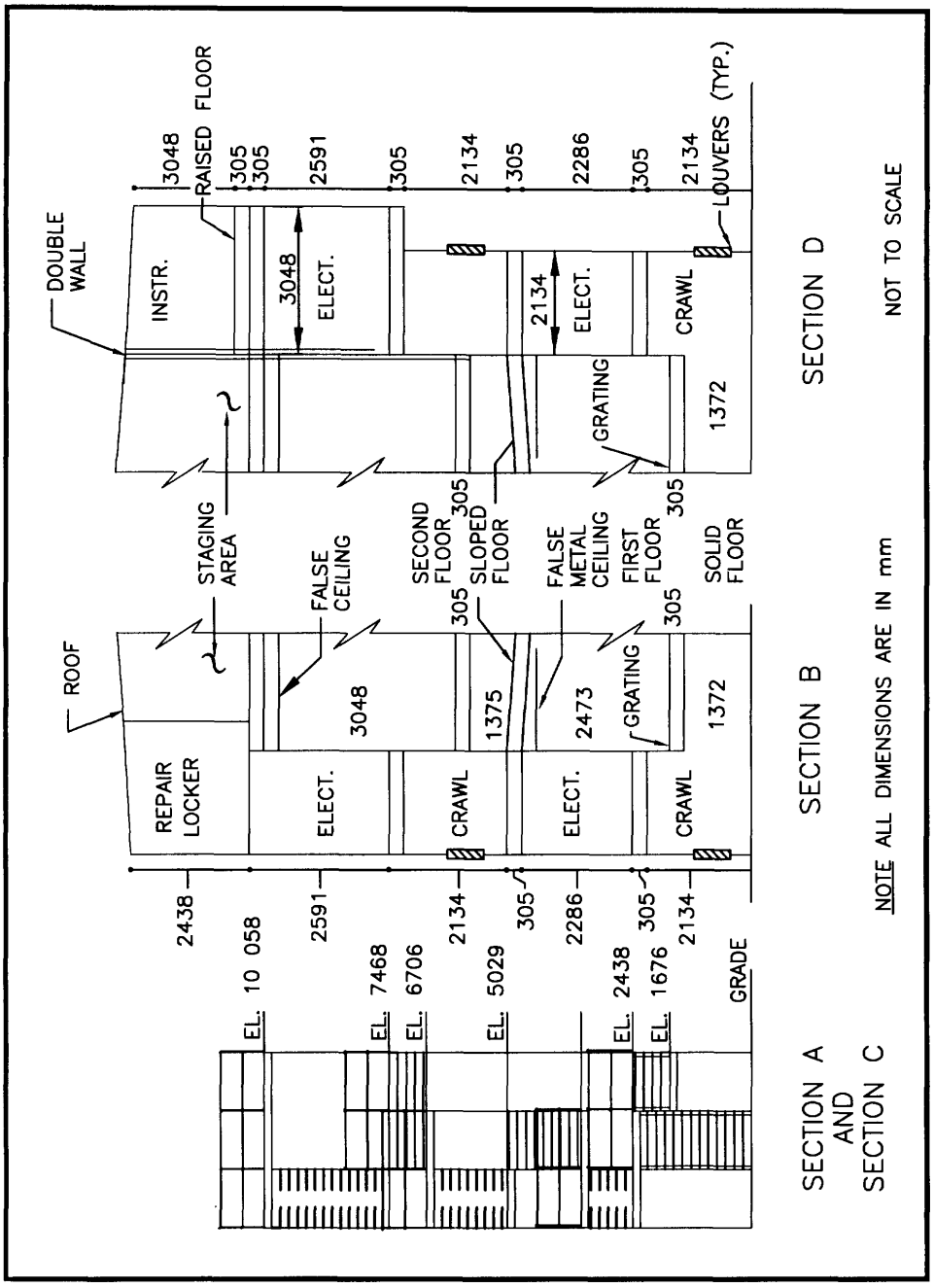


Figure B–5
19F1A/19F1B Sections

APPENDIX C
19F3 AND 19F3B STRUCTURES

19F3/19F3B	B1 Bilge Fire Building Roof Plan	C-1
19F3/19F3B	B1 First Floor Plan	C-2
19F3/19F3B	Galley/Berthing Building, B2, First Floor Plan	C-3
19F3/19F3B	Pit Fire Building, B3 and B4, First Floor Plan	C-4
19F3/19F3B	B1 Sections	C-5
19F3/19F3B	B2 Section	C-6
19F3/19F3B	B3/B4 Section	C-7

APPENDIX C (Continued)

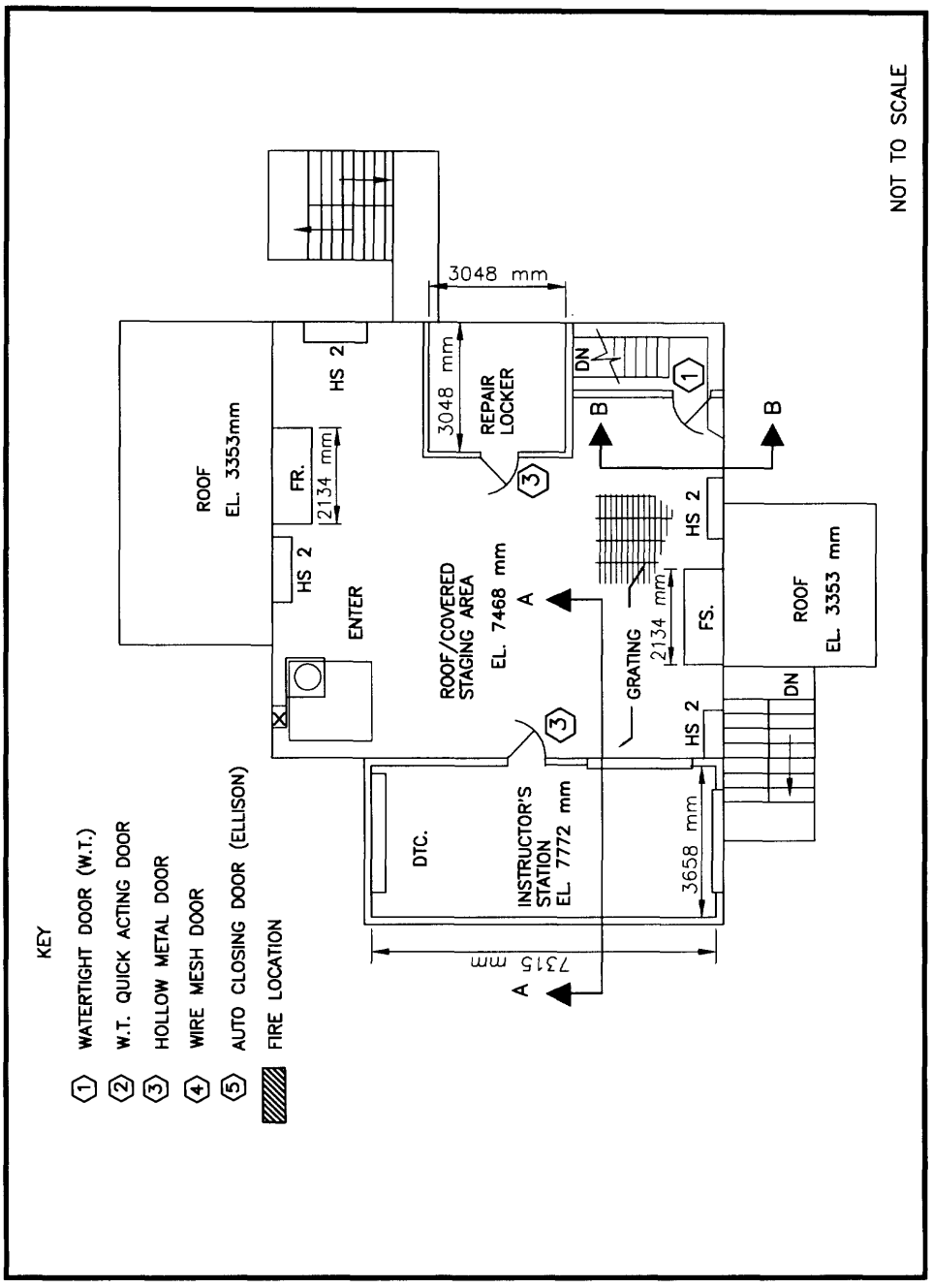


Figure C–1

19F3/19F3B B–1 Bilge Fire Building Roof Plan

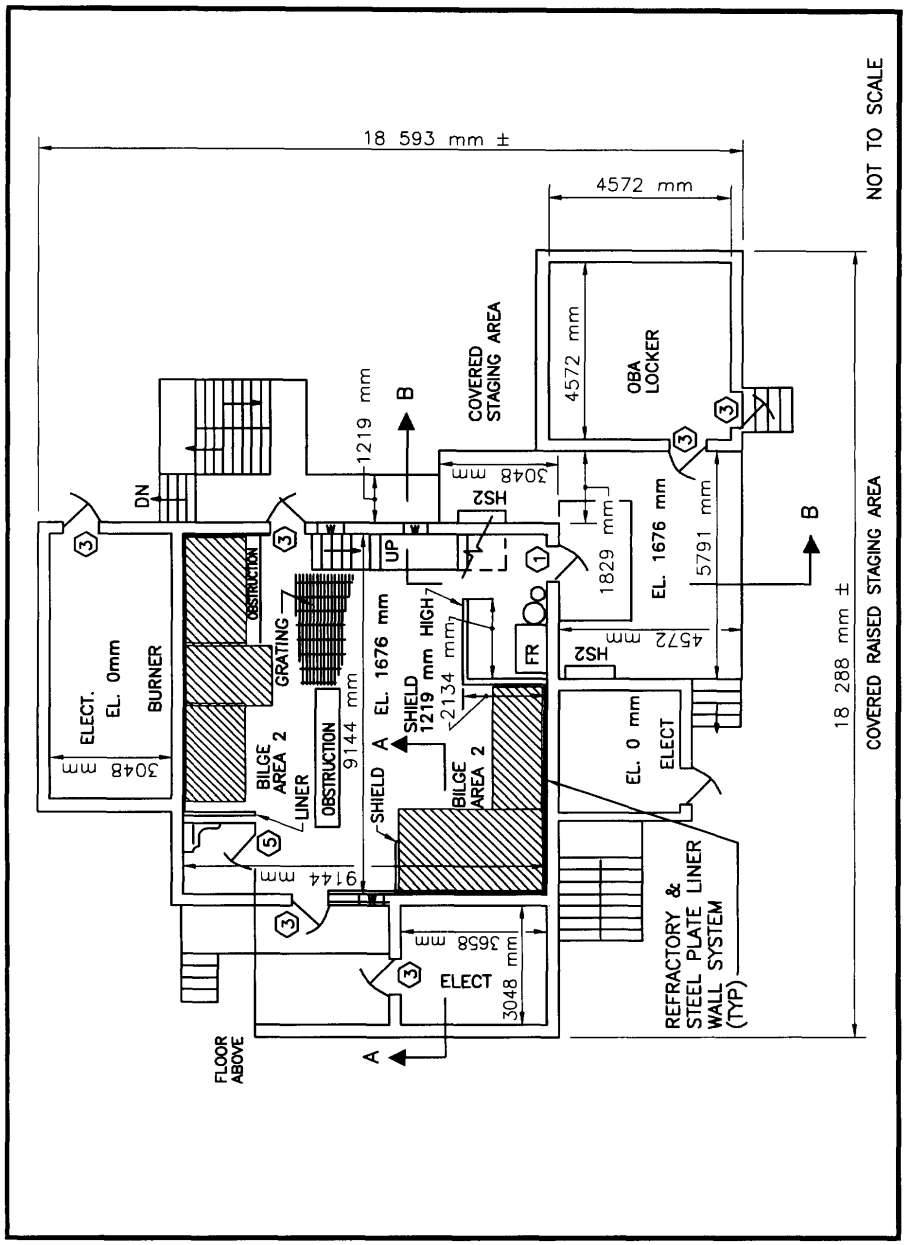


Figure C–2
19F3/19F3B B–1 First Floor Plan

APPENDIX C (Continued)

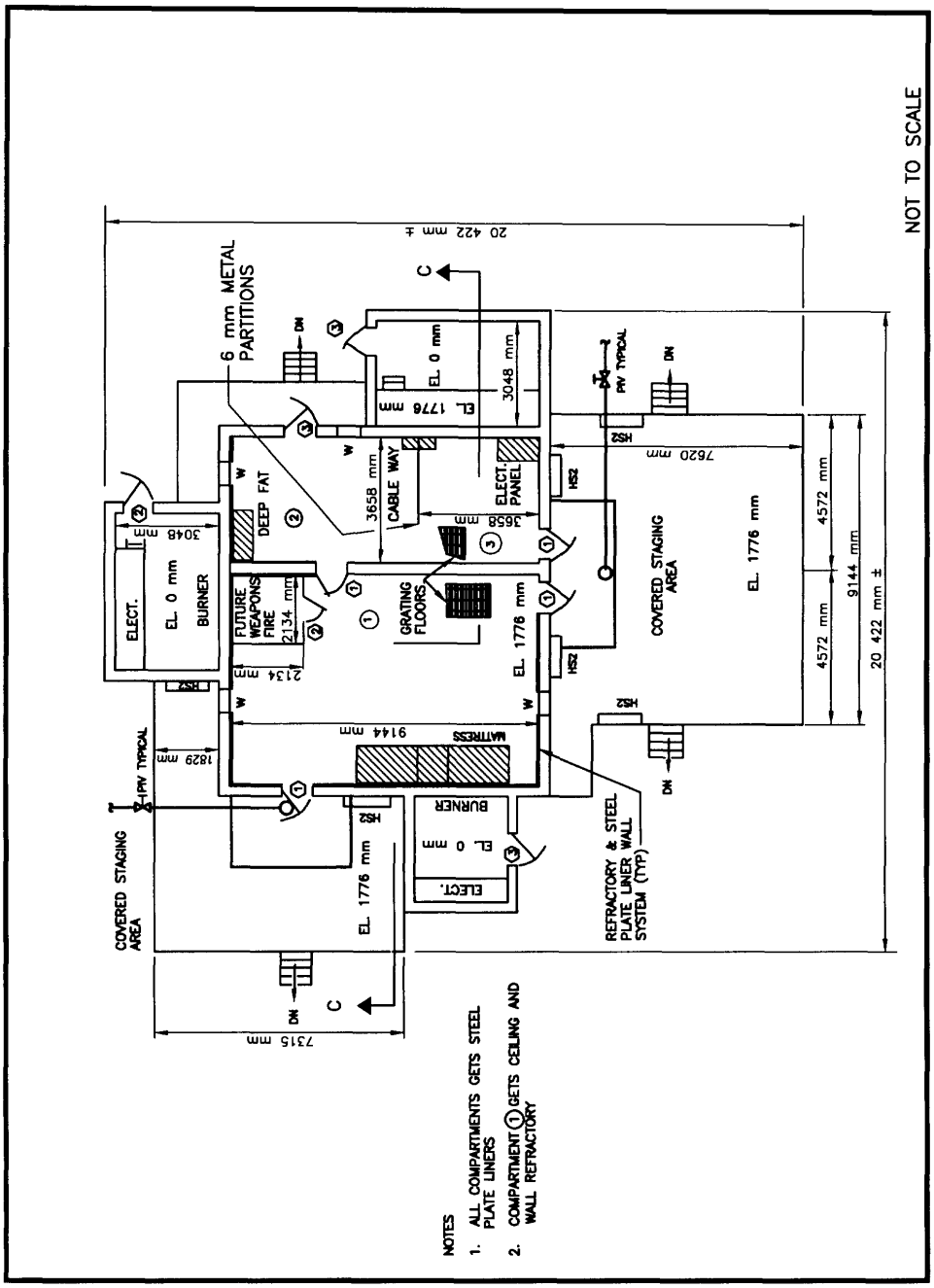


Figure C–3

19F3/19F3B Galley/Berthing Building B2 First Floor Plan

APPENDIX C (Continued)

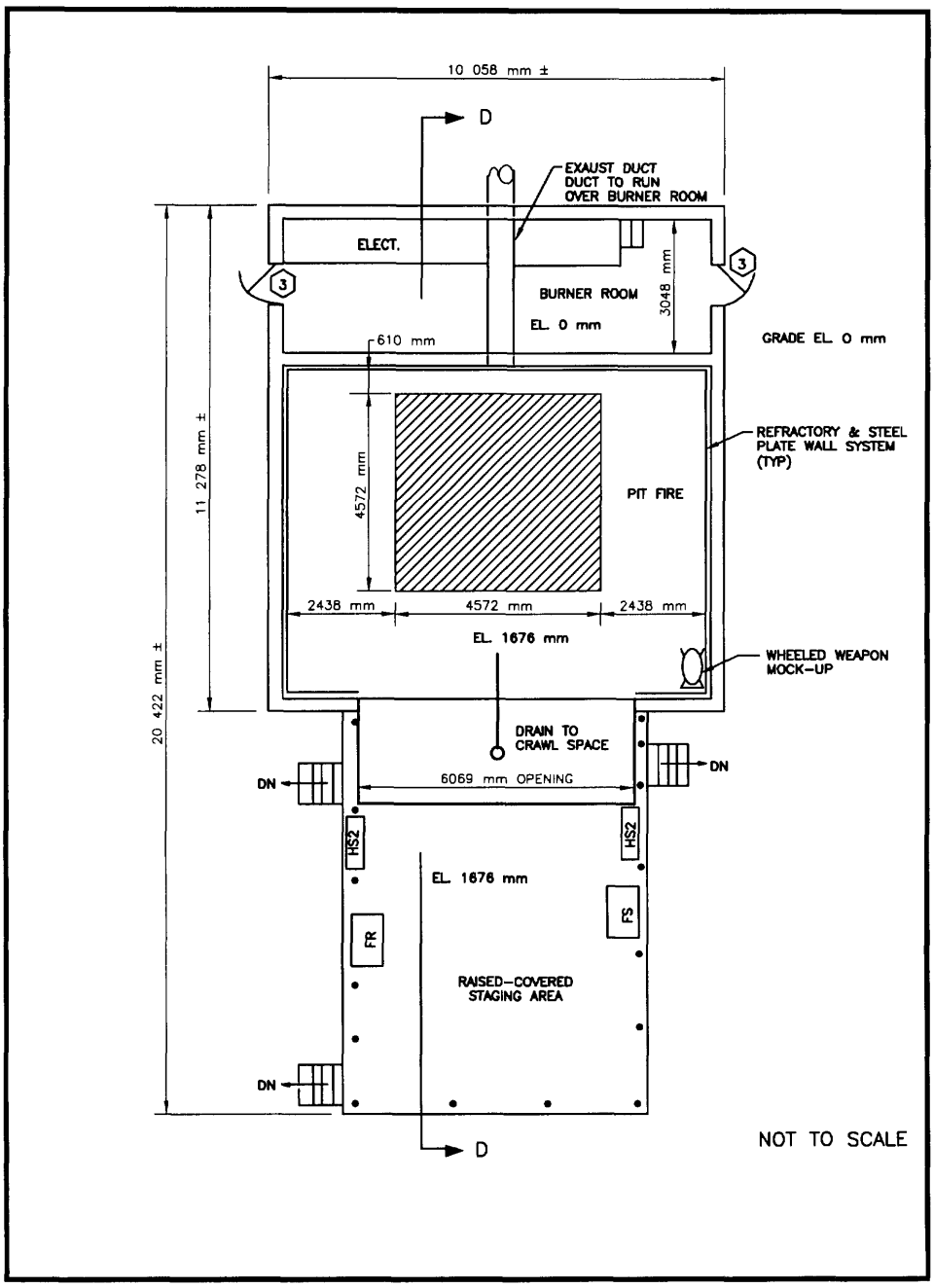


Figure C-4

19F3/19F3B Pit Fire Building
B3 & B4 First Floor Plan

APPENDIX C (Continued)

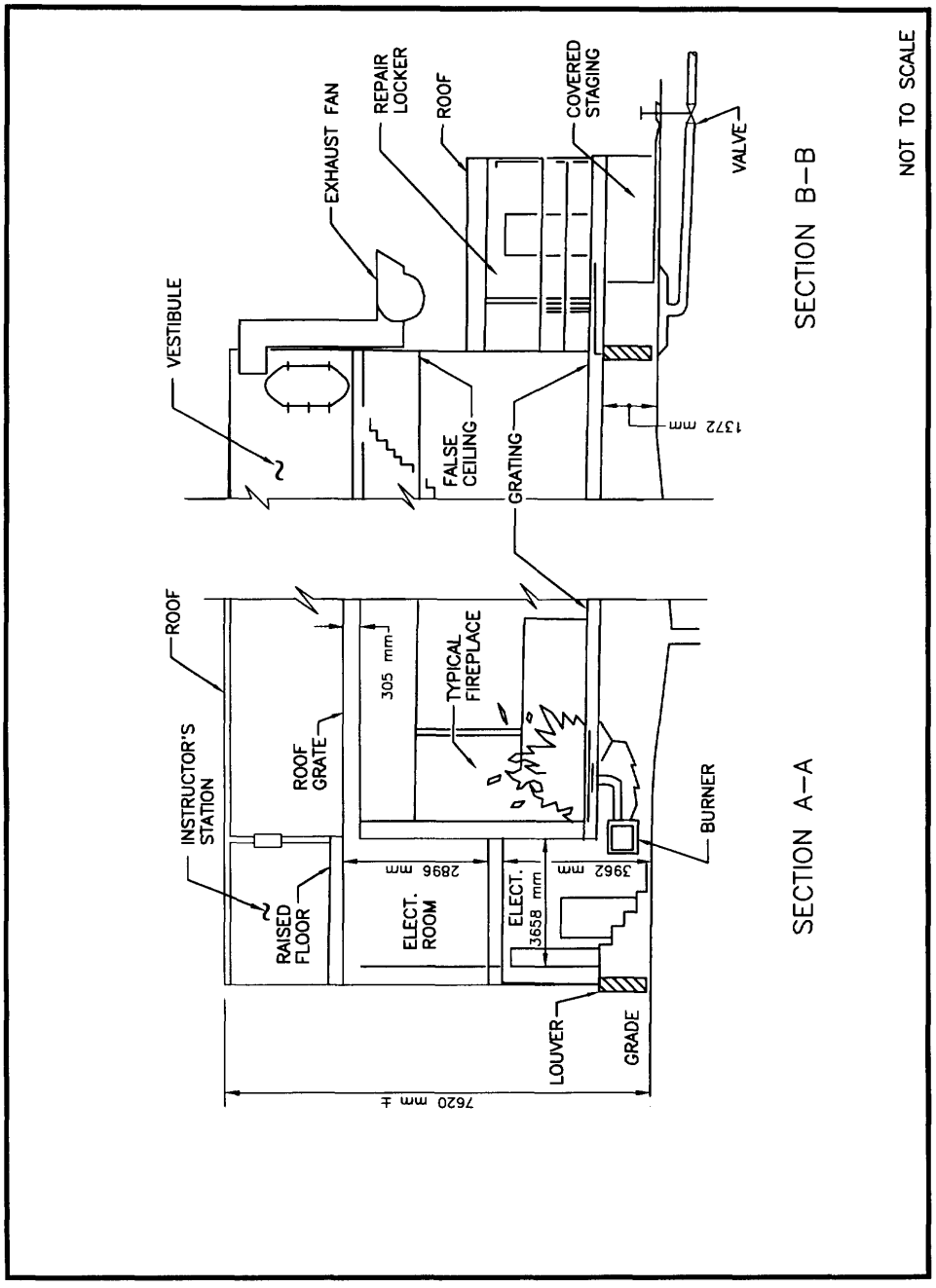


Figure C–5
19F3/19F3B B1 Sections

APPENDIX C (Continued)

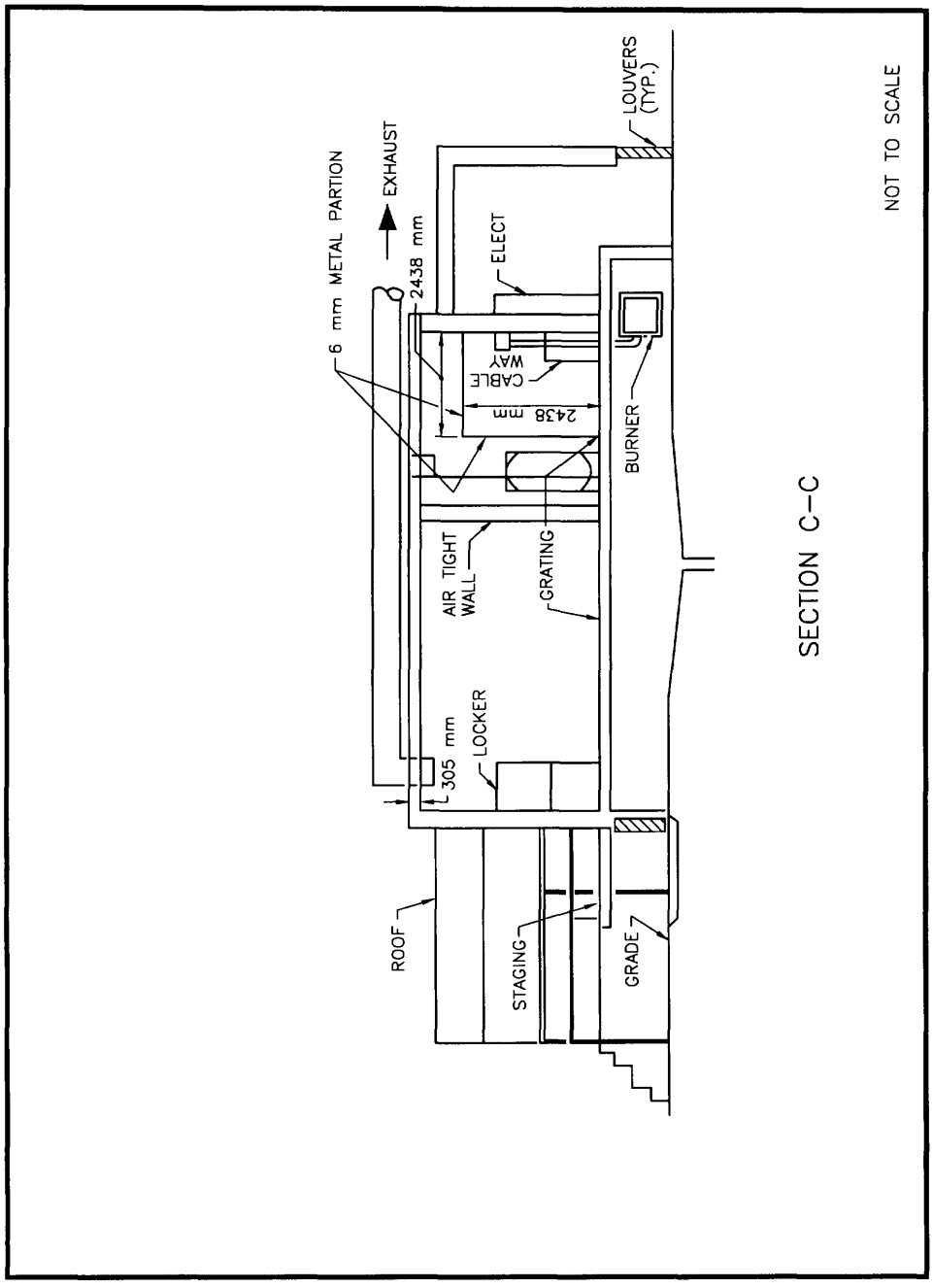


Figure C–6
19F3/19F3B B2 Section

APPENDIX C (Continued)

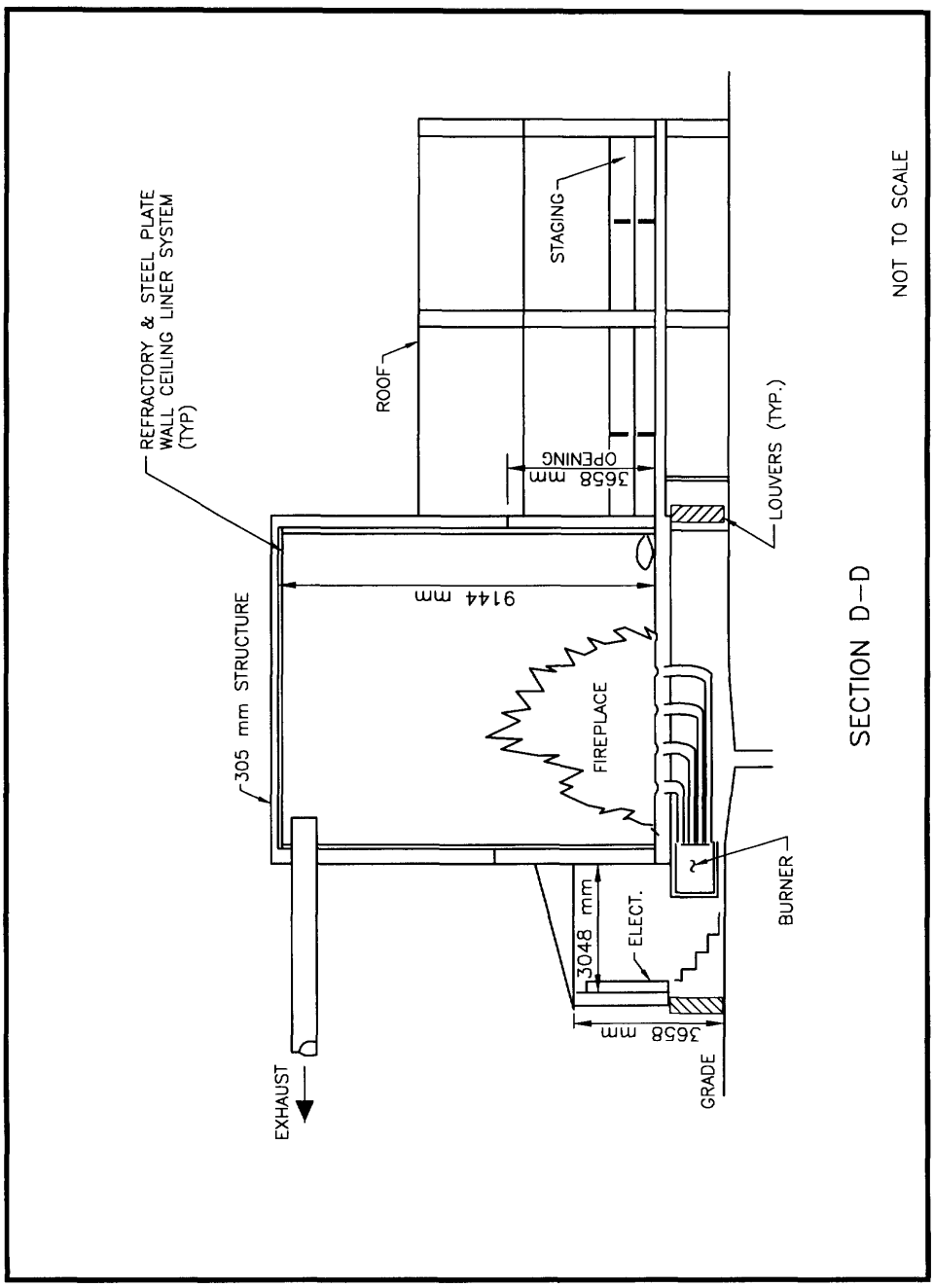
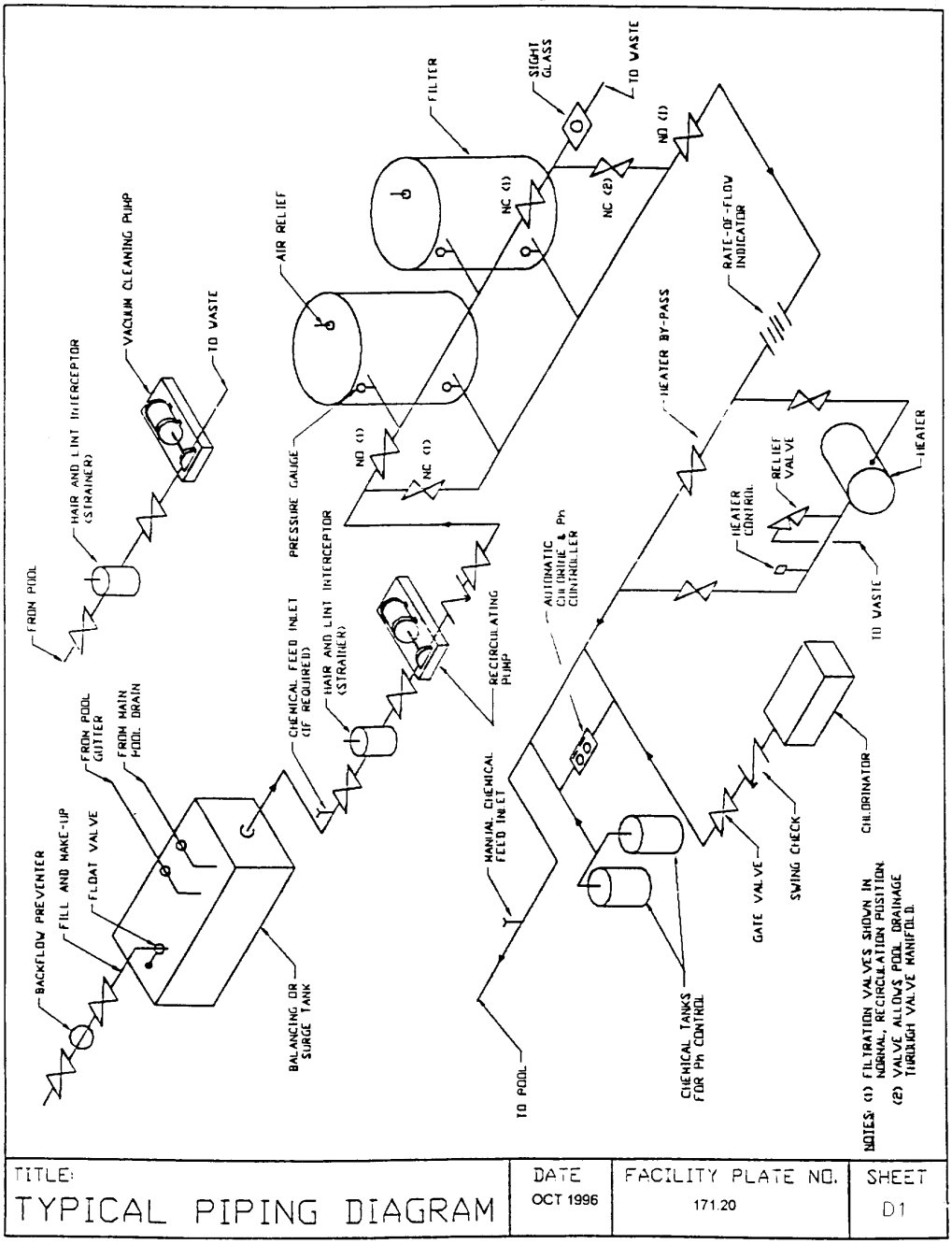


Figure C–7
19F3/19F3B B3/B4 Section

APPENDIX D
19F3A AND 19F3C STRUCTURES

19F3A/19F3C	First Floor Plan	D-1
19F3A/19F3C	Second Floor Plan	D-2
19F3A/19F3C	Roof Plan	D-3
19F3A/19F3C	Elevation	D-4


BACKFLOW PREVENTER
FILL AND MAKE-UP
FLOAT VALVE
FROM POOL GUTTER
FROM MAIN POOL DRAIN
BALANCING OR SURGE TANK
FROM POOL
HAIR AND LINT INTERCEPTOR (STRAINER)
VACUUM CLEANING PUMP
TO WASTE
CHEMICAL FEED INLET (IF REQUIRED)
HAIR AND LINT INTERCEPTOR (STRAINER)
RECIRCULATING PUMP
AIR RELIEF
PRESSURE GAUGE
NO (1)
NC (1)
FILTER
SIGHT GLASS
TO WASTE
NC (1)
NC (2)
NO (1)
AUTOMATIC CHLORINE & Ph CONTROLLER
HEATER BY-PASS
RATE-OF-FLOW INDICATOR
HEATER CONTROL
RELIEF VALVE
HEATER
TO WASTE
MANUAL CHEMICAL FEED INLET
TO POOL
CHEMICAL TANKS FOR Ph CONTROL
GATE VALVE
SWING CHECK
CHLORINATOR
NOTES: (1) FILTRATION VALVES SHOWN IN NORMAL, RECIRCULATION POSITION.
(2) VALVE ALLOWS POOL DRAINAGE THROUGH VALVE MANIFOLD.
TITLE:
TYPICAL PIPING DIAGRAM
DATE
OCT 1996
FACILITY PLATE NO.
171.20
SHEET
D1

APPENDIX D (Continued)

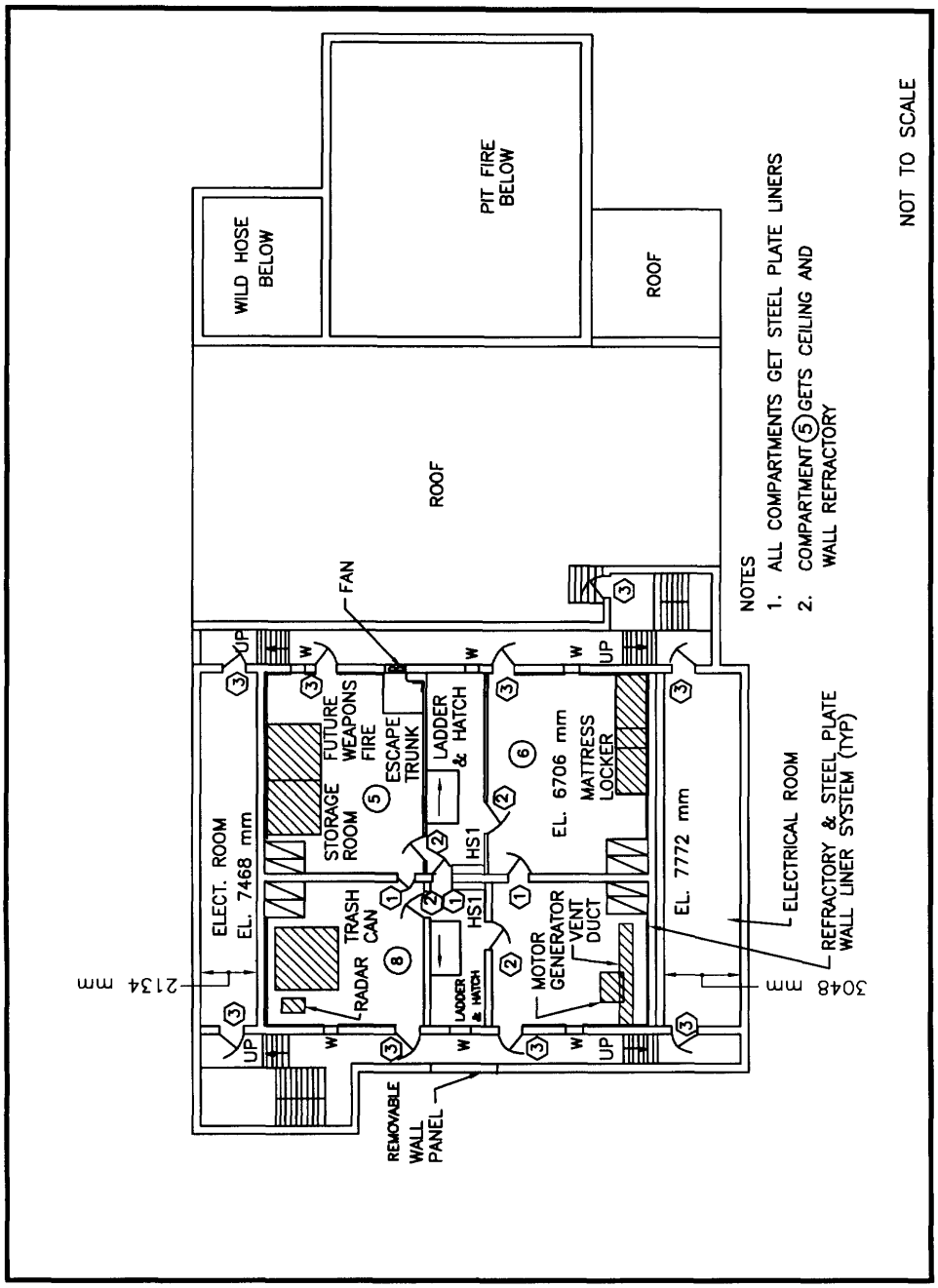


Figure D–2
19F3A/19F3C Second Floor Plan

APPENDIX D (Continued)

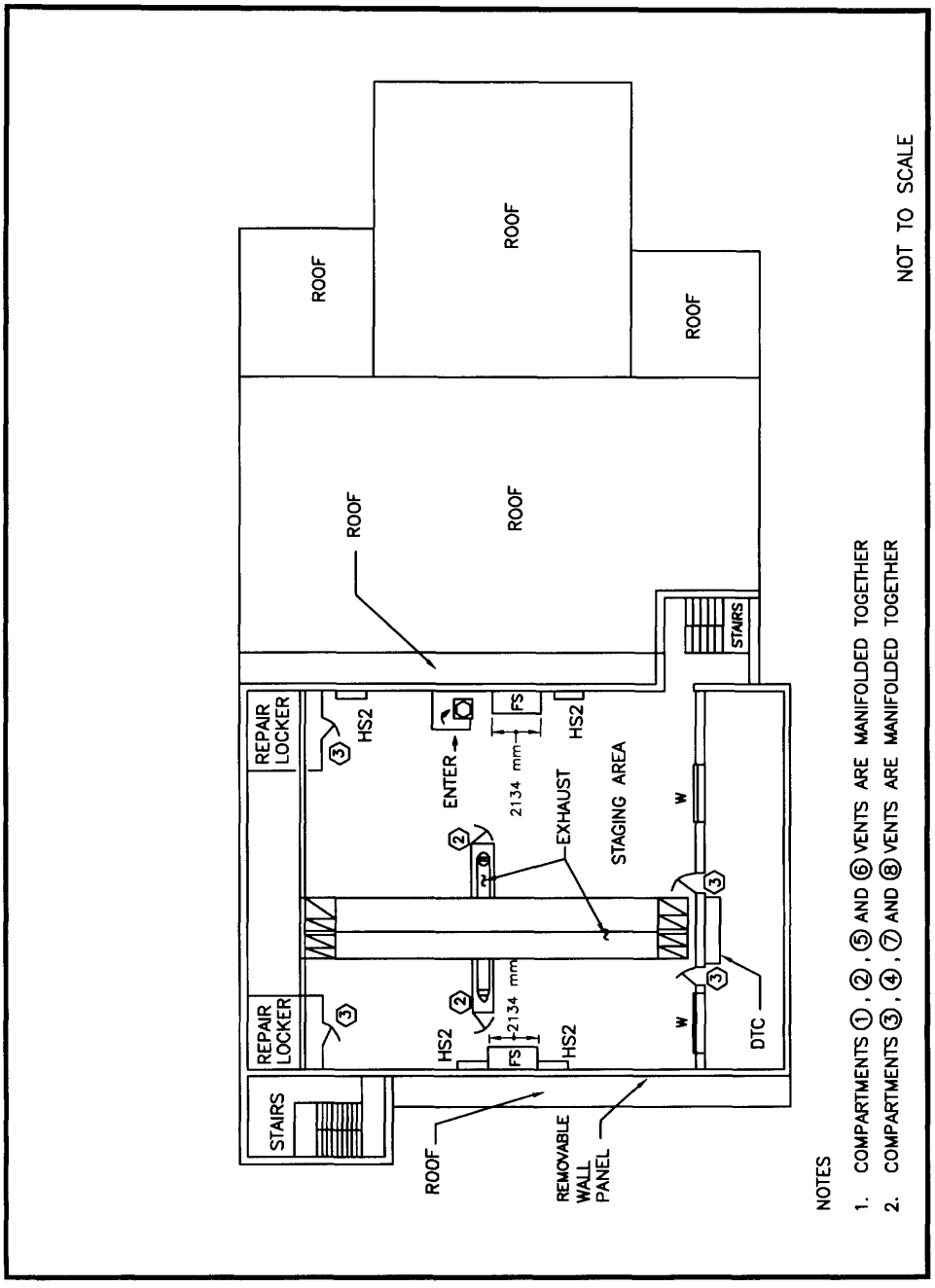


Figure D–3
19F3A/19F3C Roof Plan

APPENDIX D (Continued)

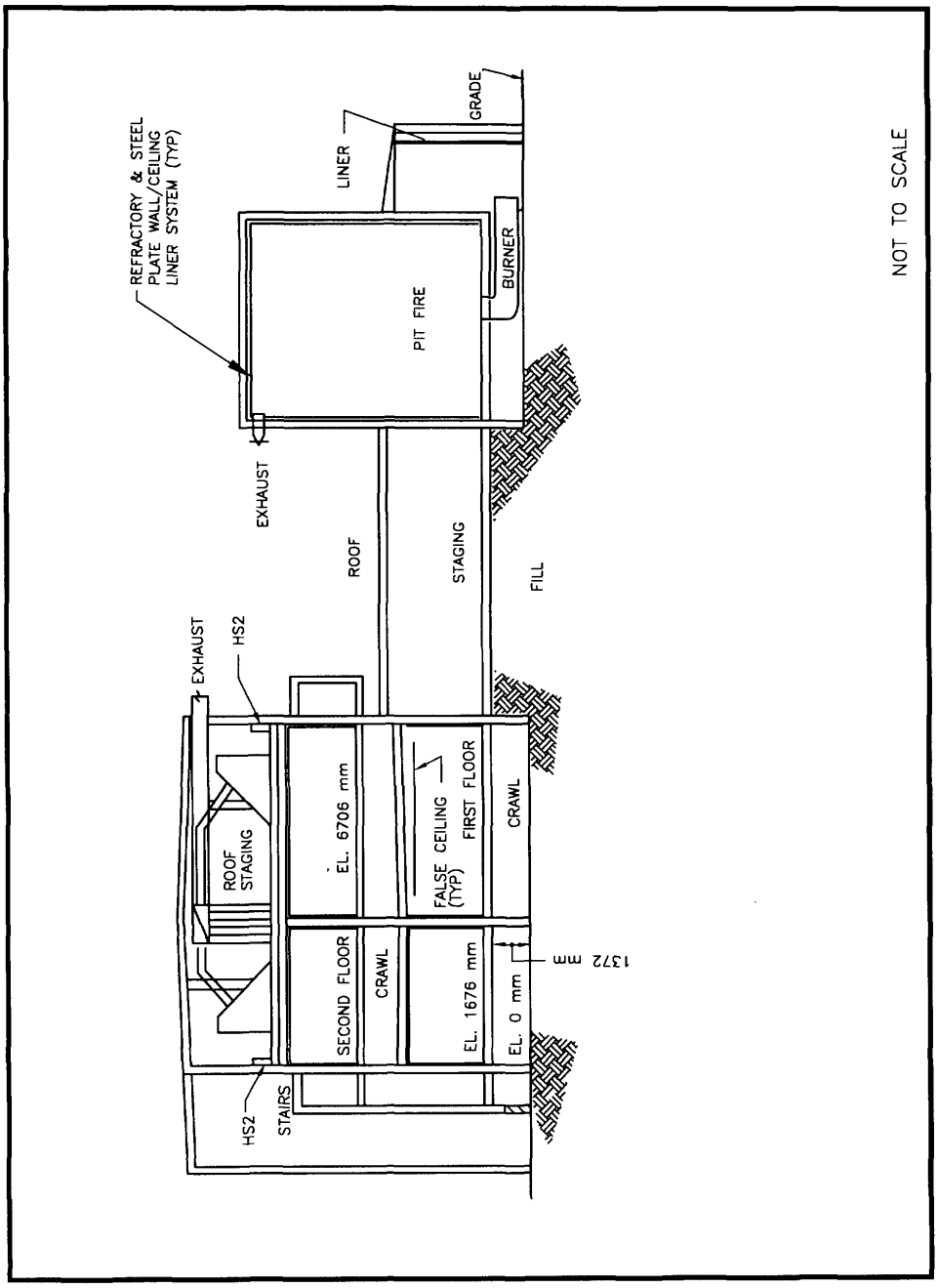


Figure D–4
19F3A/19F3C Elevation

APPENDIX E
19F4 AND 19F4A STRUCTURES

19F4/19F4A	Training Deck Floor Plan	E-1
19F4/19F4A	Elevation	E-2
19F4/19F4A	Foam Deck	E-3
19F4/19F4A	AFFF Balanced Pressure Proportioning System	E-4
19F4/19F4A	Training and Foam Deck Railing	E-5
19F4/19F4A	Crawl Space Plan and Pedestal	E-6

APPENDIX E (Continued)

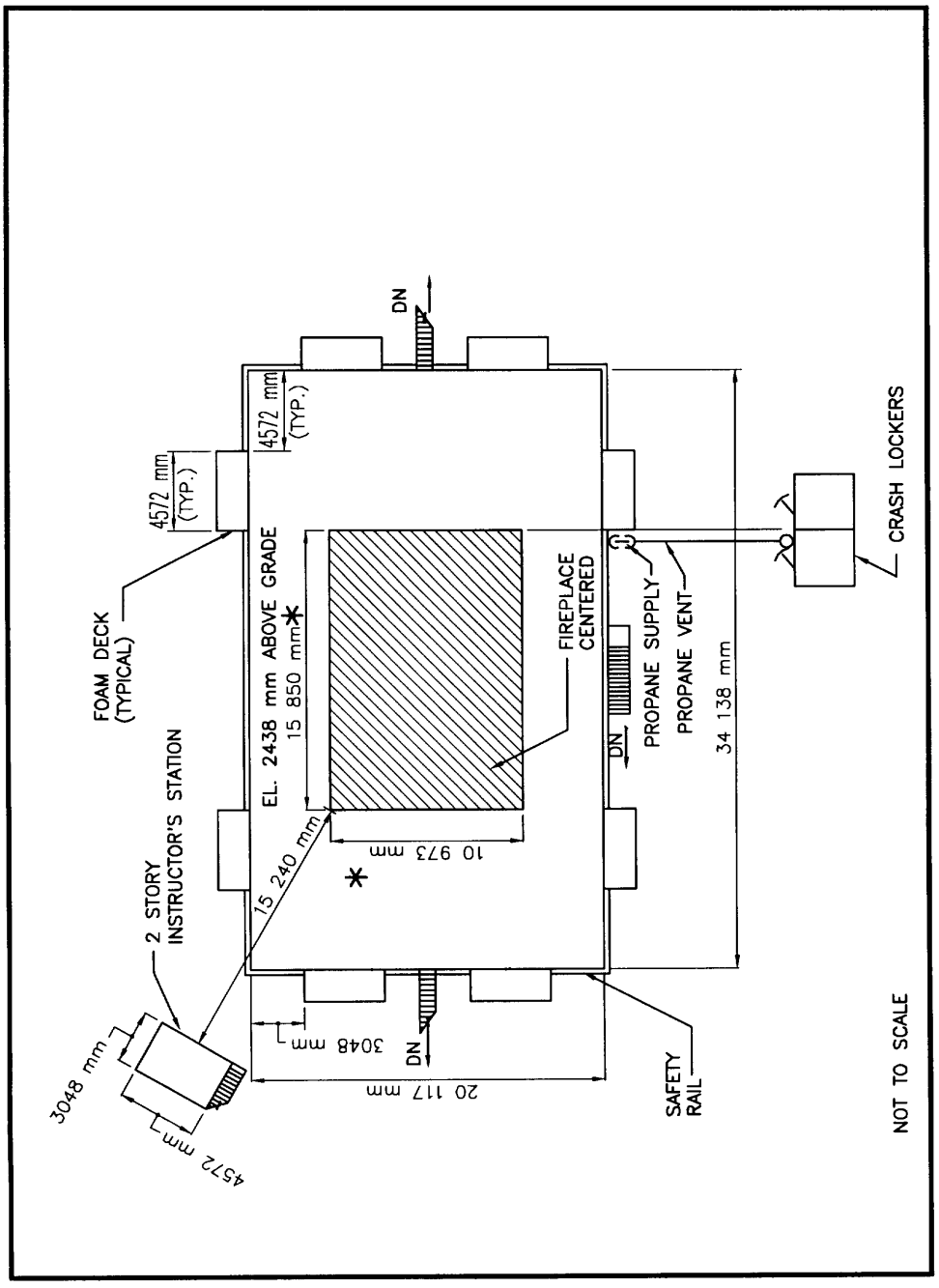


Figure E–1
19F4/19F4A Training Deck Floor Plan

APPENDIX E (Continued)

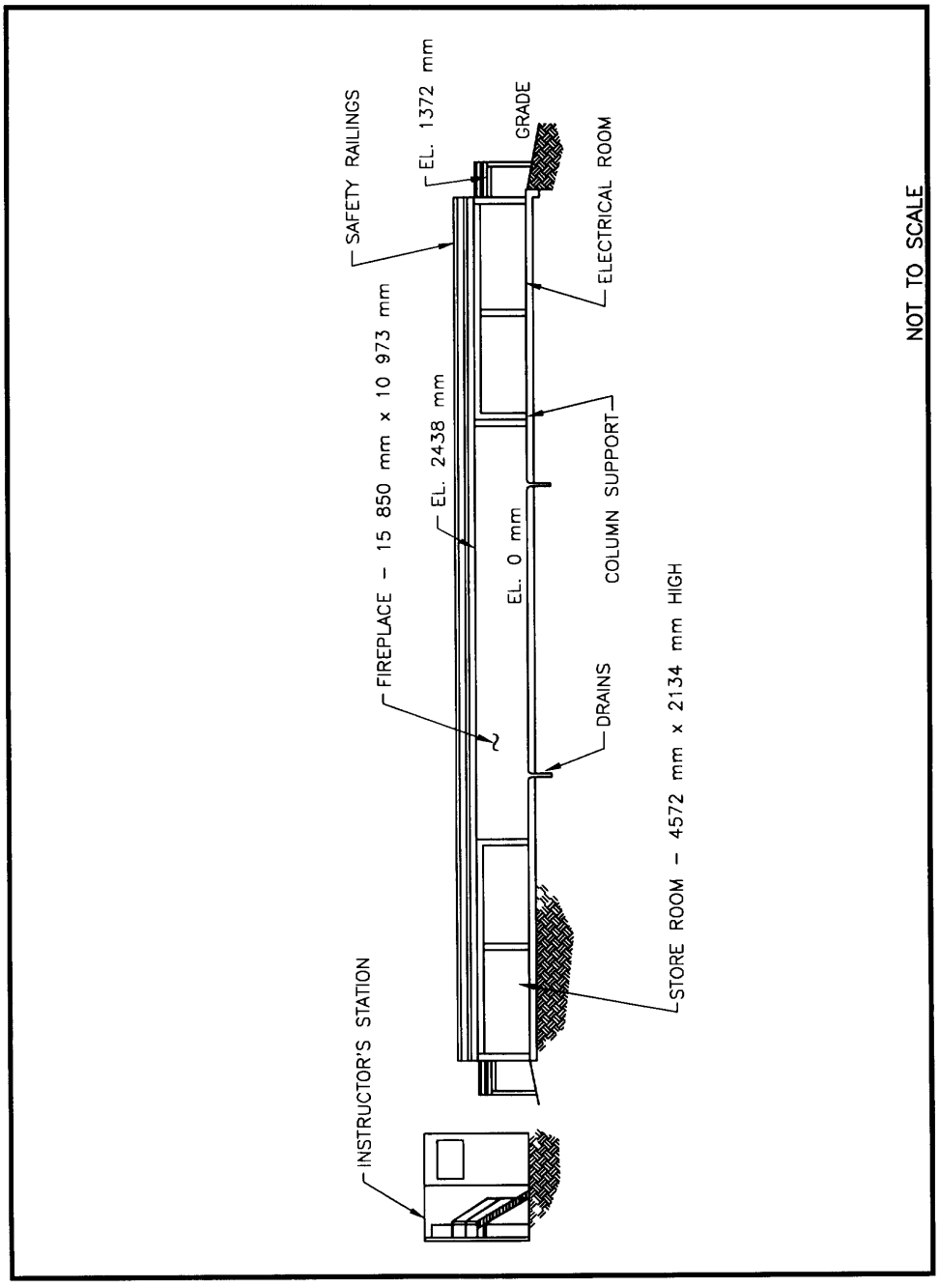


Figure E-2
19F4/19F4A Elevation

APPENDIX E (Continued)

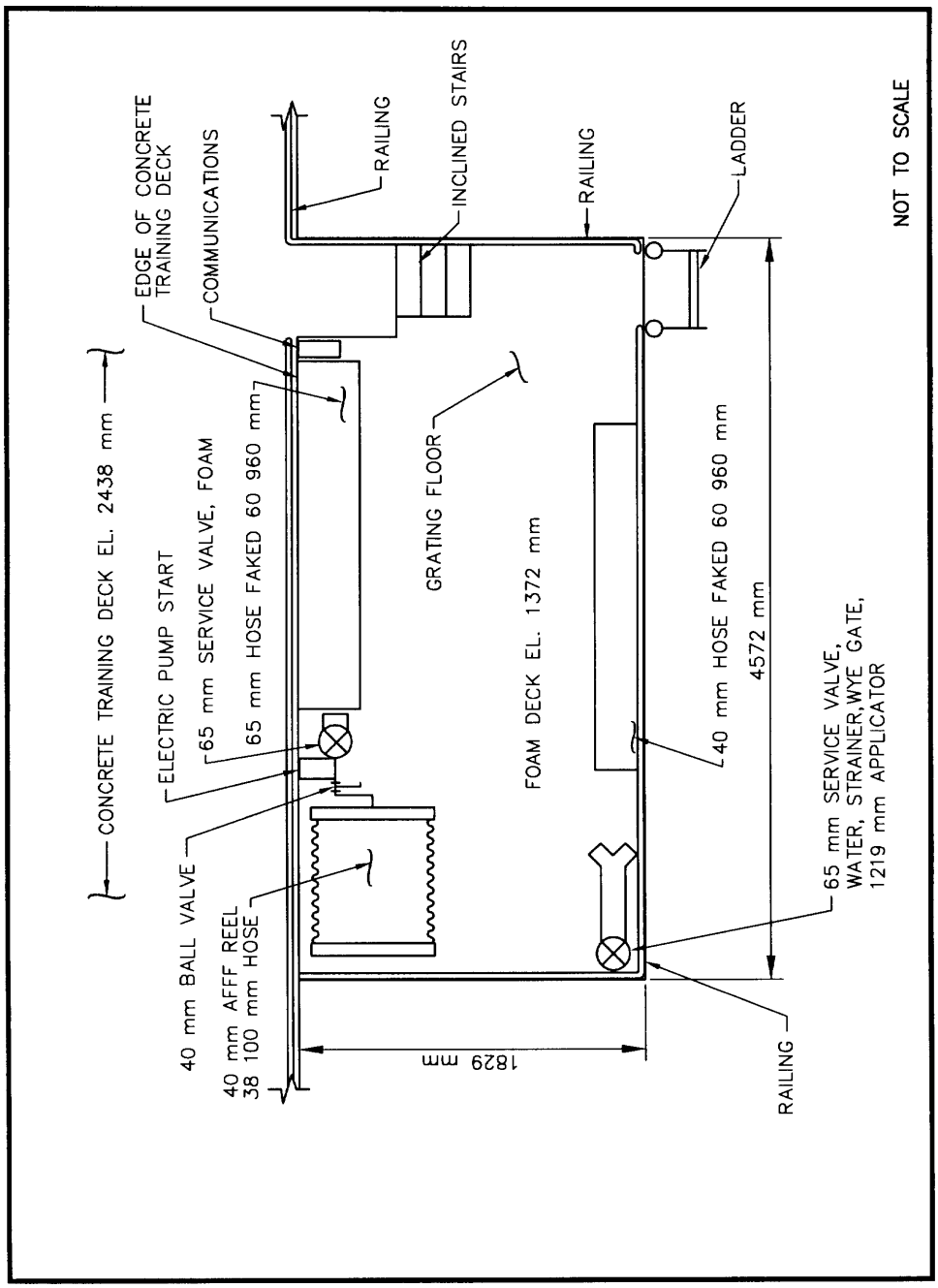


Figure E-3
19F4/19F4A Foam Deck

APPENDIX E (Continued)

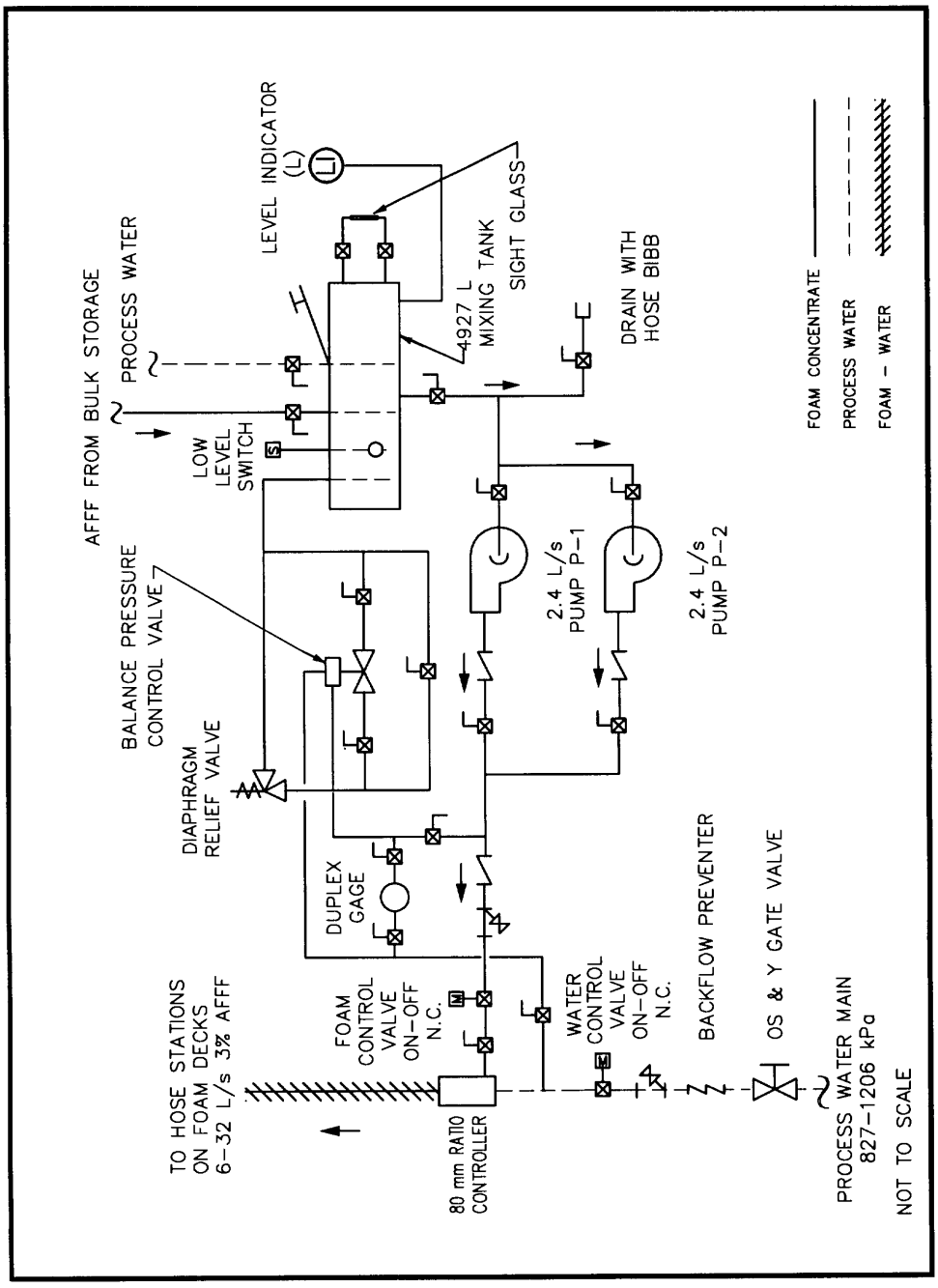


Figure E-4
19F4/19F4A AFFF Balanced Pressure
Proportioning System

APPENDIX E (Continued)

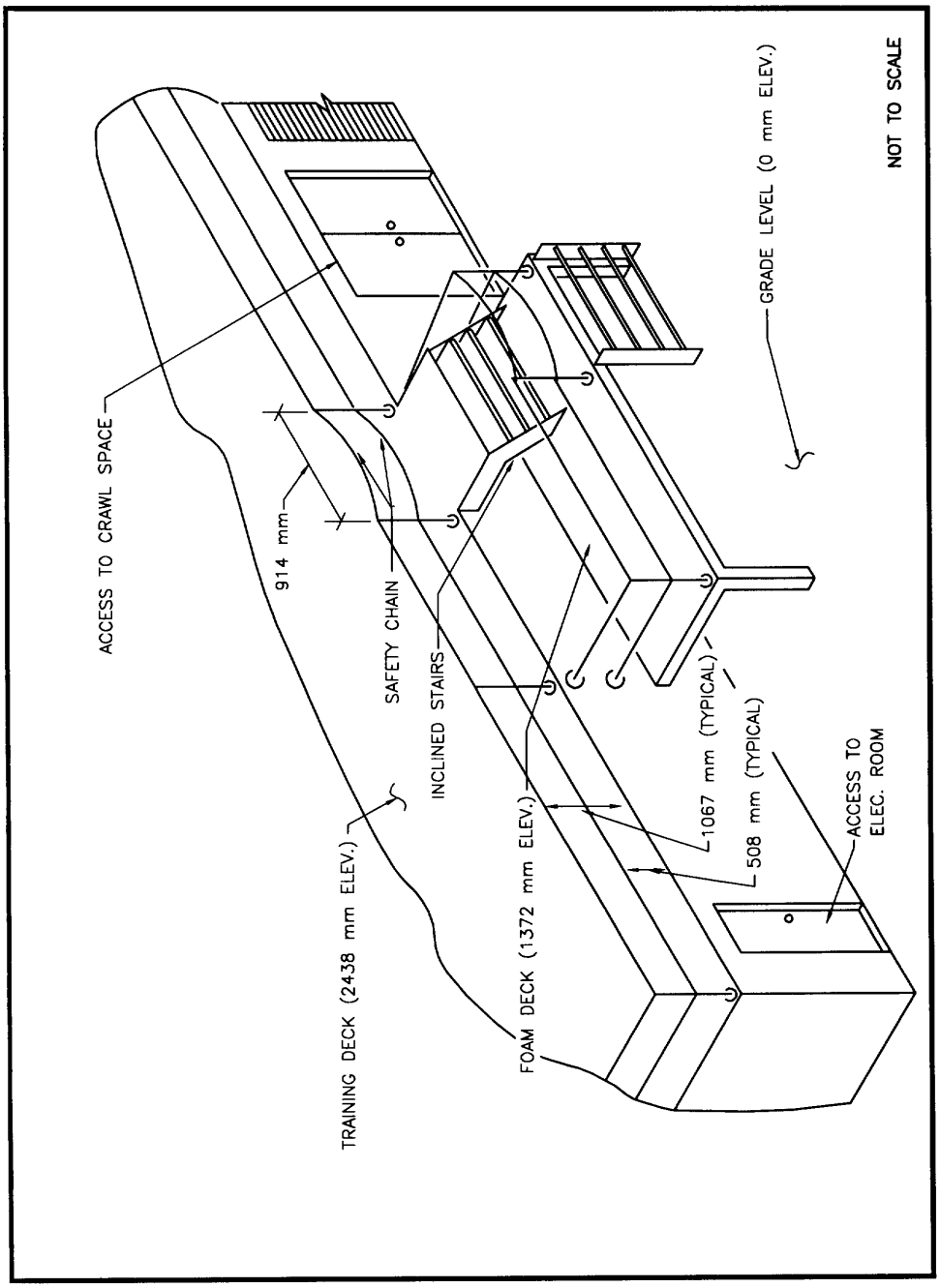


FIGURE E-5
TRAINING AND FOAM DECK RAILING

APPENDIX E (Continued)

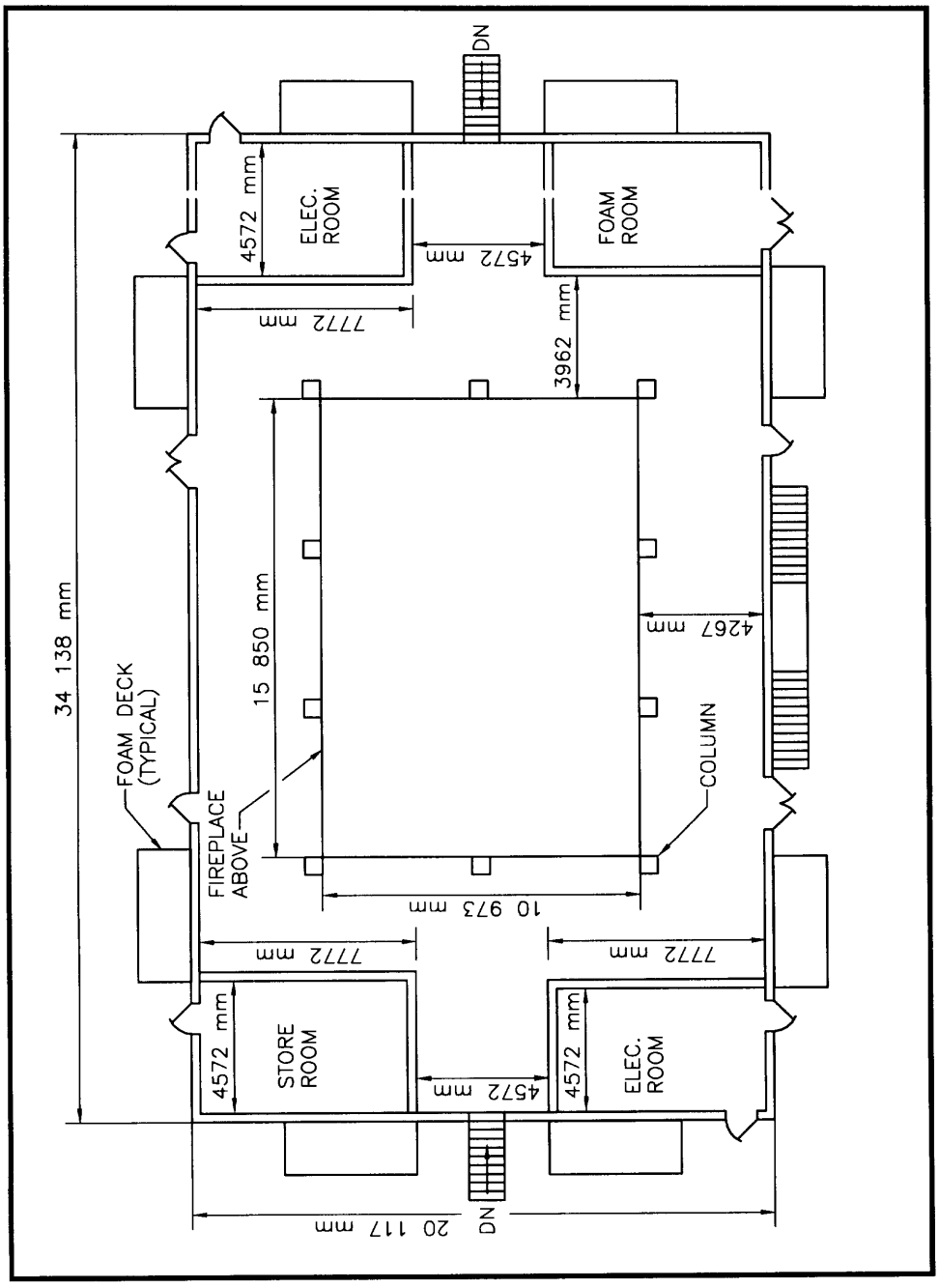


Figure E-6

19F4/19F4A Crawlspace Plan and Pedestal

APPENDIX F
19F5 AND 19F5A STRUCTURES

19F5/19F5A	First Floor Plan	F-1
19F5/19F5A	Elevation	F-2

APPENDIX F (Continued)

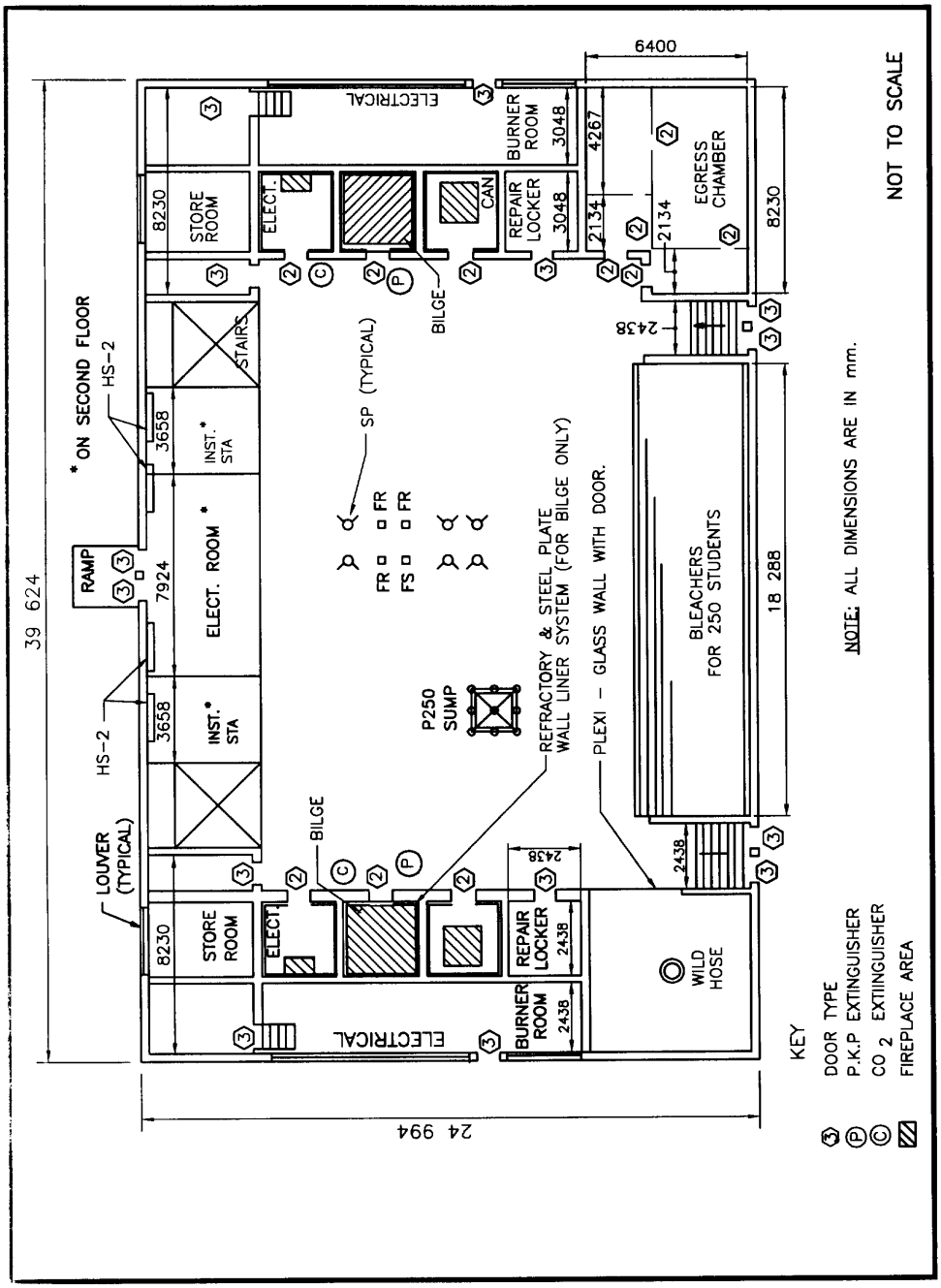


Figure F-1
19F5/19F5A First Floor Plan

APPENDIX F (Continued)

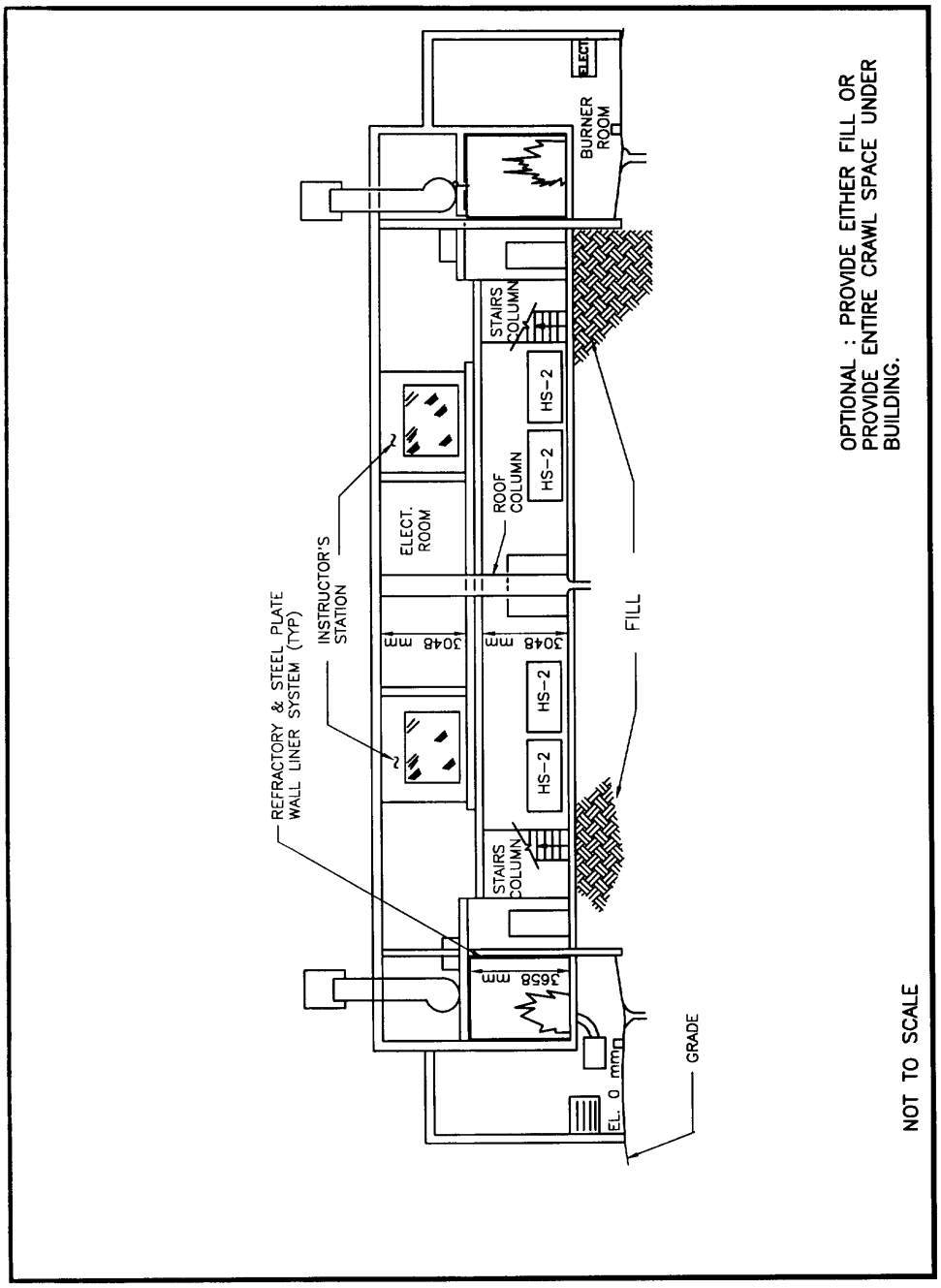


Figure F-2
19F5/19F5A Elevation

APPENDIX G
21C12 AND 21C12A STRUCTURES

21C12/21C12A	First Floor Plan	G-1
21C12/21C12A	Section	G-2
21C12/21C12A	Section	G-3
21C12/21C12A	Training Compartment/Equipment Mockup	G-4
21C12/21C12A	OBA Canister Storage Rack	G-5
21C12/21C12A	EAB Cabinet	G-6
21C12/21C12A	OBA Locker	G-7
21C12/21C12A	Fire Hose Locker Wall Mounted	G-8
21C12/21C12A	Fire Hose Locker Floor Mounted	G-9
21C12/21C12A	AFFF Fill Station	G-10
21C12/21C12A	EAB Outlet Housing	G-11
21C12/21C12A	Combined Hose Station	G-12
21C12/21C12A	EAB System Schematic	G-13
21C12/21C12A	Alarm System Schematic	G-14

APPENDIX G (Continued)

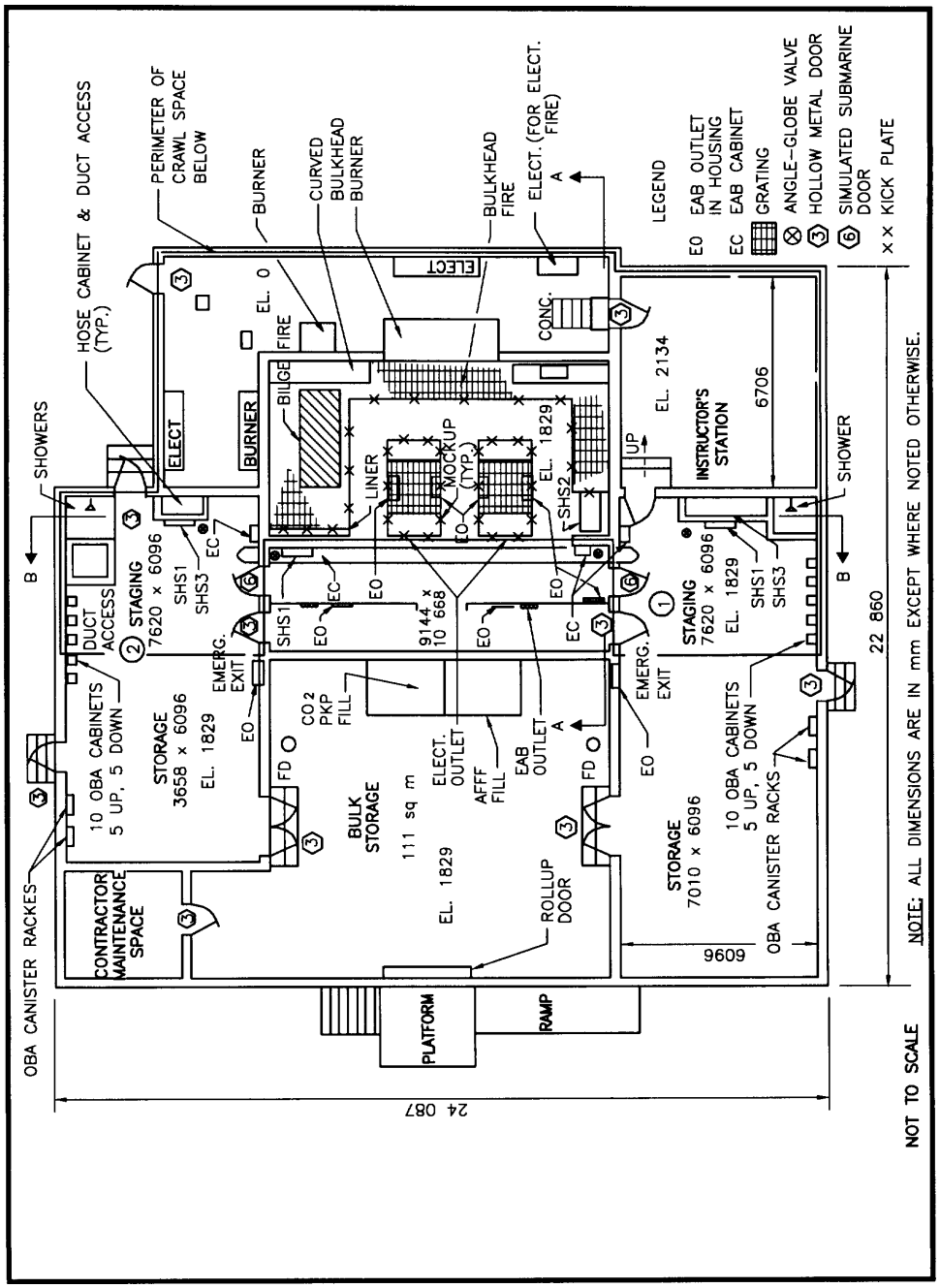


Figure G–1
21C12/21C12A First Floor Plan

APPENDIX G (Continued)

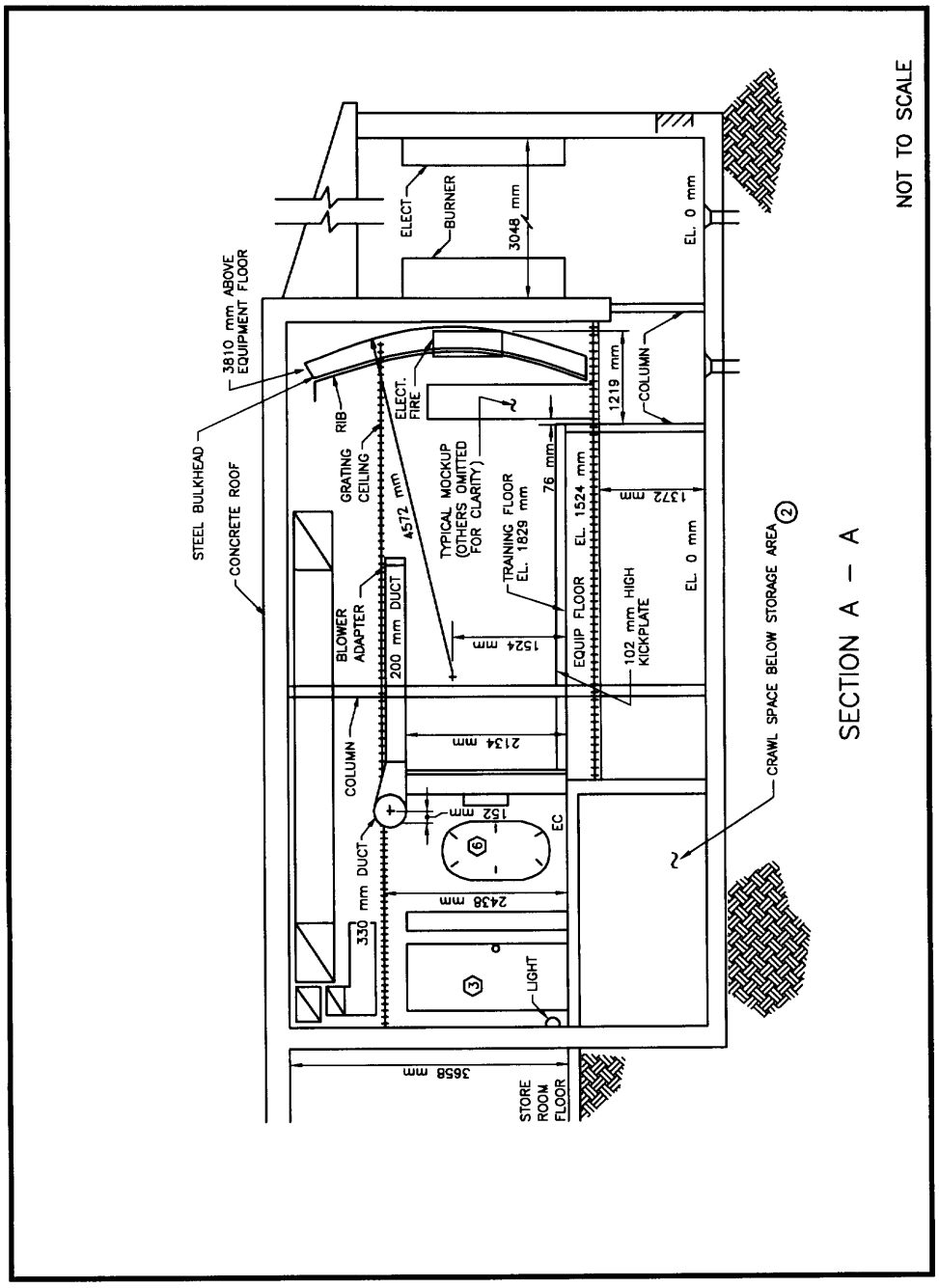


Figure G–2
21C12/21C12A Section

APPENDIX G (Continued)

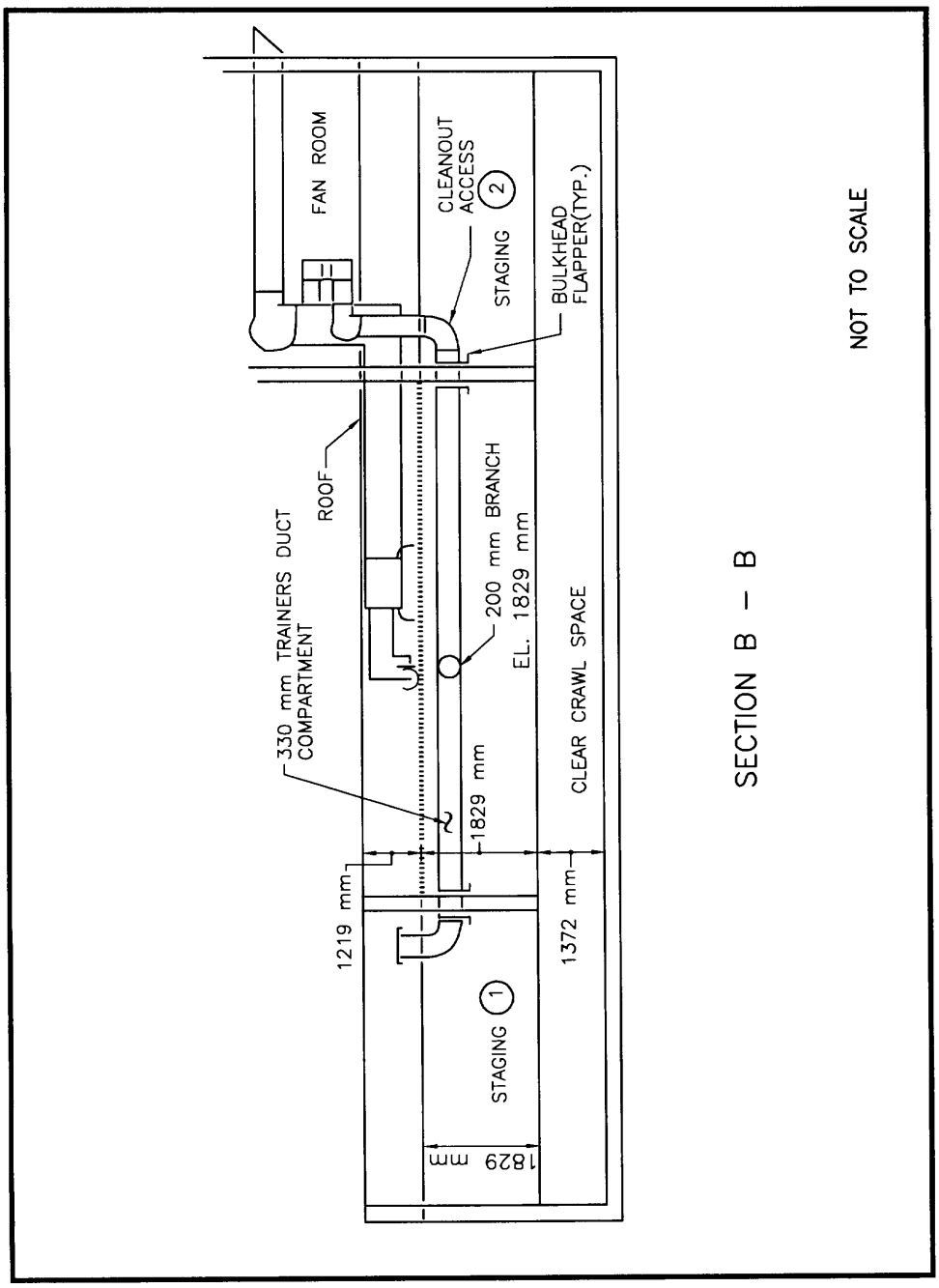
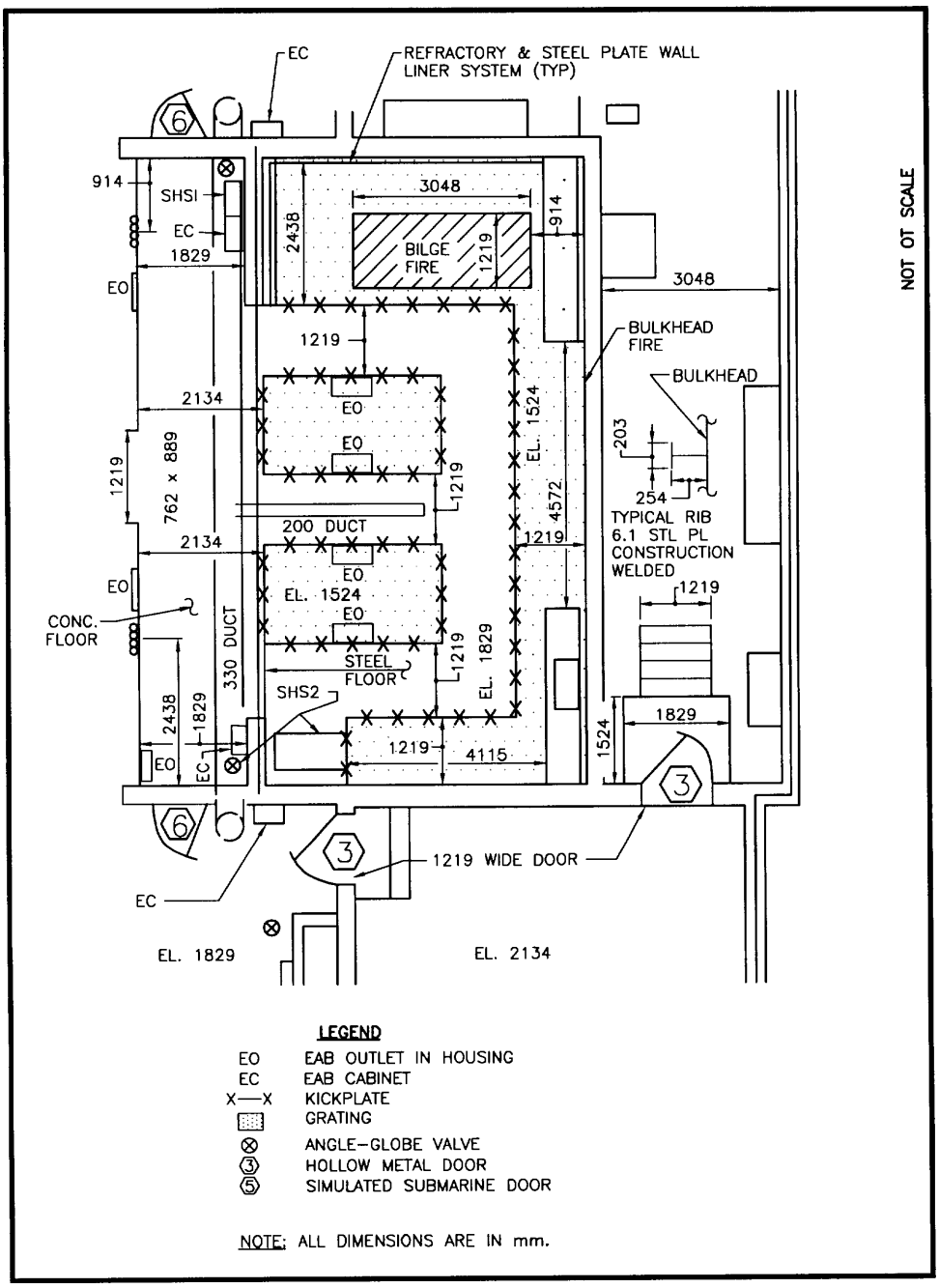


Figure G-3
21C12/21C12A Section

APPENDIX G (Continued)



LEGEND

EO	EAB OUTLET IN HOUSING
EC	EAB CABINET
X—X	KICKPLATE
	GRATING
⊗	ANGLE–GLOBE VALVE
③	HOLLOW METAL DOOR
⑤	SIMULATED SUBMARINE DOOR

NOTE: ALL DIMENSIONS ARE IN mm.

Figure G–4A

21C12/21C12A Training Compartment/Equipment Mockup

APPENDIX G (Continued)

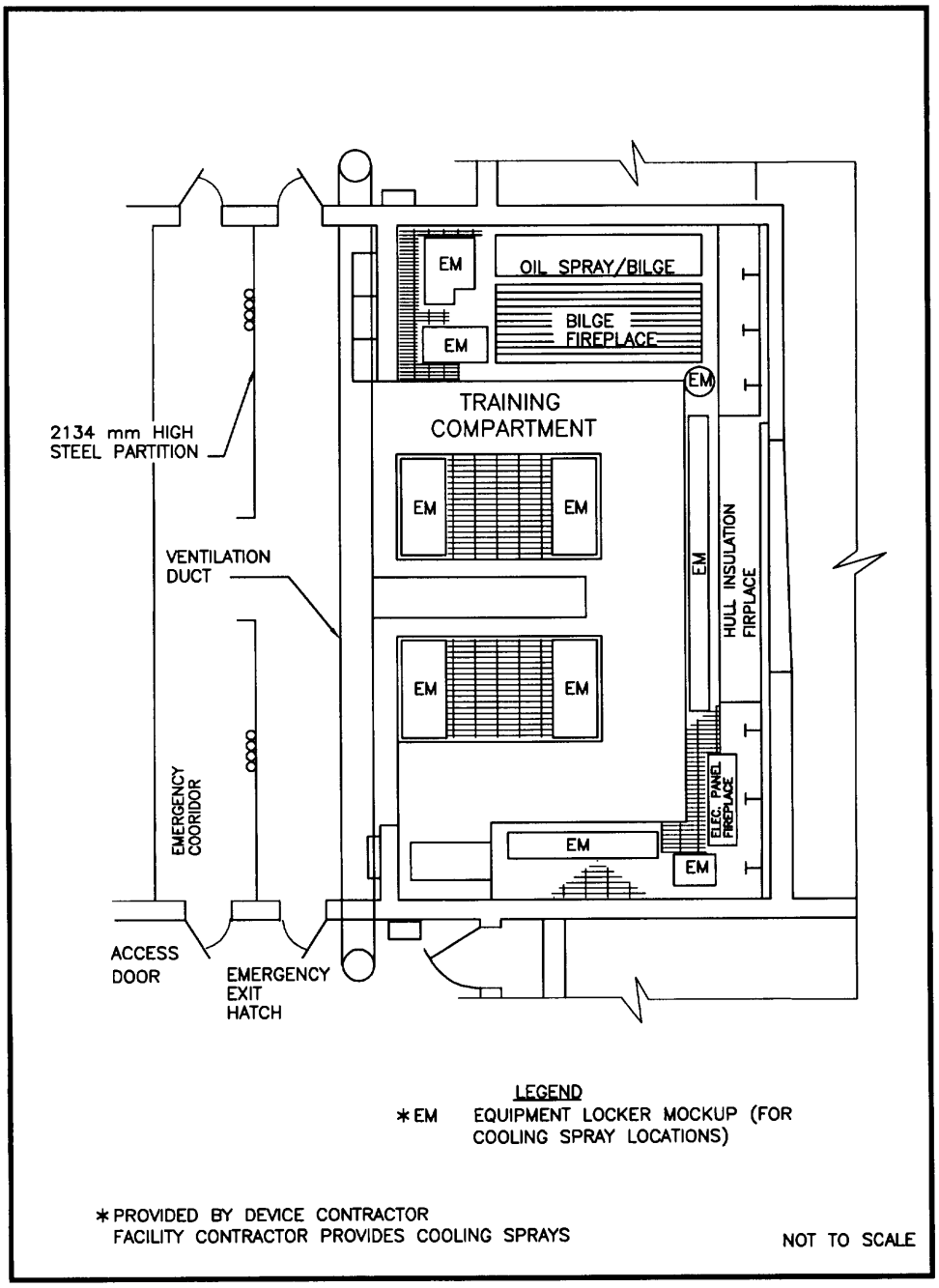


Figure G–4B

21C12/21C12A Training Compartment/Equipment Mockup

APPENDIX G (Continued)

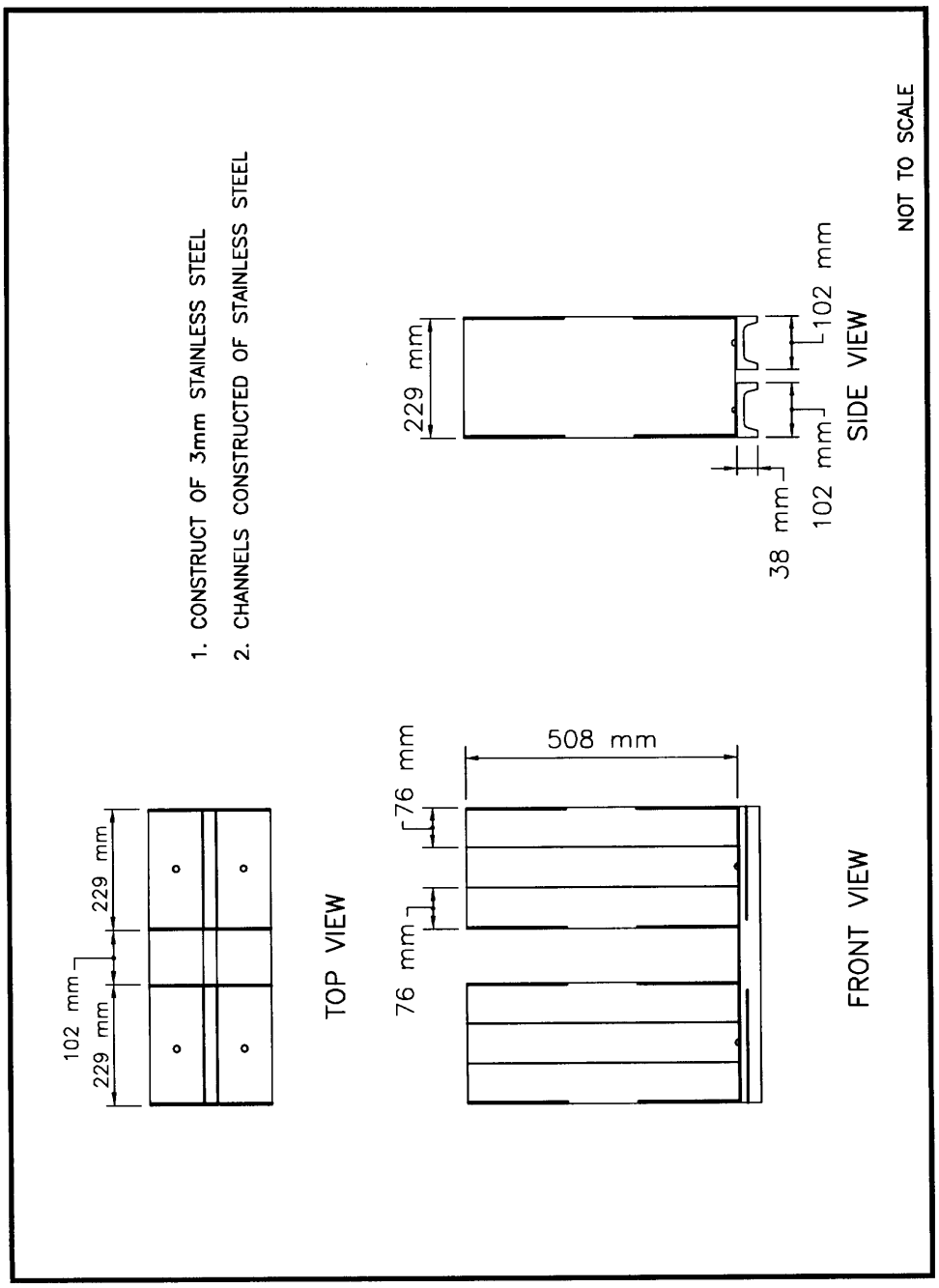


Figure G–5
21C12/21C12A OBA Canister Storage Rack

APPENDIX G (Continued)

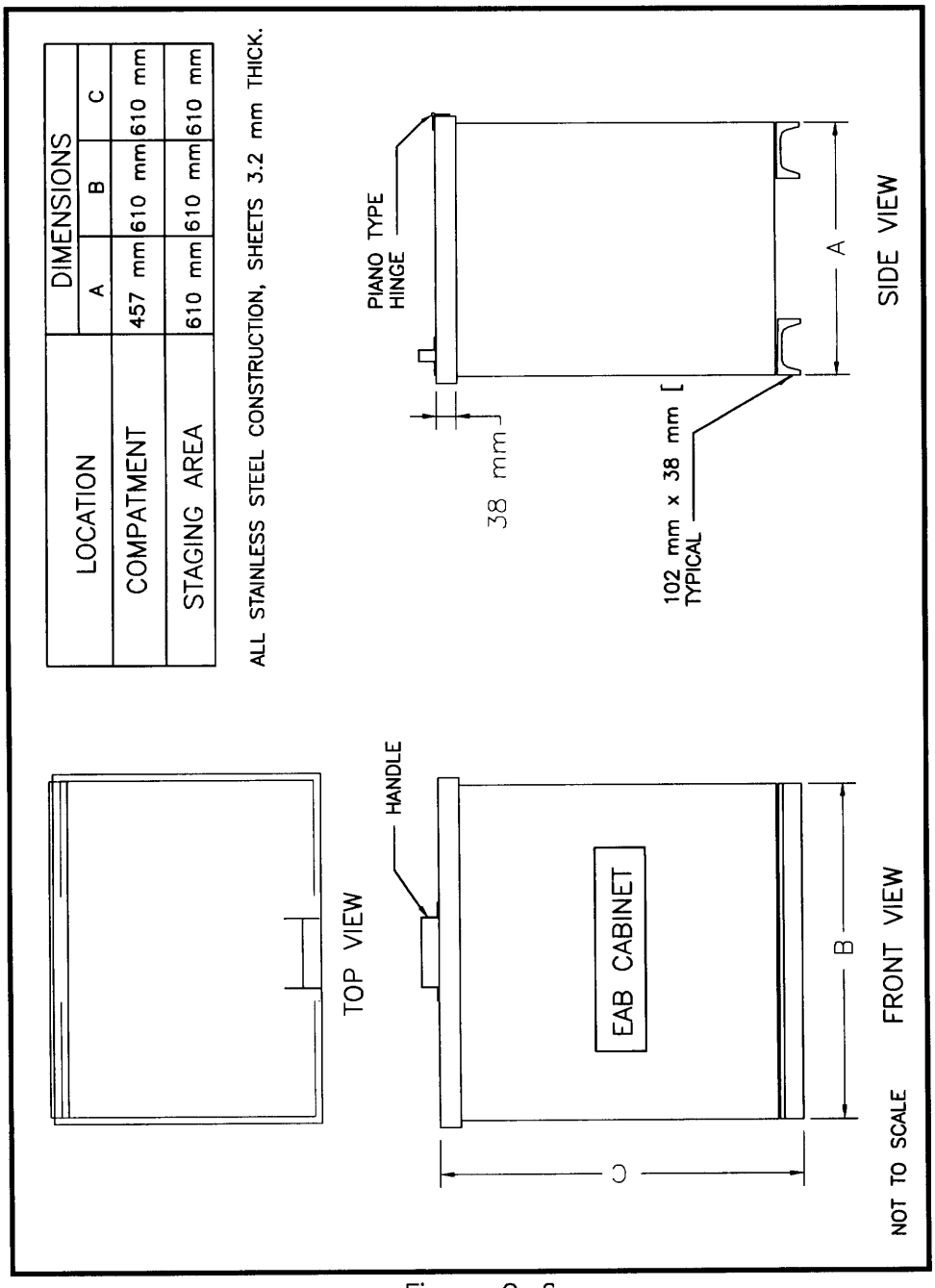


Figure G–6
21C12/21C12A EAB Cabinet

APPENDIX G (Continued)

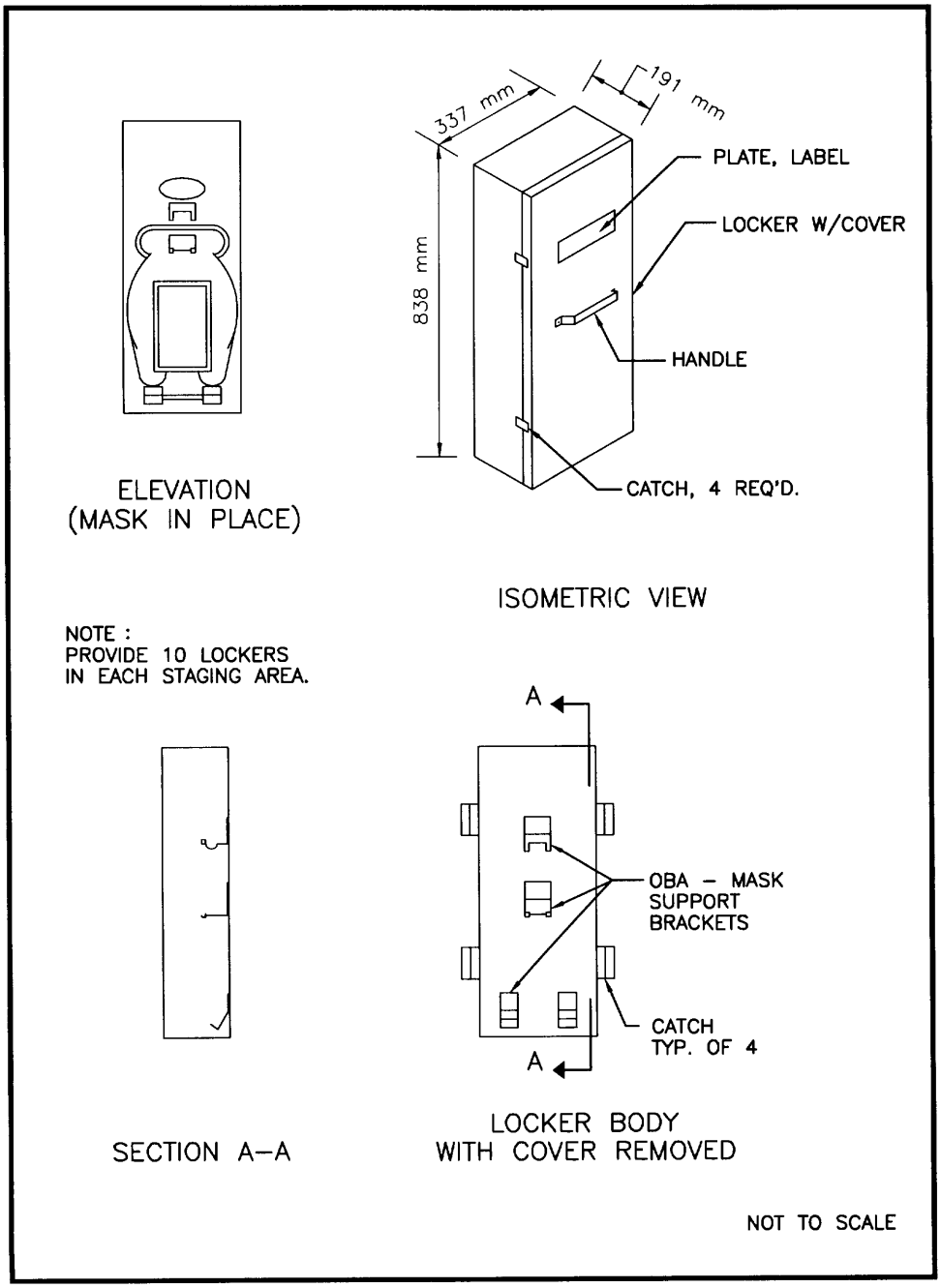


Figure G–7
21C12/21C12A OBA Locker

APPENDIX G (Continued)

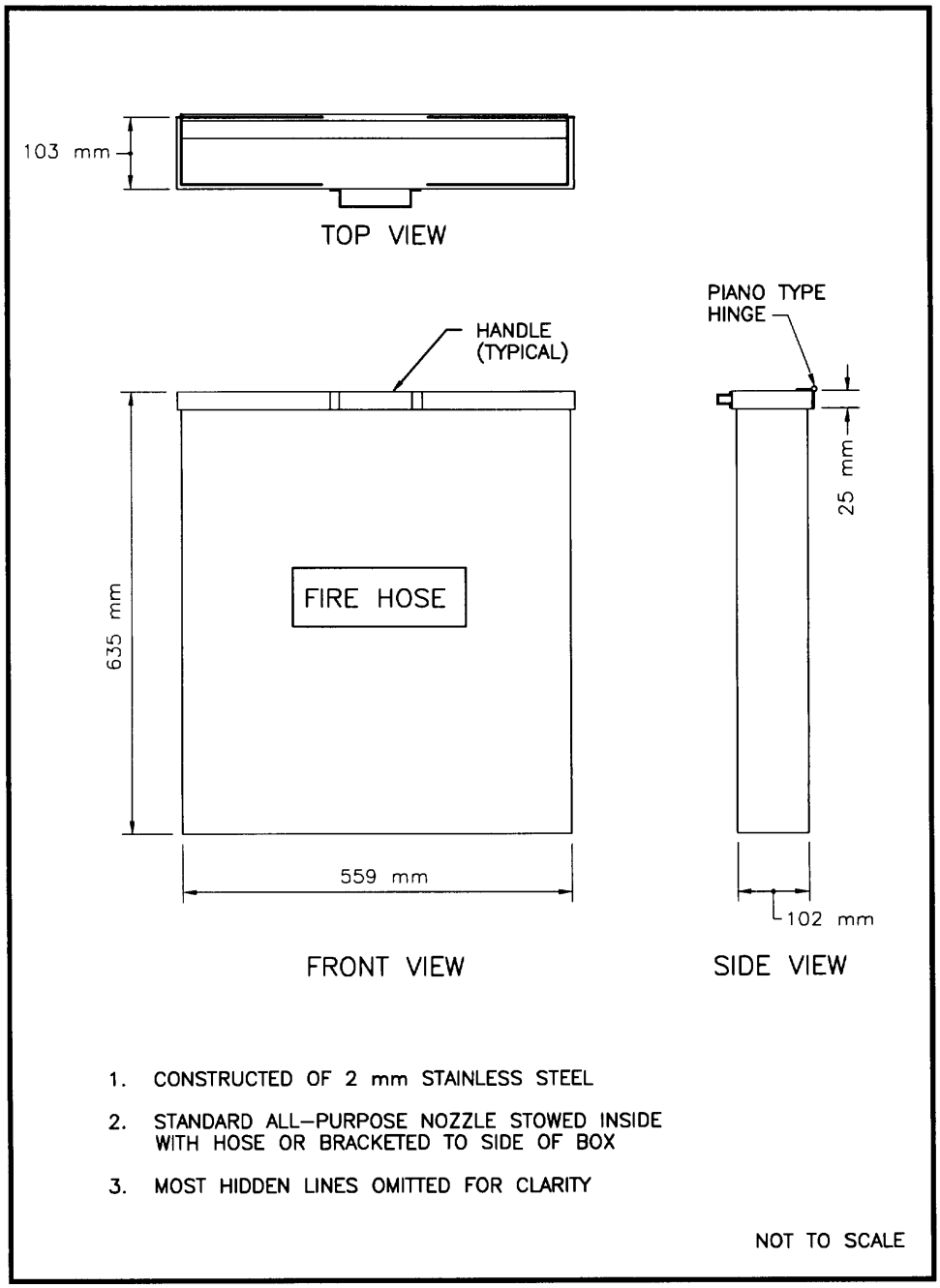


Figure G-8
21C12/21C12A Fire Hose Locker Wall Mounted

APPENDIX G (Continued)

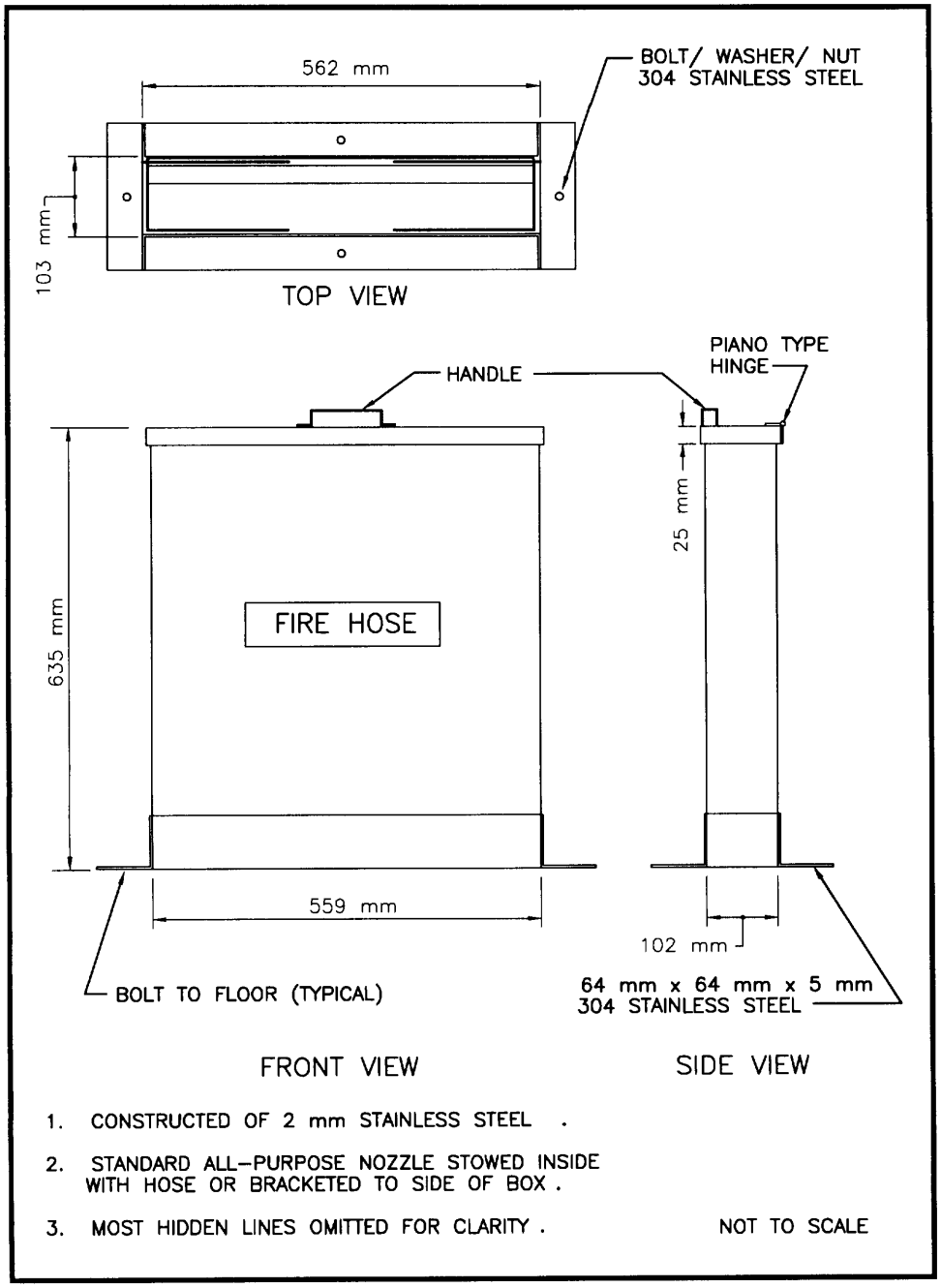


Figure G-9
21C12/21C12A Fire Hose Locker Floor Mounted

APPENDIX G (Continued)

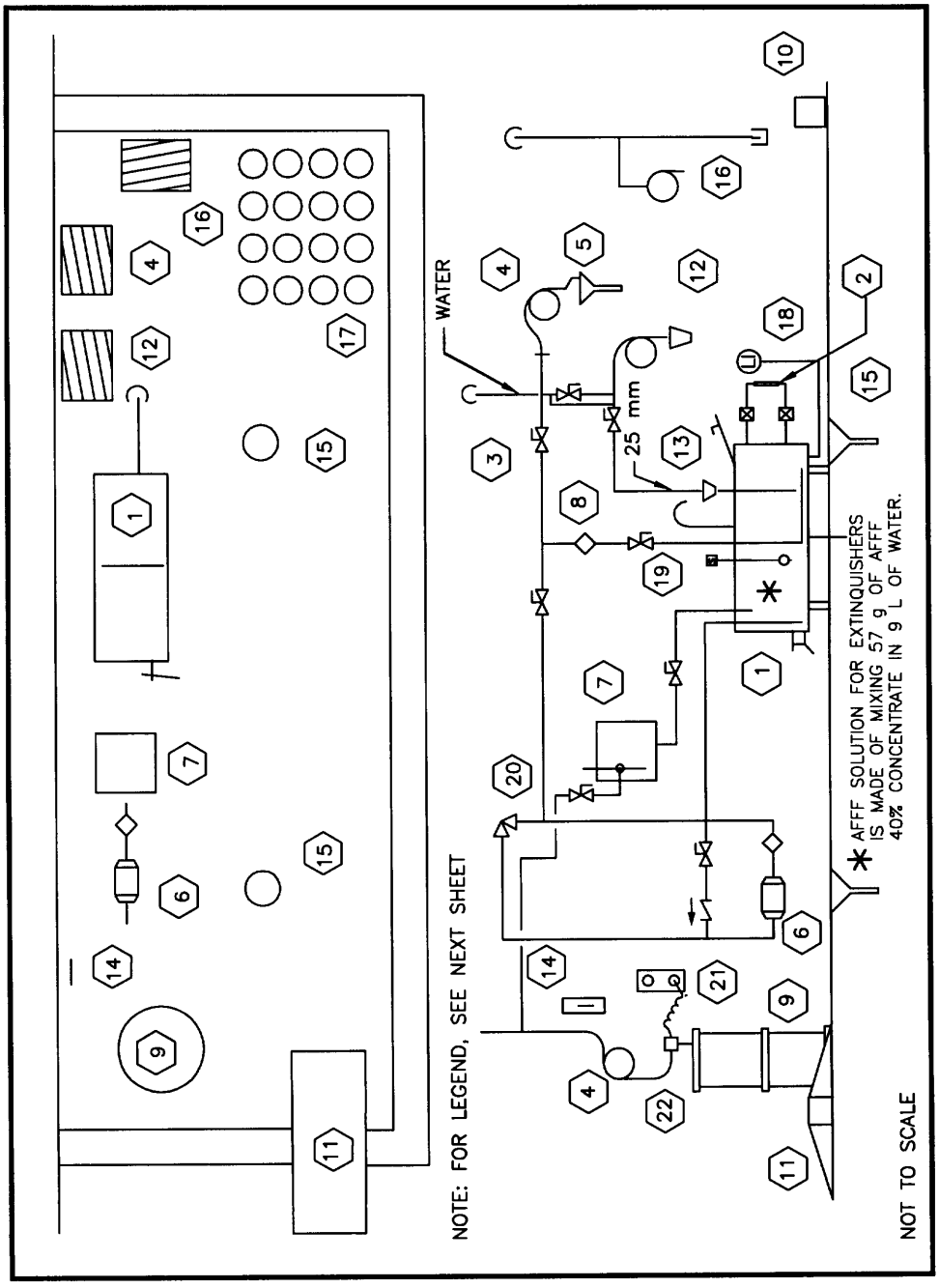


Figure G-10A
AFFF Fill Station

APPENDIX G (Continued)

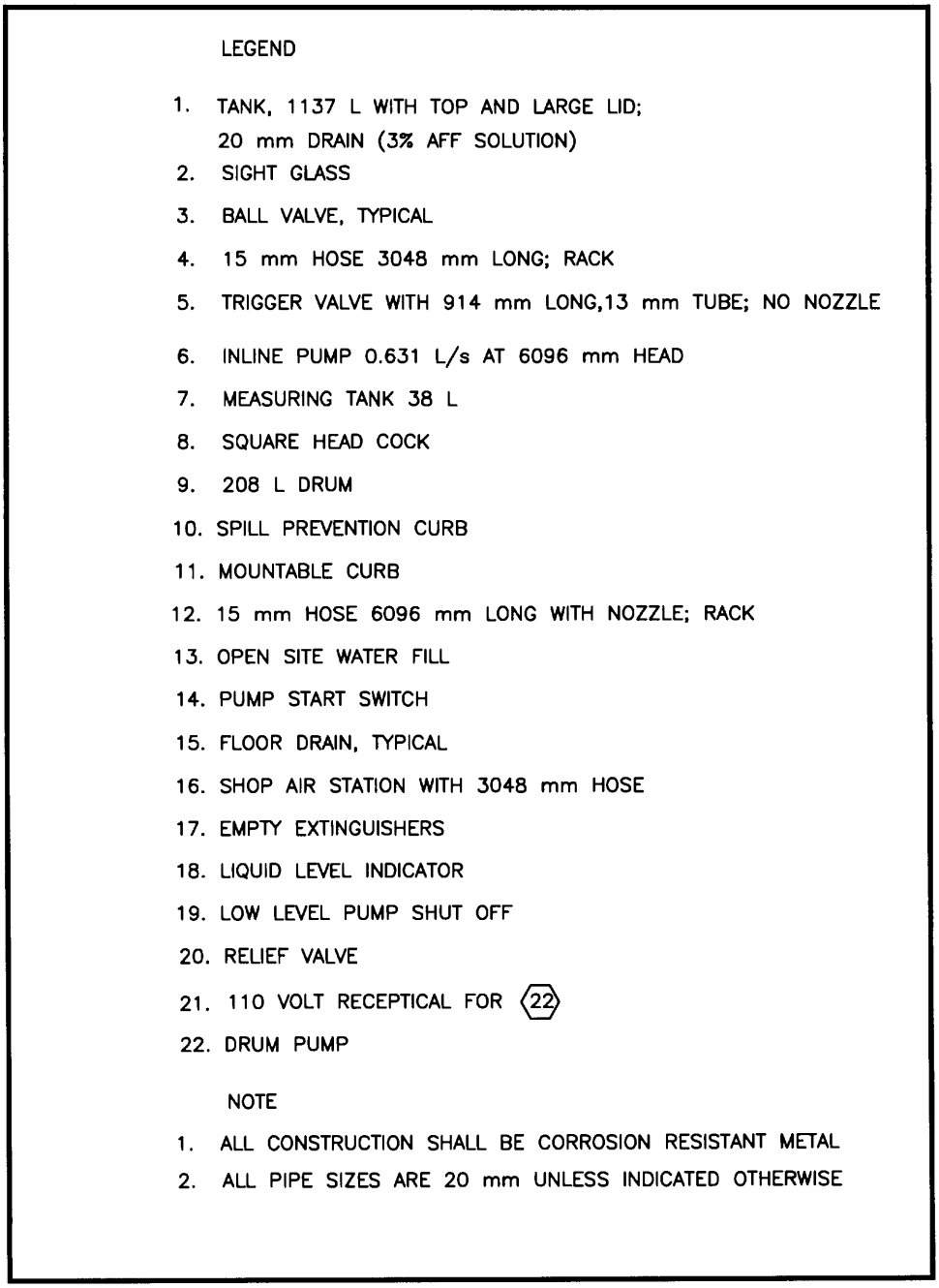


Figure G–10B
AFFF Fill Station

APPENDIX G (Continued)

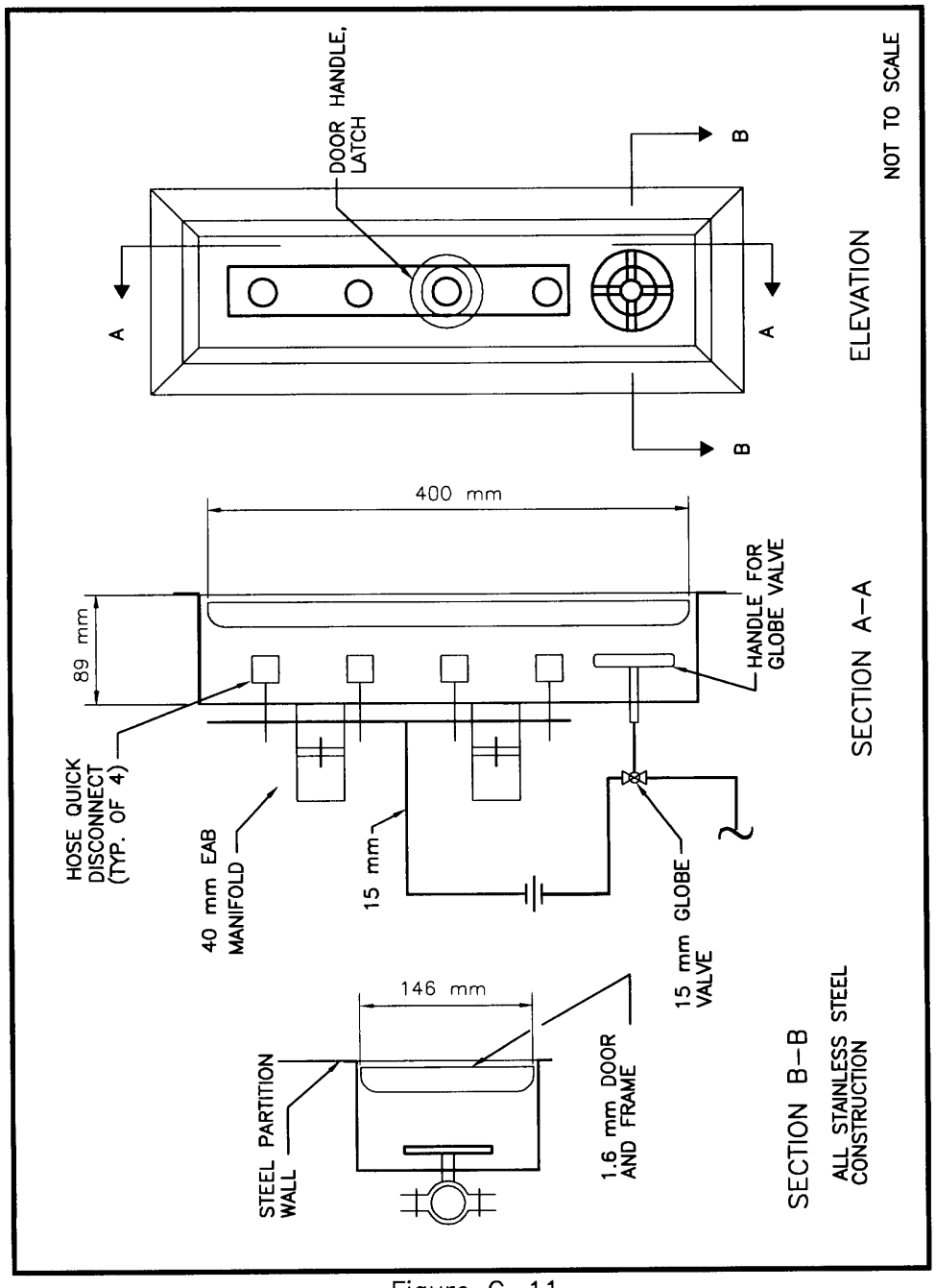


Figure G–11
21C12/21C12A EAB Outlet Housing

APPENDIX G (Continued)

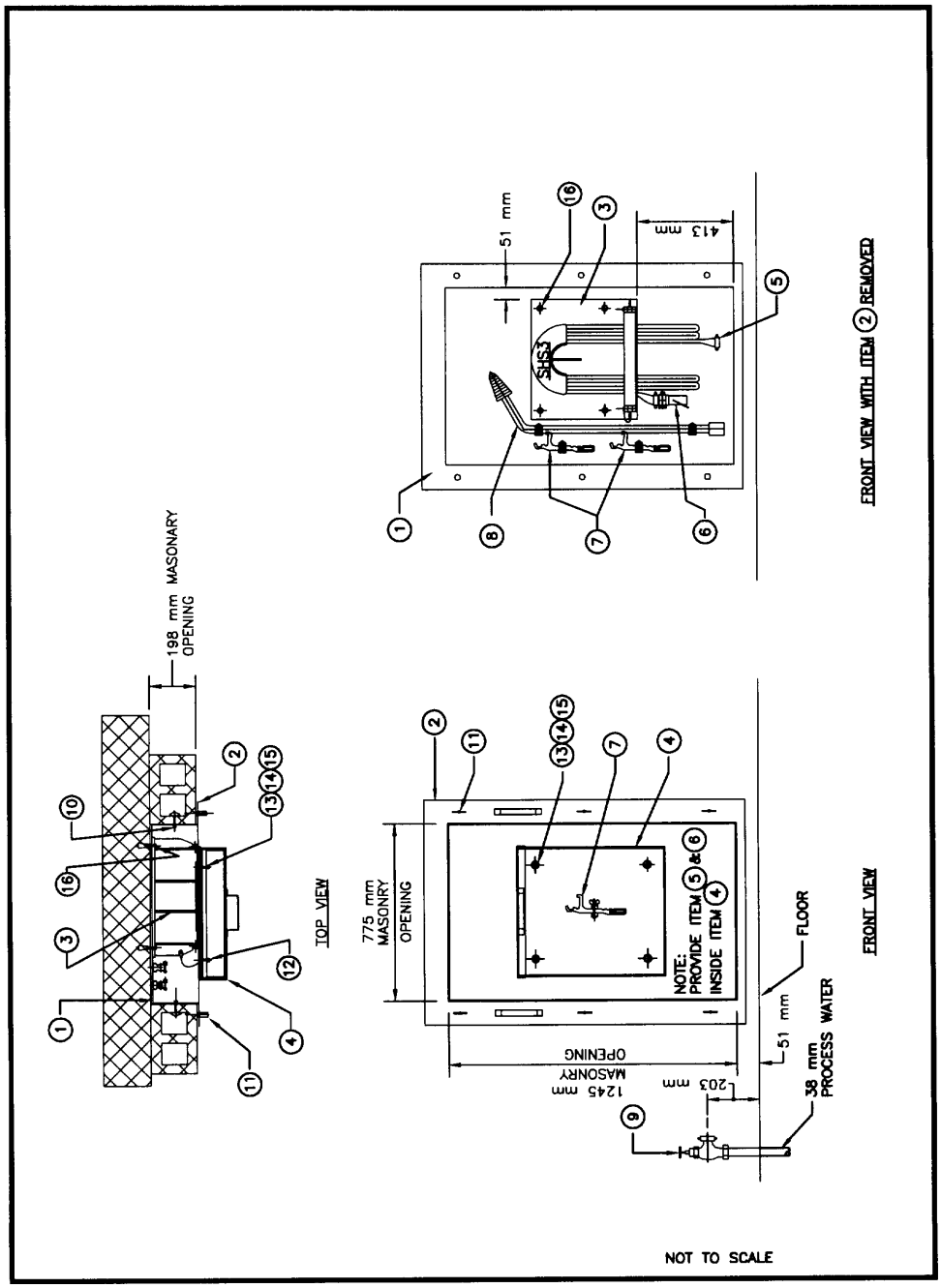


Figure G–12A
COMBINED HOSE STATION

APPENDIX G (Continued)

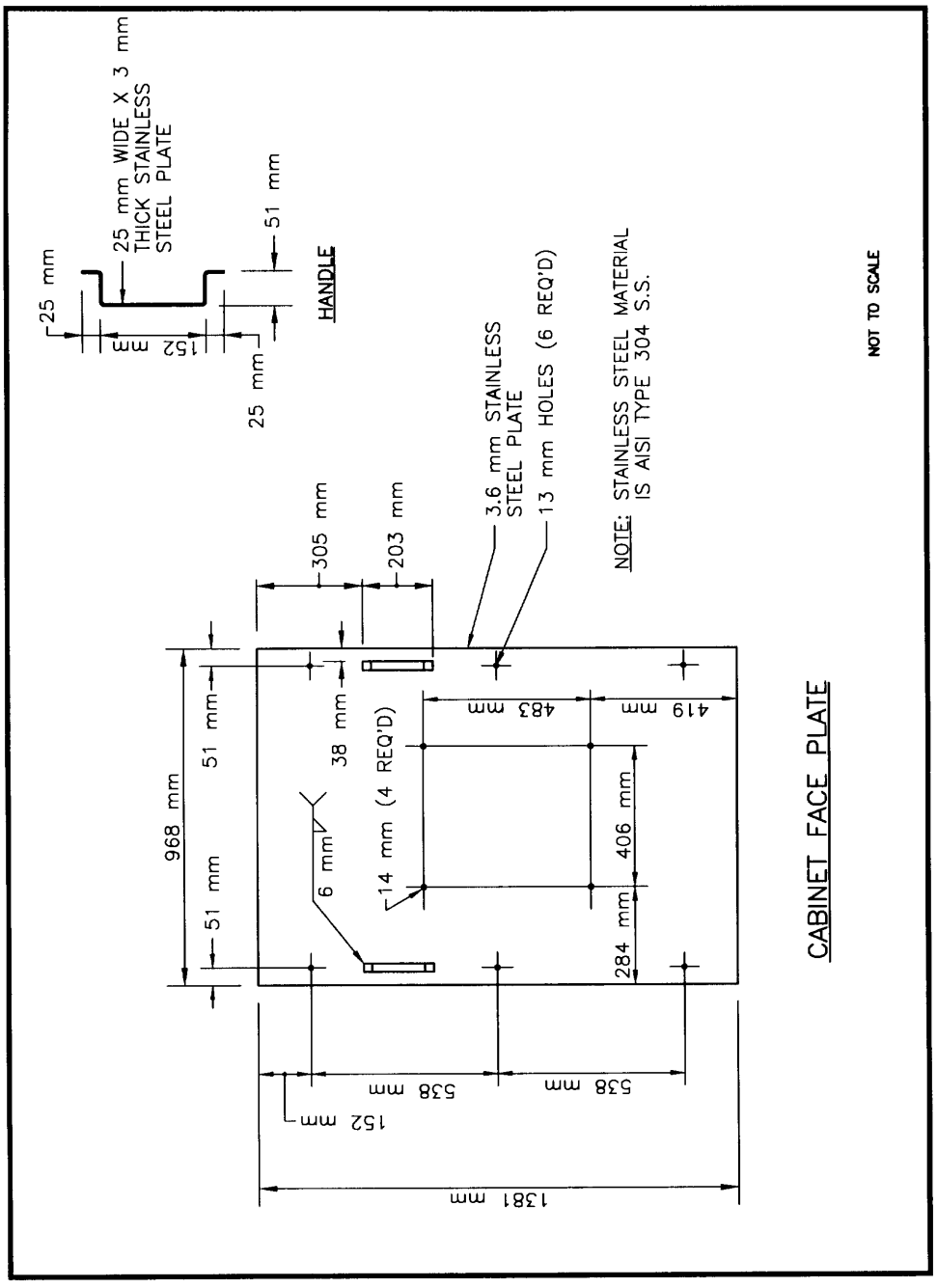


Figure G–12B
COMBINED HOSE STATION

APPENDIX G (Continued)

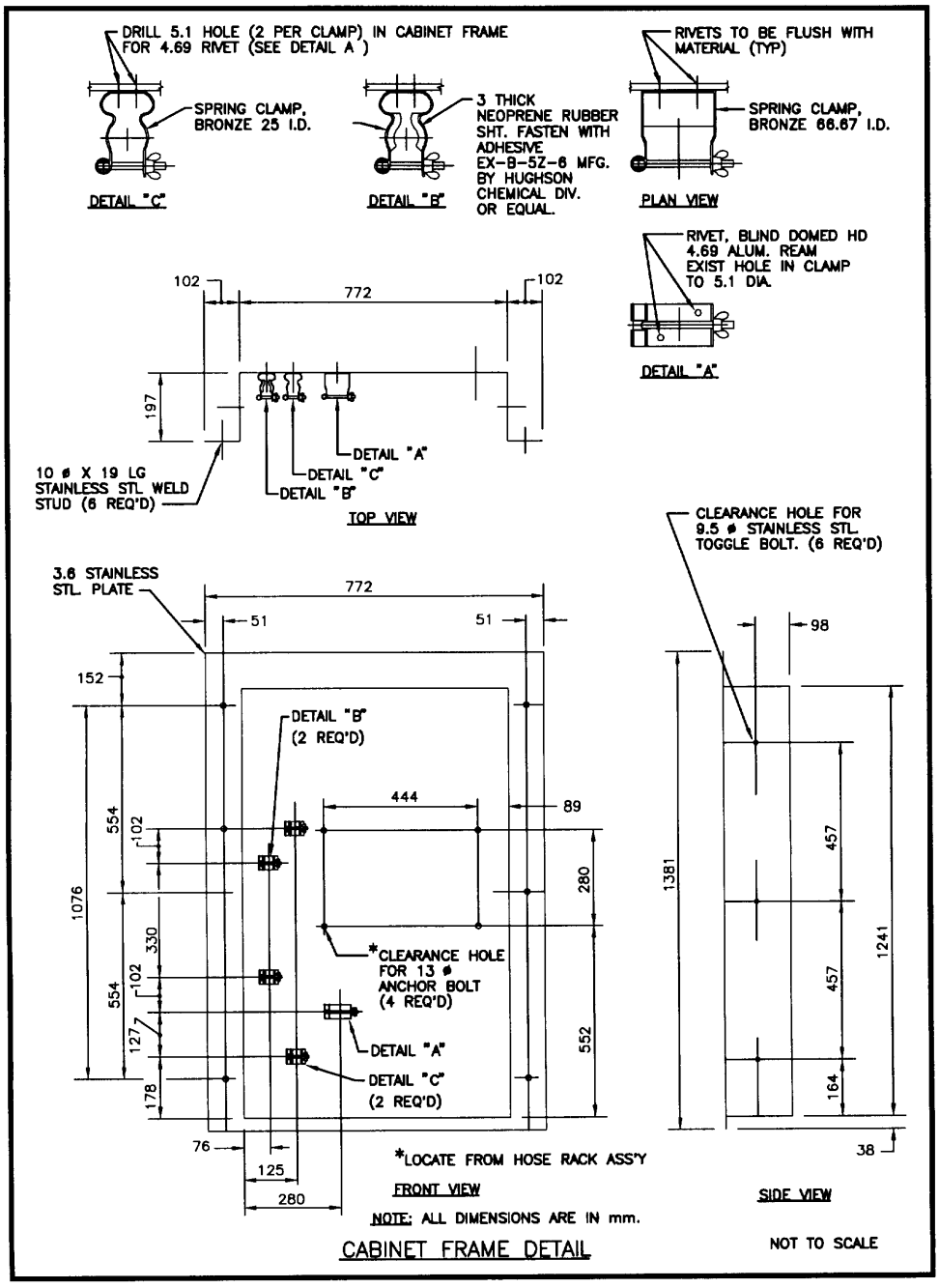


Figure G–12C

COMBINED HOSE STATION

APPENDIX G (Continued)

LIST OF MATERIALS

ITEM	QTY.	DESCRIPTION	REF. DRAWINGS
1	1	CABINET FRAME ASSY.	
2	1	CABINET FACE PLATE	
3	1	HOSE RACK ASSY.	
4	1	FIRE HOSE LOCKER ASSY	
5	2	FIRE HOSE – 40 mm x 7620 mm LONG	MIL–H–24606
6	2	FIRE HOSE NOZZLE – BRASS STYLE – 2069	NAVSHIPS 810–1385834
7	3	SPANER WRENCH STYLE 46	NAVSHIPS 810–4444647
8	1	APPLICATOR – 410 – STYLE 2069	NAVSHIPS 810–1385834
9	1	WALL OR FLOOR MTD. 40 mm HOSE ANGLE GLOBE VALVE, ONE END FLANGED. ONE END MALE THREADED WITH HOSE CAP AND CHAIN. BRONZE 40 mm	NAVSEA 803–1385711
10	6	10 mm ø S.S. TOGGLE BOLTS 114mm LONG	
11	6	10 mm ø S.S. WING NUTS	
12	4	13 mm THICK SPACER – S.S.	
13	4	13 mm S.S. NUT	
14	4	13 mm S.S. LOCK WASHER	
15	4	13 mm ø BOLT – 32 mm LONG	
16	4	13 mm ø ANCHOR BOLTS	

NOTE: STAINLESS STEEL MATERIAL IS AISI TYPE 304 S.S.

Figure G–12D
COMBINED HOSE STATION

APPENDIX G (Continued)

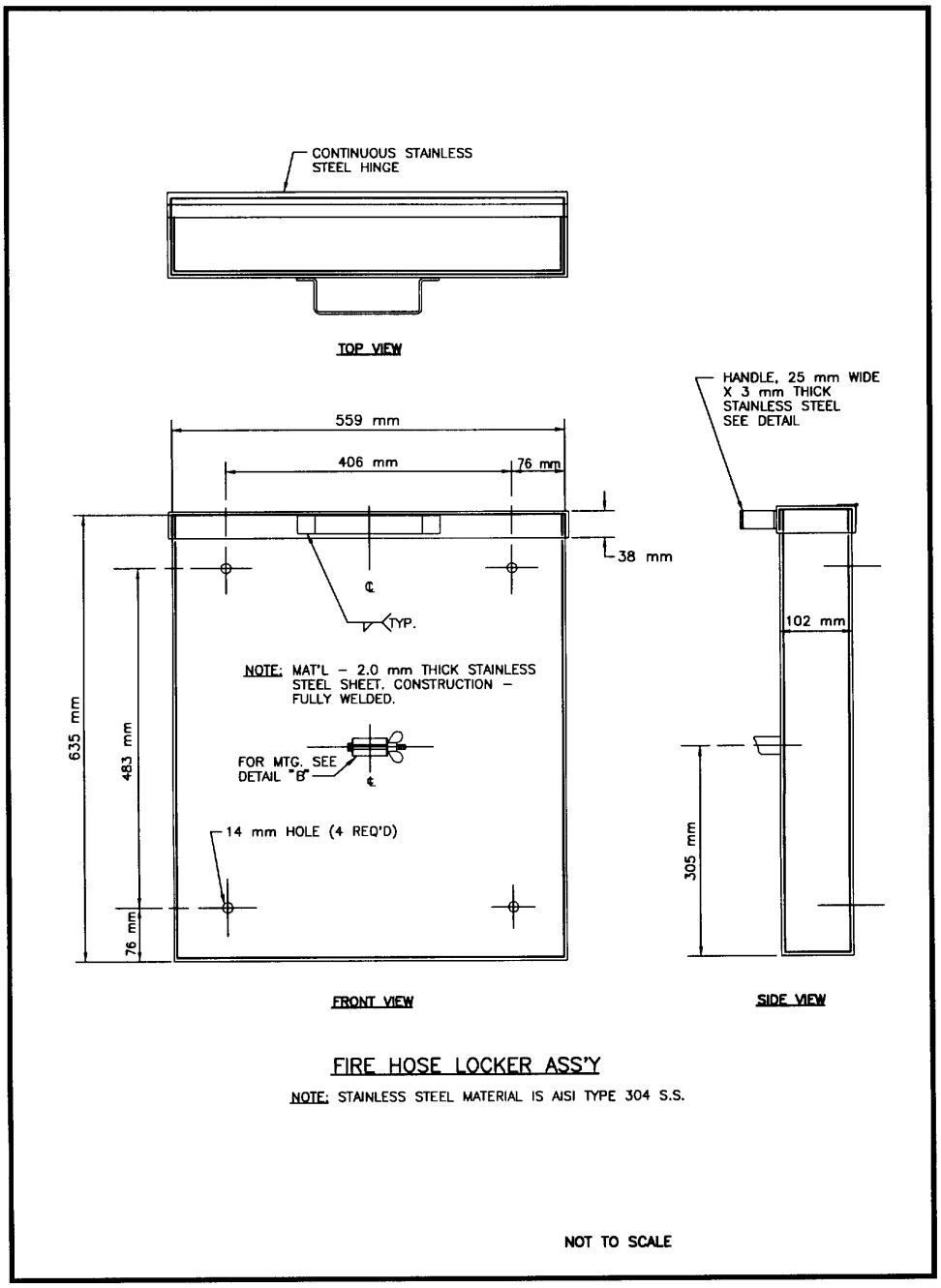


Figure G–12E
COMBINED HOSE STATION

APPENDIX G (Continued)

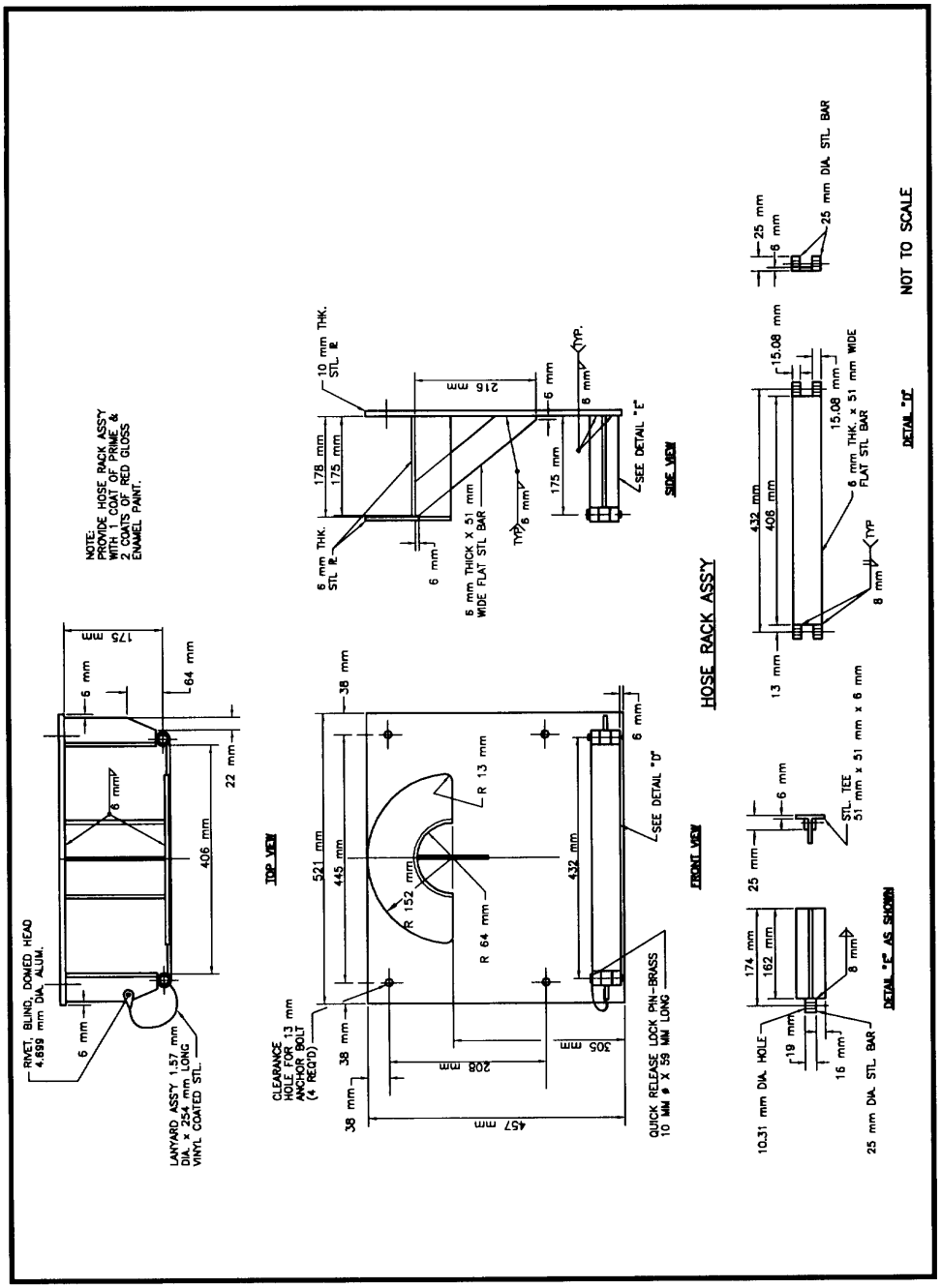


Figure G–12F
COMBINED HOSE STATION

APPENDIX G (Continued)

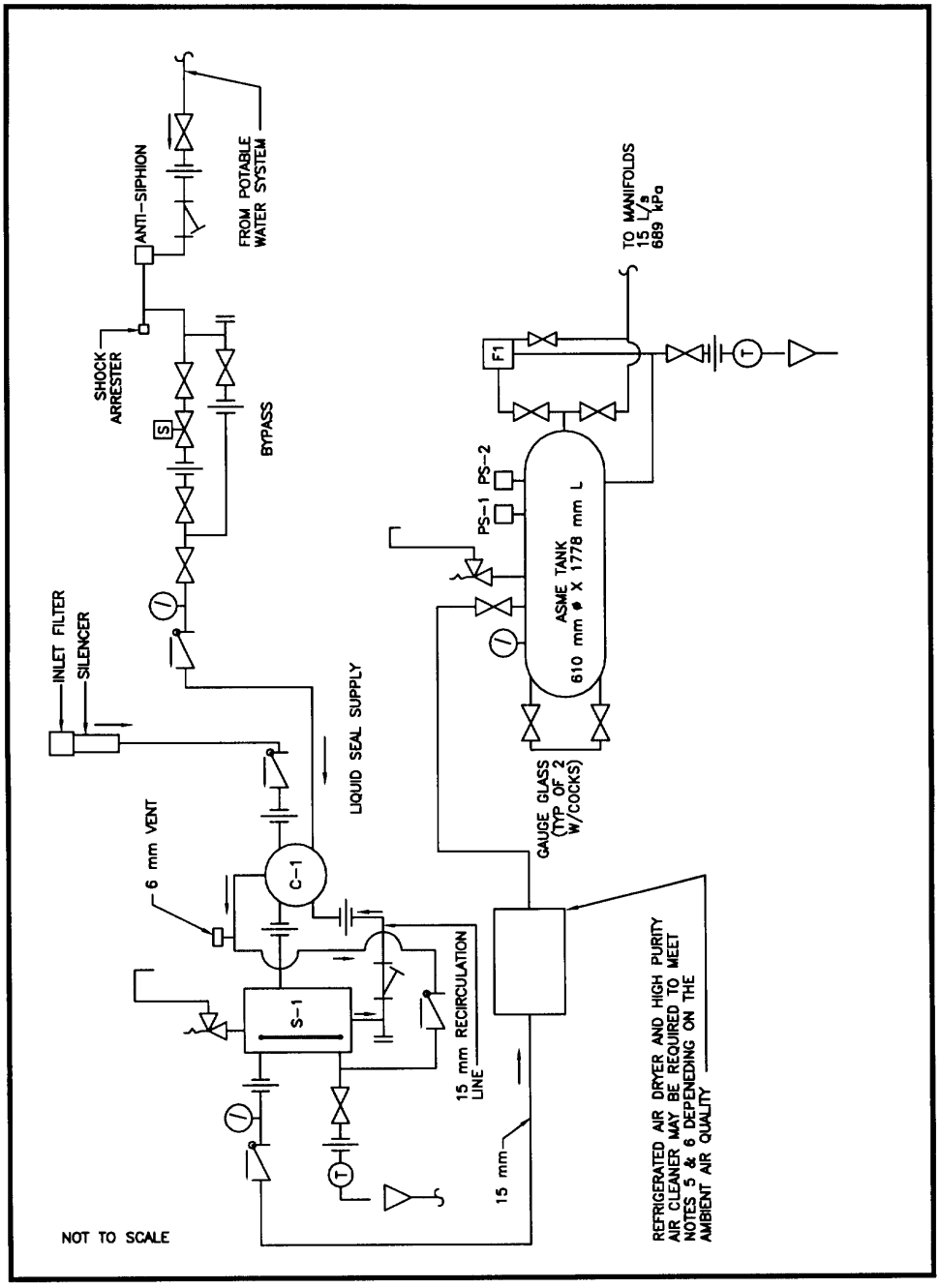


Figure G–13A

EAB SYSTEM SCHEMATIC

APPENDIX G (Continued)

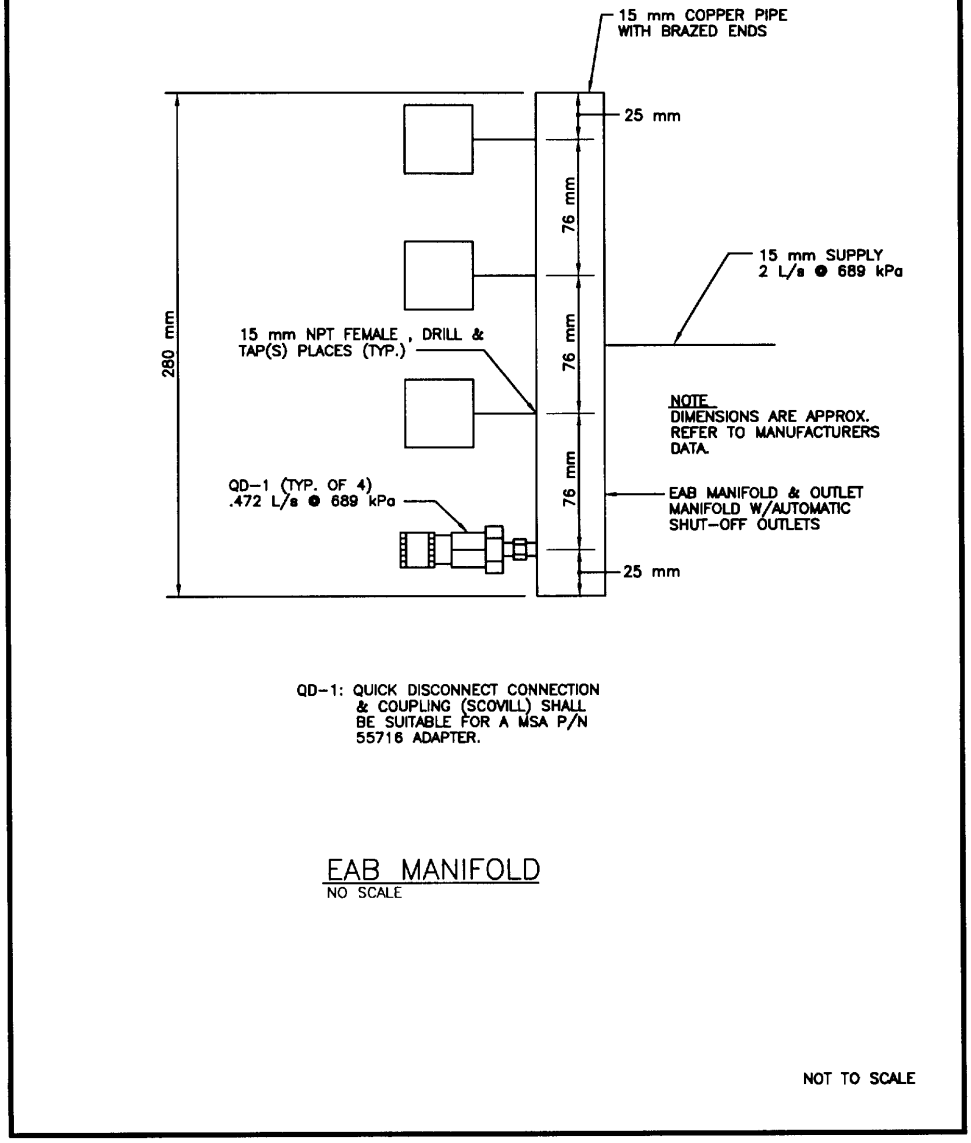


Figure G-13B
EAB SYSTEM SCHEMATIC

APPENDIX G (Continued)

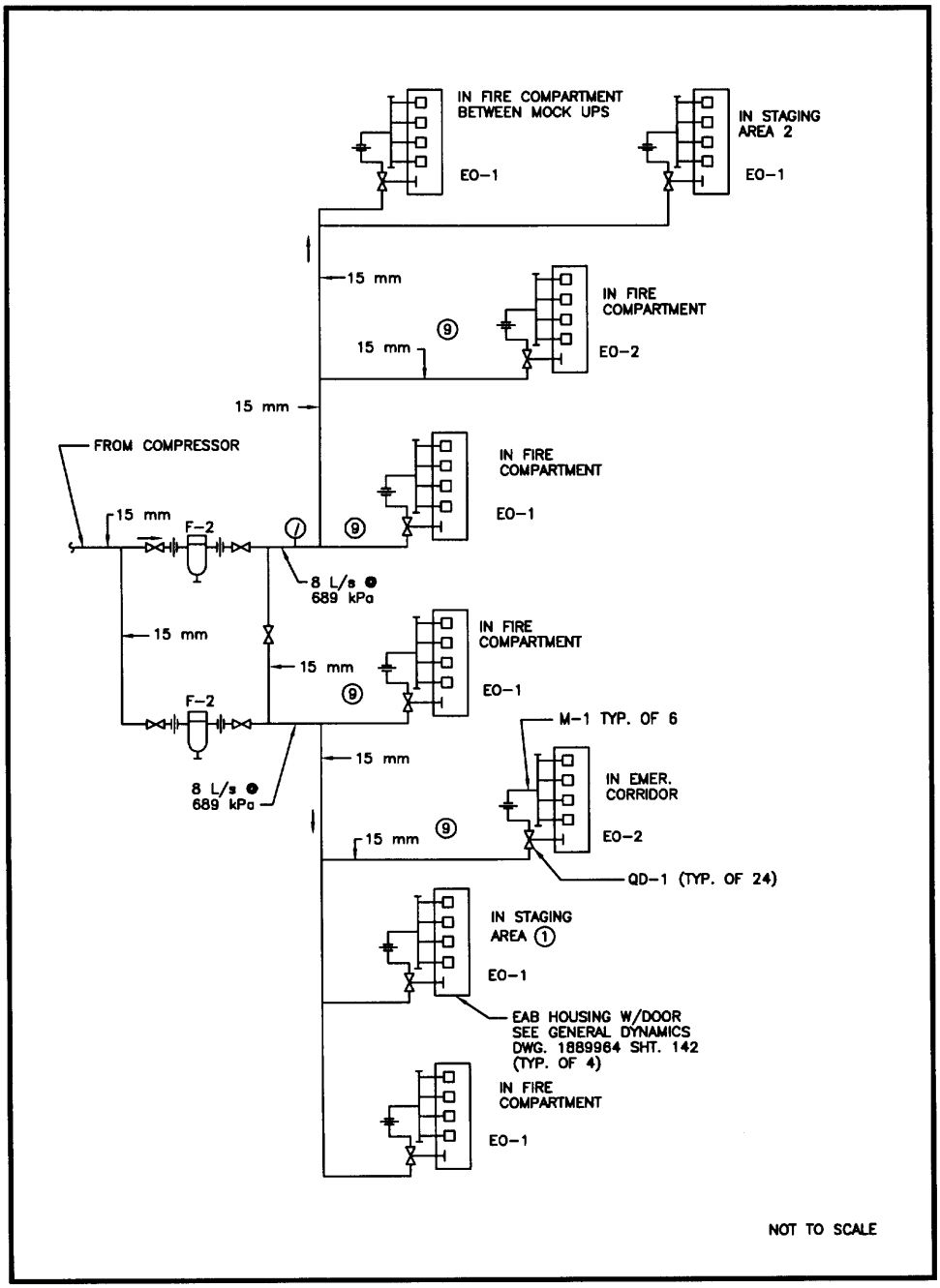


Figure G-13C
EAB SYSTEM SCHEMATIC

APPENDIX G (Continued)

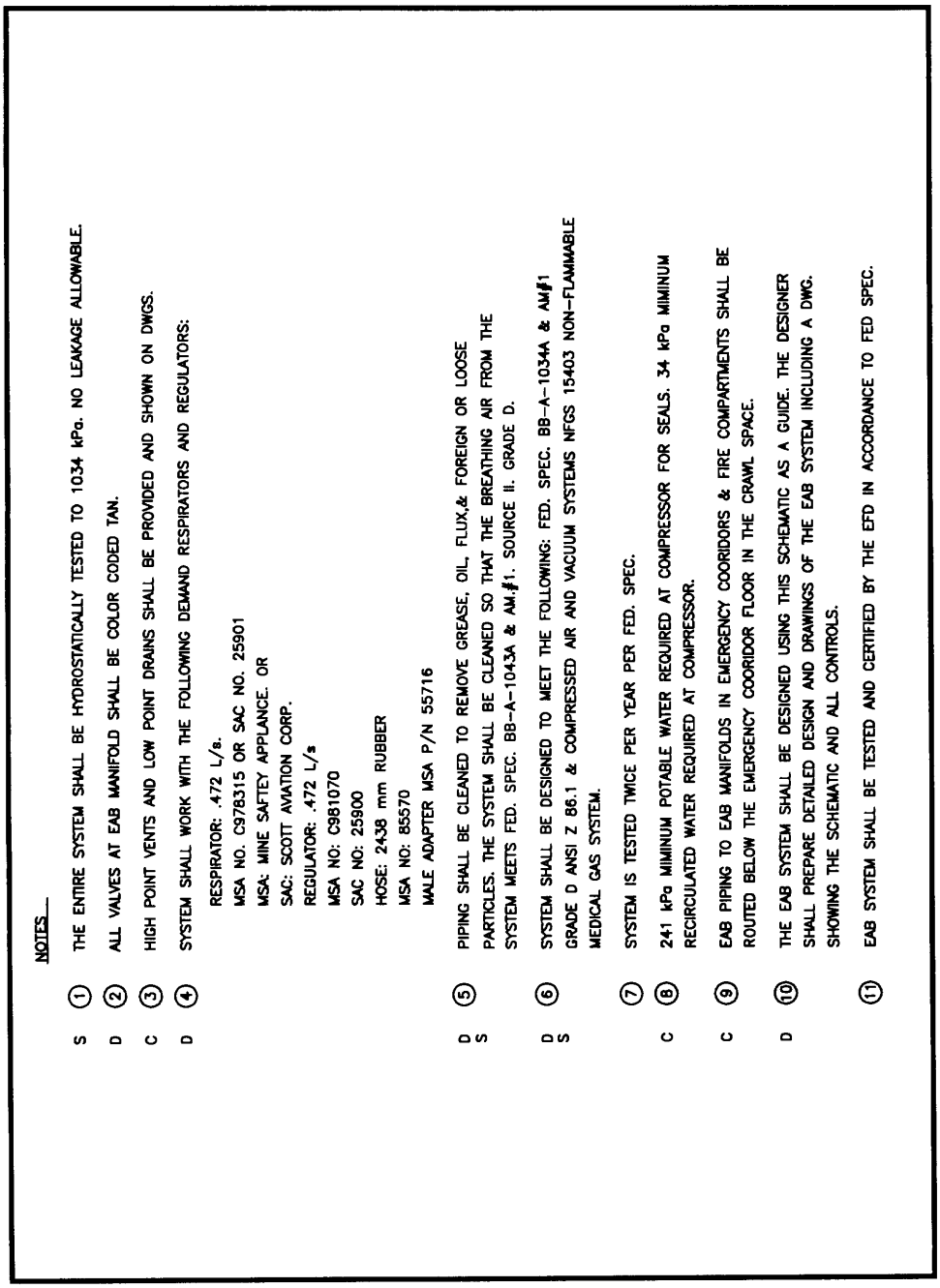


Figure G-13D

EAB SYSTEM SCHEMATIC

APPENDIX G (Continued)

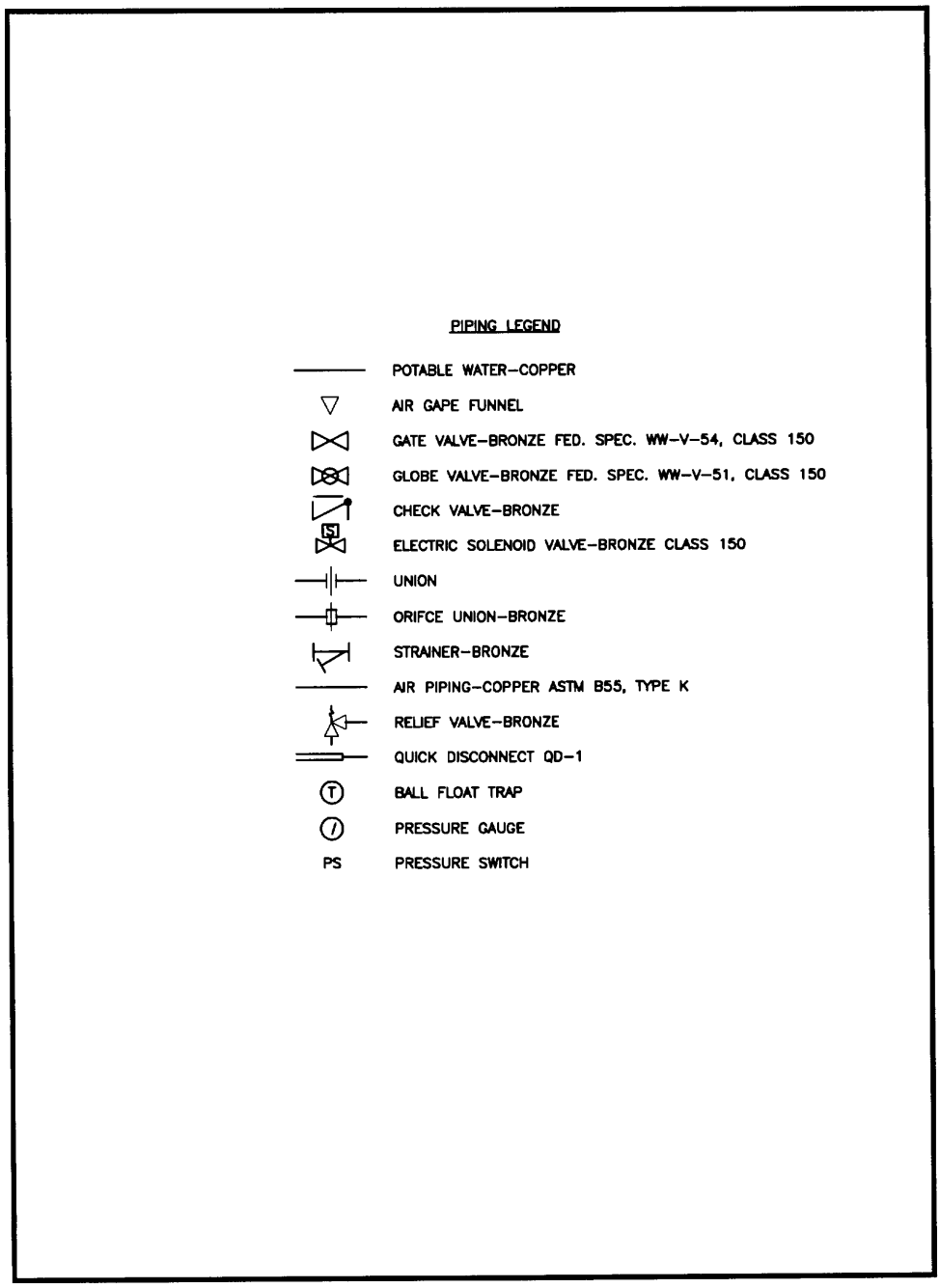


Figure G–13E
EAB SYSTEM SCHEMATIC

APPENDIX G (Continued)

REVISION CHANGES

MOVED SOLENOID VALVE
ADDED 2 EO-1 STATIONS
ADDED NOTE 11
CHANGED NOTE 6
ADDED AIR PURIFIER

EQUIPMENT SCHEDULE

NO.	DESCRIPTION	REFERENCE	SOURCE OF SUPPLY
F-1	SEPARATOR W/ FLOAT VALVE DRAIN TRAP		COMMERICAL- NASH *
F-2	15 mm AIR FILTER W/1 PARTICULATE FILTER 0.3 MICRON @ 99.7% & 2 ORGANIC CHARCOAL FILTERS 0.108 L/s CAPACITY		COMMERICAL- MINE SAFETY APPLIANCE CO.
S-1	SEPARATOR W/ FLOAT VALVE		COMMERICAL- NASH *
C-1	COMPRESSOR - 23 L/s, 689 kPa 245 KW, 3500 Mg/kg MOTOR		COMMERICAL- NASH, MODEL OC-5C UNIT *
QD-1	QUICK DISCONNECT CONNECTION & COUPLEING SHALL BE SUITABLE FOR A MALE ADAPTER (MSA P/N 55716) USED ON M-1		COMMERICAL- SCOVILL
M-1	FOUR OUTLET MANIFOLD ASSEMBLY (EAB MANIFOLD)		COMMERICAL- SCOTT AVIATION CORP.
EO-1	M-1 IN RECESSED CABINET		COMMERICAL- PROVIDE W/ DOOR
EO-2	M-1 W/O CABINET		COMMERICAL

*THE EAB COMPRESSOR UNIT SHALL BE AN OIL-LESS, SINGLE-STAGE, POSITIVE DISPLACEMENT, NON-PULSATING, LIQUID RING TYPE: NAS-ENGINEERING CO. MODLE OC-5C OR EQUAL.

D EAB EQUIPMENT:(GOVERMENT FURNISHED)

MINE SAFETY APPLIANCE CO. MODEL 85570, 2438 mm LONG RUBBER LONG WITH DEMAND REGULATOR 0.472 L/s REDUCES AIR PRESSURE FROM 689 kPa TO 14 kPa & DEMAND FLOW RESPIRATOR WITH ALL VISION FACE PIECE, 0.472 L/s @ 14 kPa

NOTE LEGEND

D- NOTES FOR APPLYING TO DWG
S- NOTE FOR SPECIFICATION REQUIREMENT
C- DESIGN COMMENTS FOR DESIGNER

Figure G-13F
EAB SYSTEM SCHEMATIC

APPENDIX G (Continued)

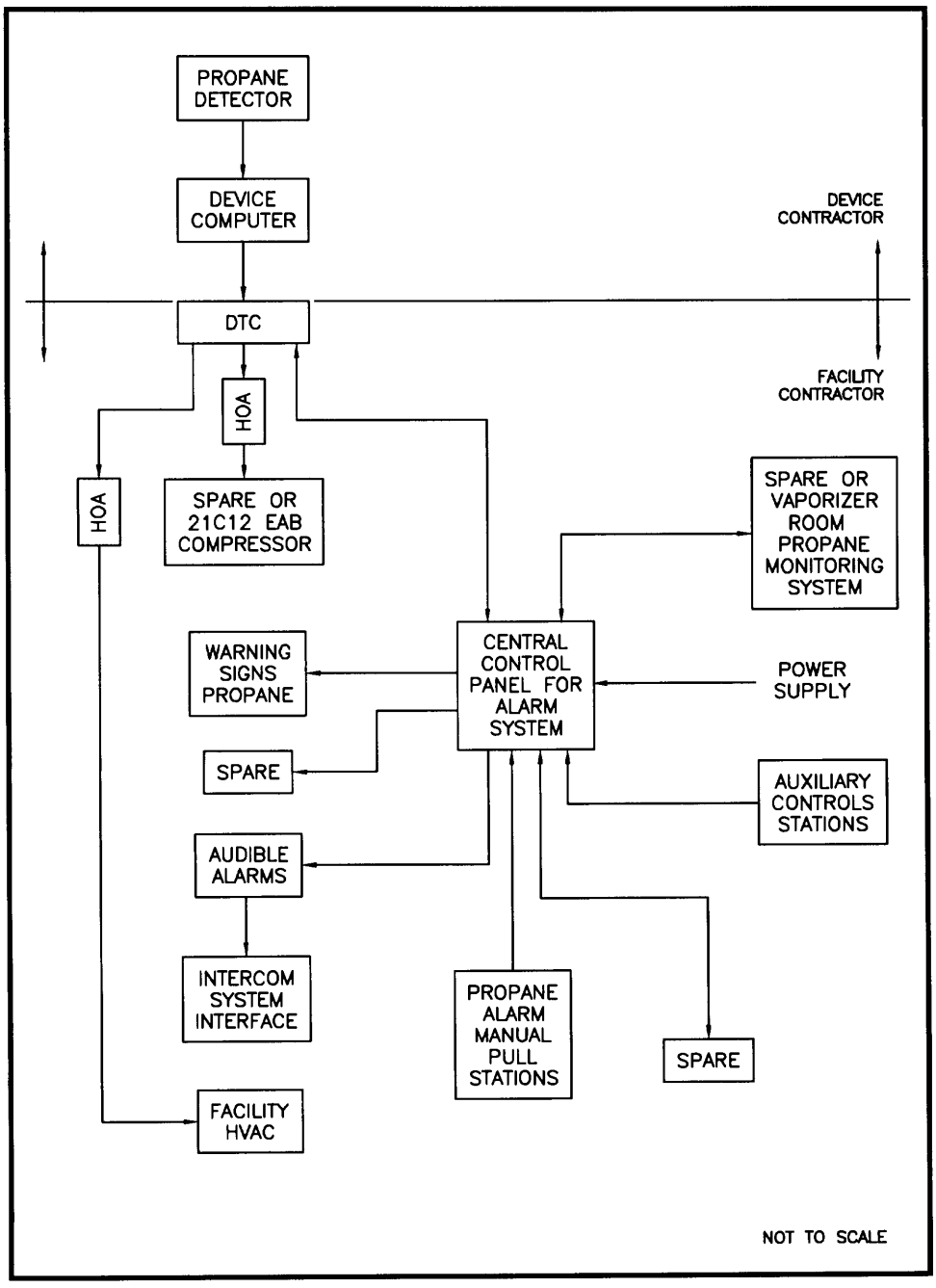


Figure G-14

21C12/21C12A - ALARM SYSTEM SCHEMATIC

APPENDIX H
GAS CHAMBER

Gas Chamber Gas Mask Wall Storage H-1
Gas Chamber Floor Plan H-2

APPENDIX H (Continued)

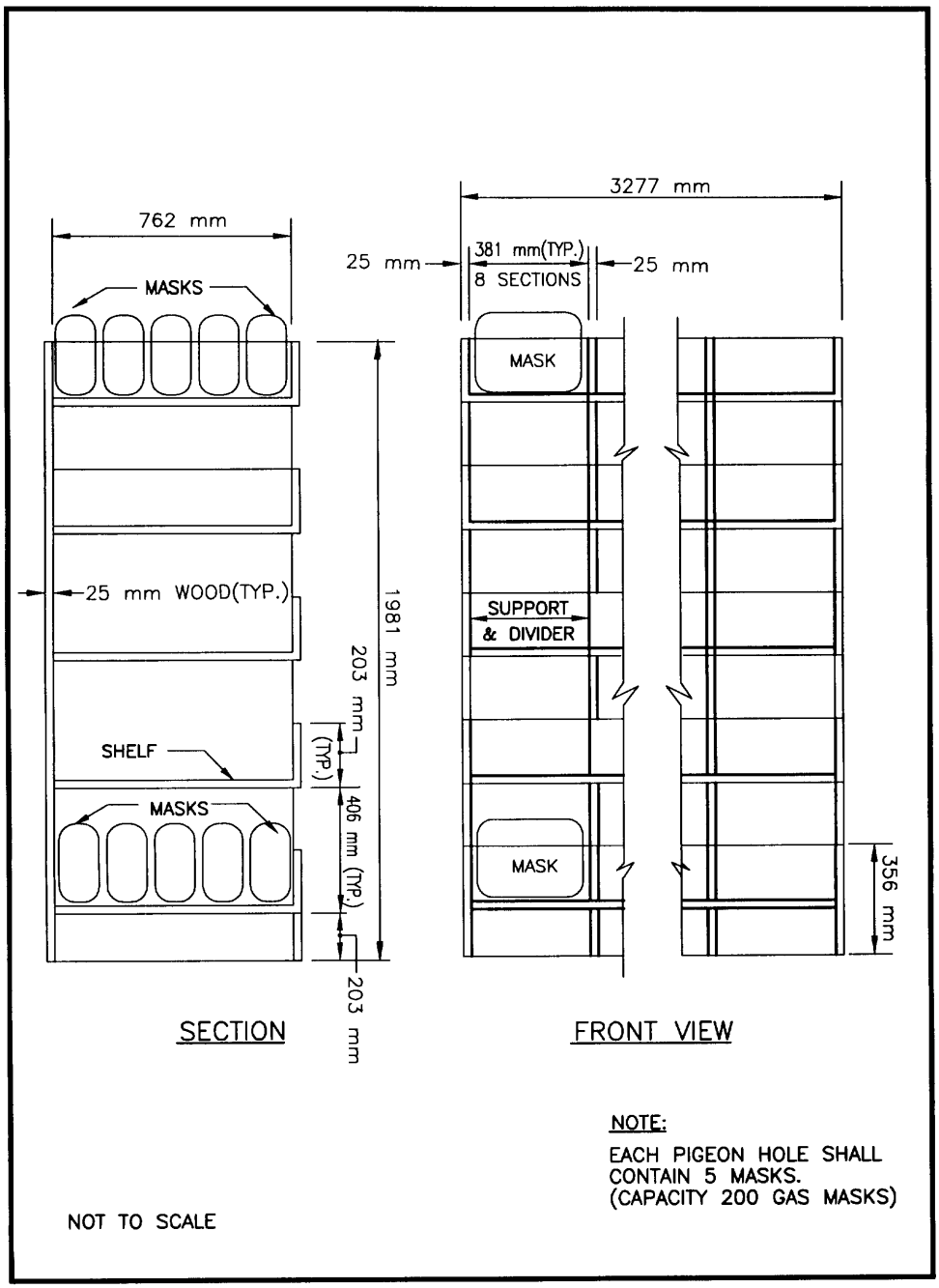


Figure H-1
Gas Chamber Gas Mask Wall Storage

APPENDIX H (Continued)

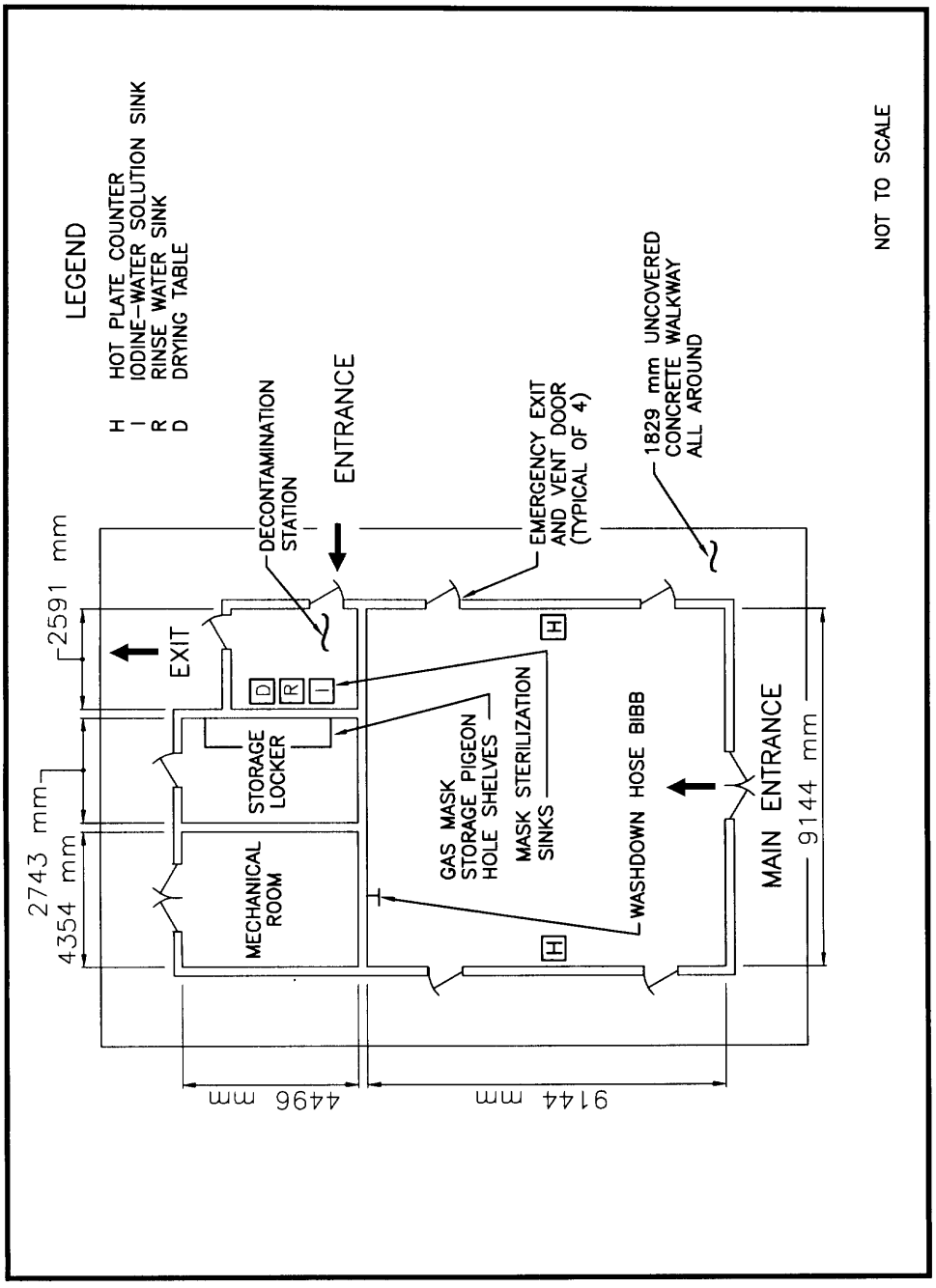
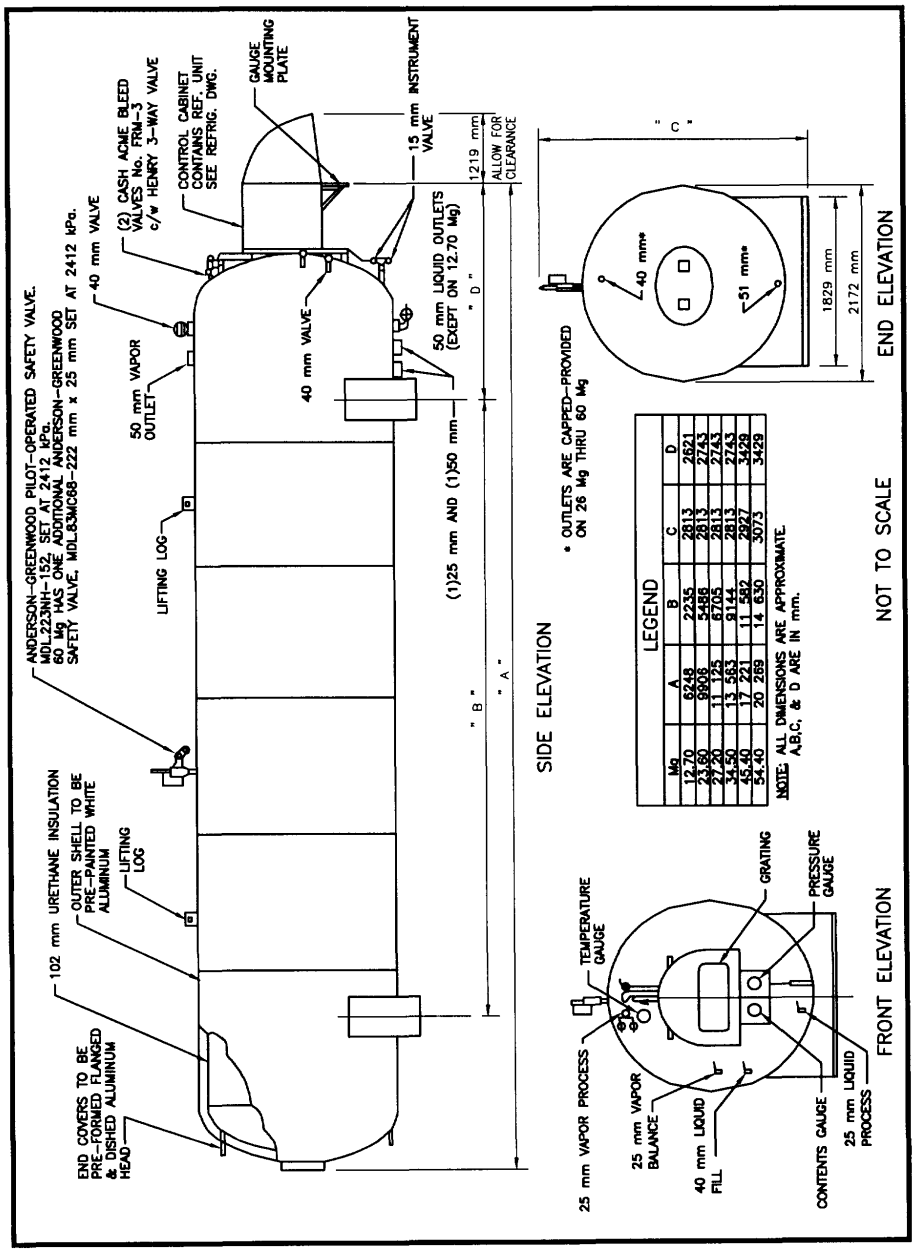


Figure H–2
Gas Chamber Floor Plan

APPENDIX I
CO_2

21C12/21C12A	CO_2 Bulk Tank Details	I-1
21C12/21C12A	CO_2 Schematics	I-2
21C12/21C12A	CO_2 Schematics	I-3
21C12/21C12A	CO_2 Manual Extinguisher Fill Pump	I-4
21C12/21C12A	CO_2 Flow Schematic	I-5
21C12/21C12A	CO_2 Wiring Schematic	I-6
21C12/21C12A	CO_2 Legend	I-7



Mg	A	B	C	D
12.70	6248	2235	2813	2621
24.60	9906	5486	2813	2743
29.20	11 125	6705	2813	2743
34.50	13 563	9144	2813	2743
45.40	17 221	11 582	2927	3429
54.40	20 269	14 630	3073	3429

Figure I–1
21C12/21C12A CO_2 Bulk Tank Details

APPENDIX I (Continued)

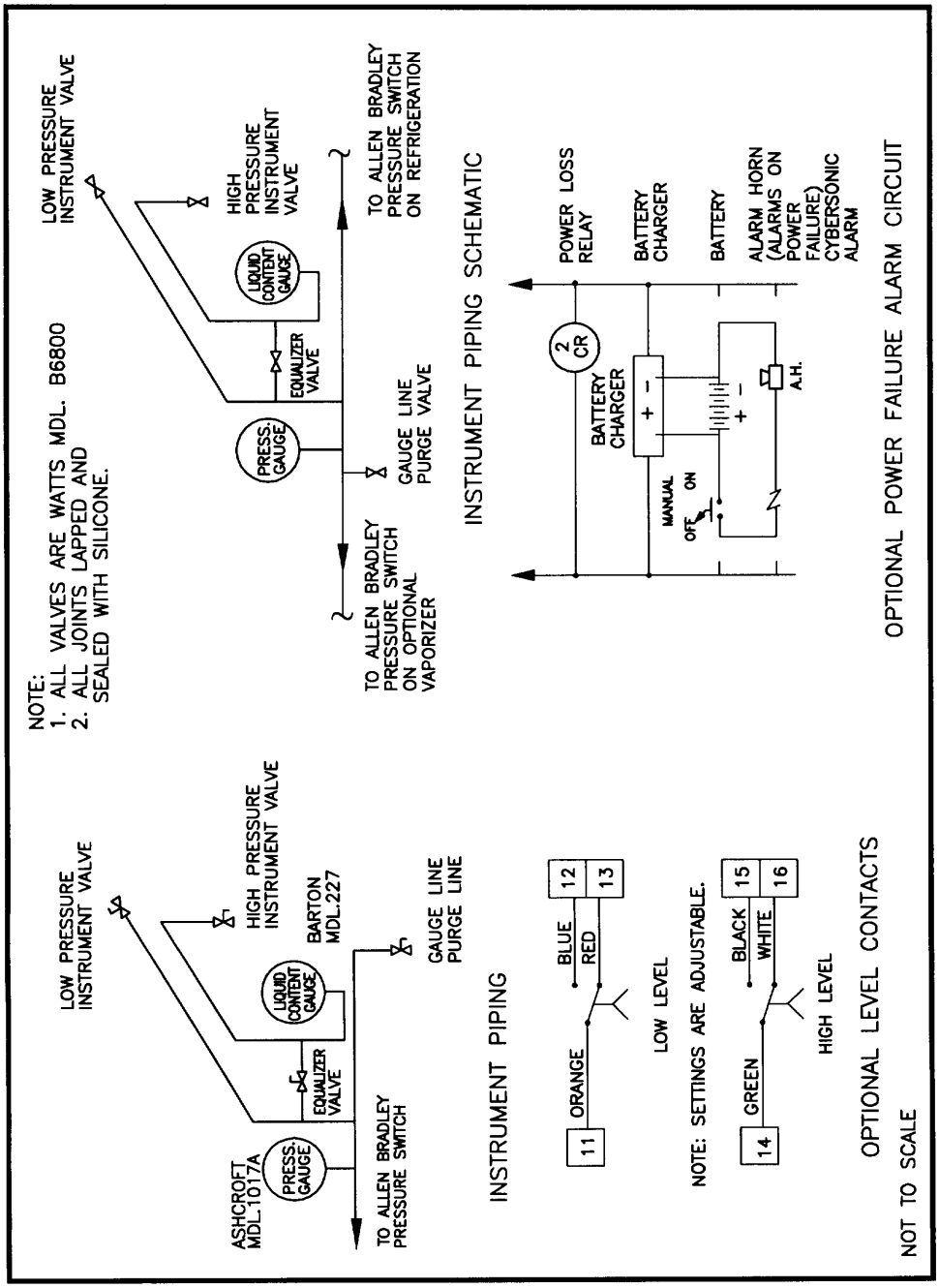


Figure I-2
21C12/21C12A CO_2 Schematics

APPENDIX I (Continued)

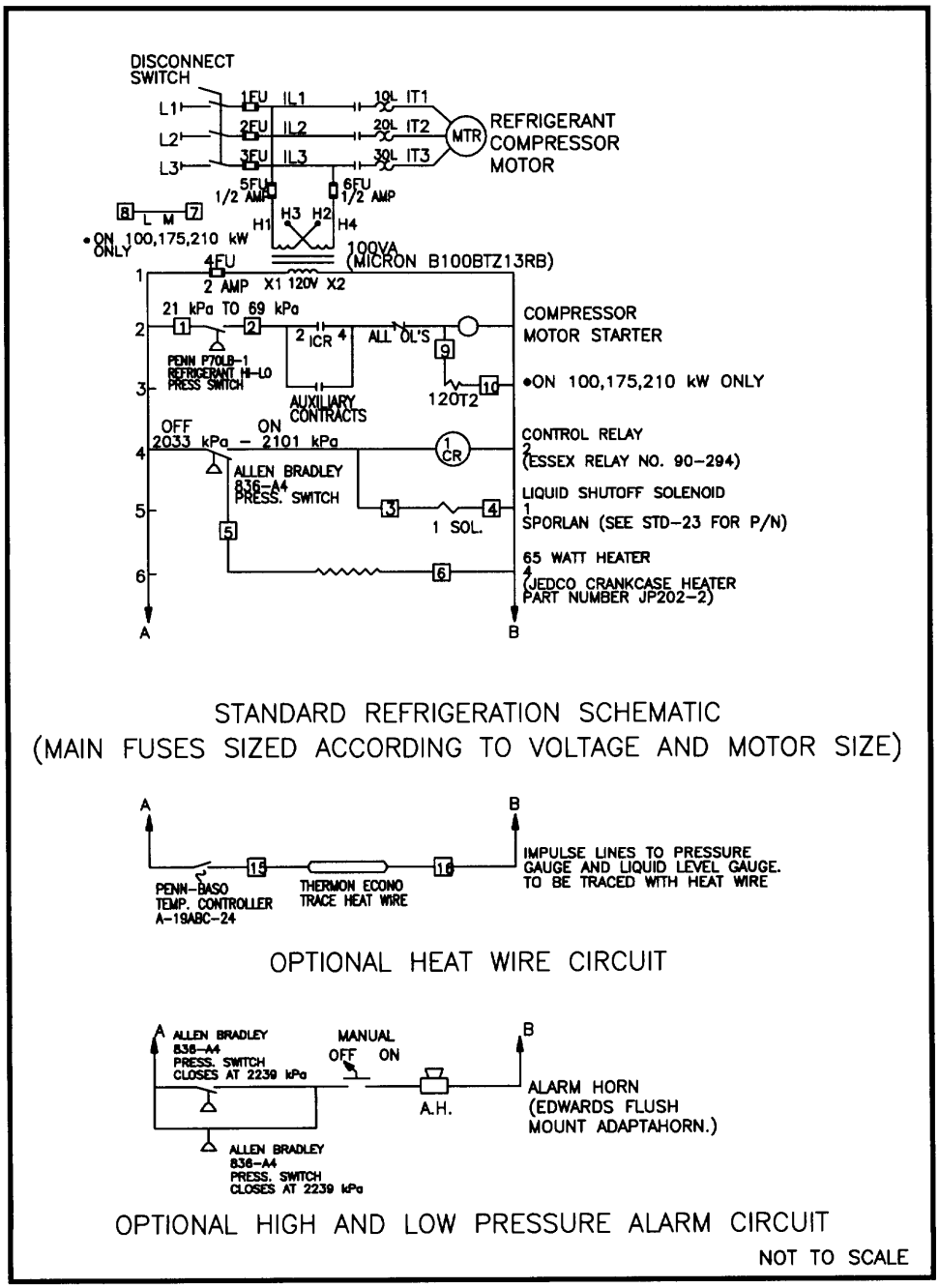


Figure I-3
21C12/21C12A CO_2 Schematics

APPENDIX I (Continued)

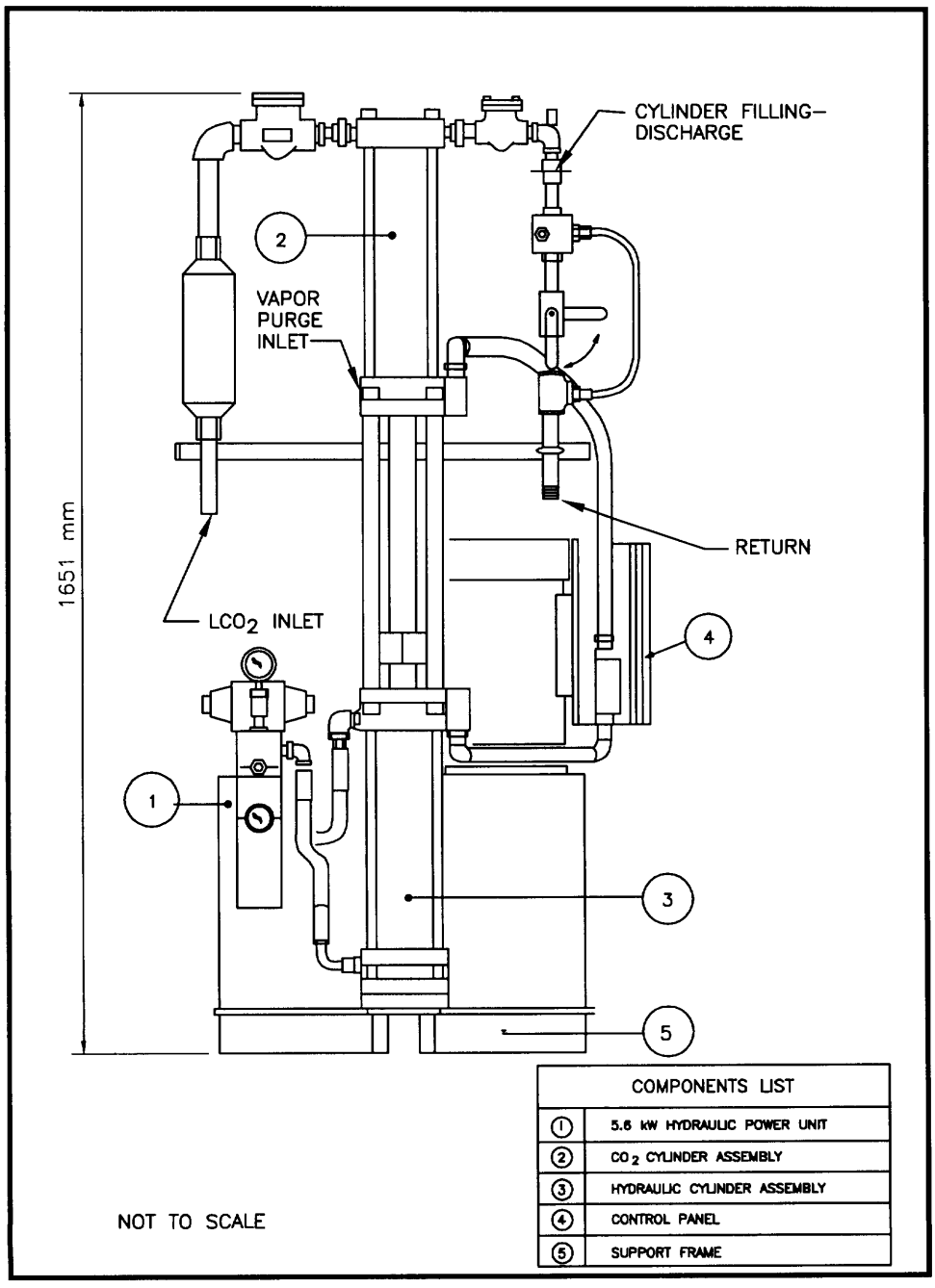


Figure I–4
21C12/21C12A CO_2 Manual Extinguisher Fill Pump

APPENDIX I (Continued)

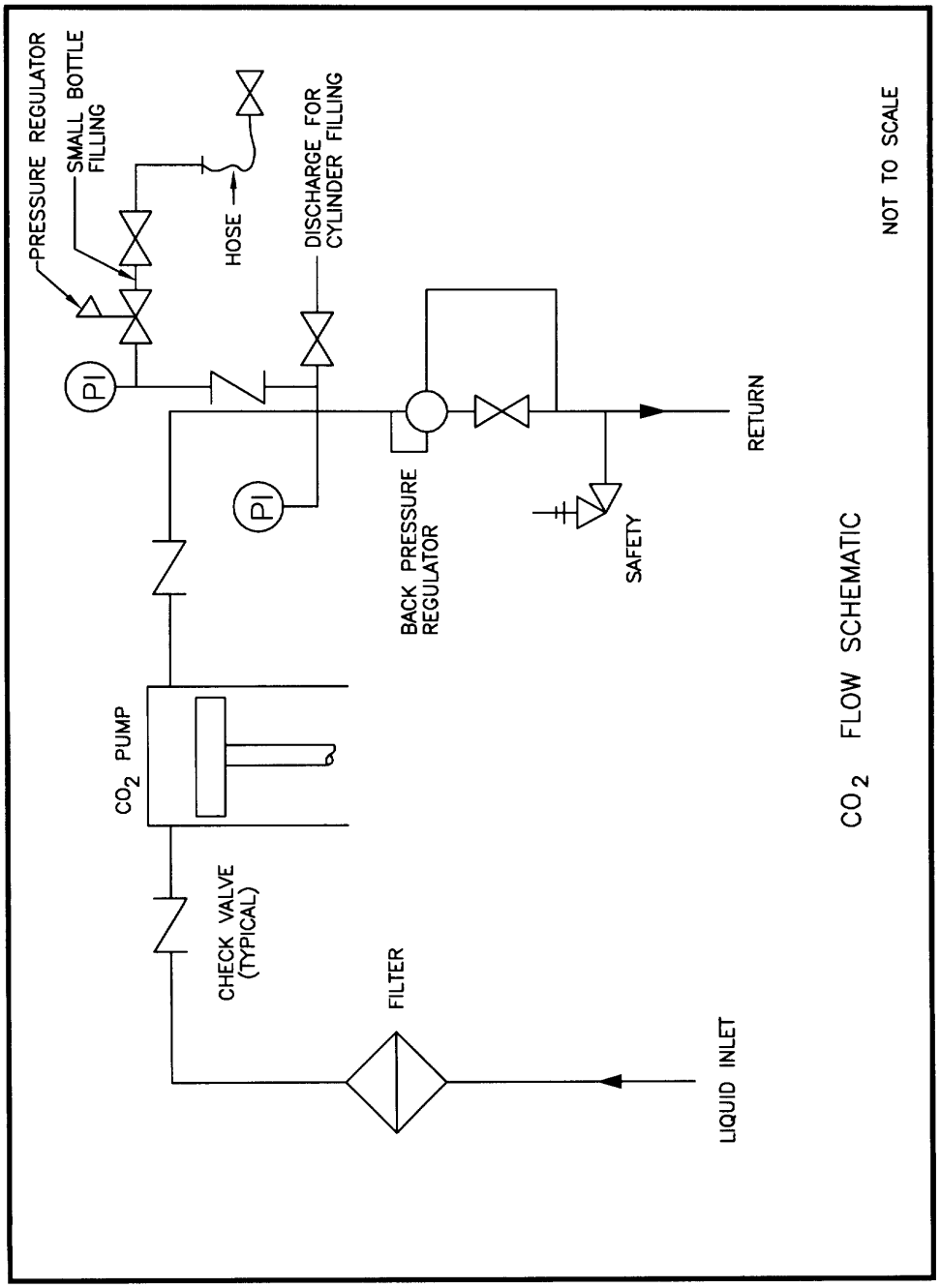


Figure I–5
21C12/21C12A CO_2 Flow Schematic

APPENDIX I (Continued)

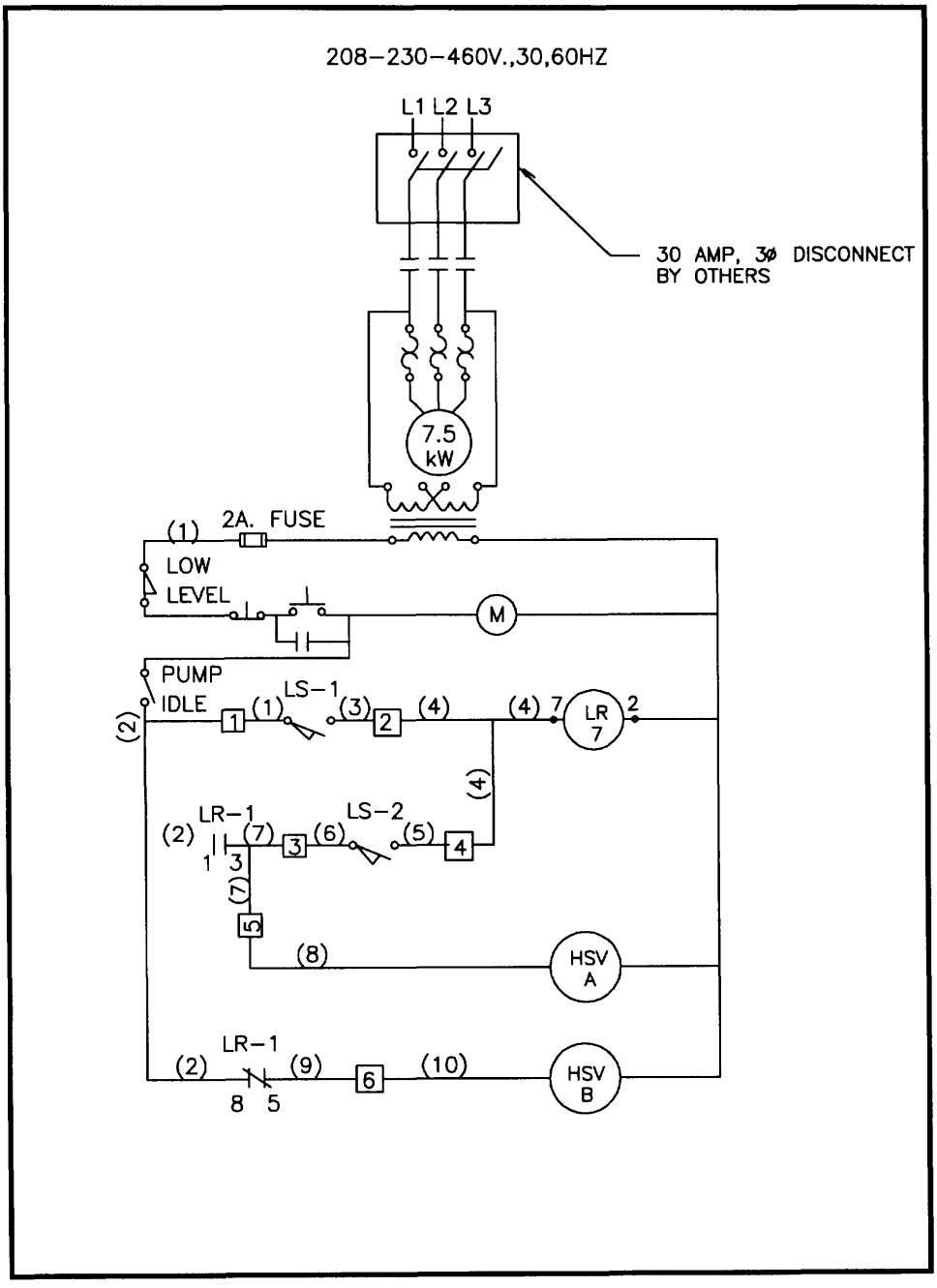


Figure I–6
21C12/21C12A CO_2 Wiring Schematic

APPENDIX I (Continued)

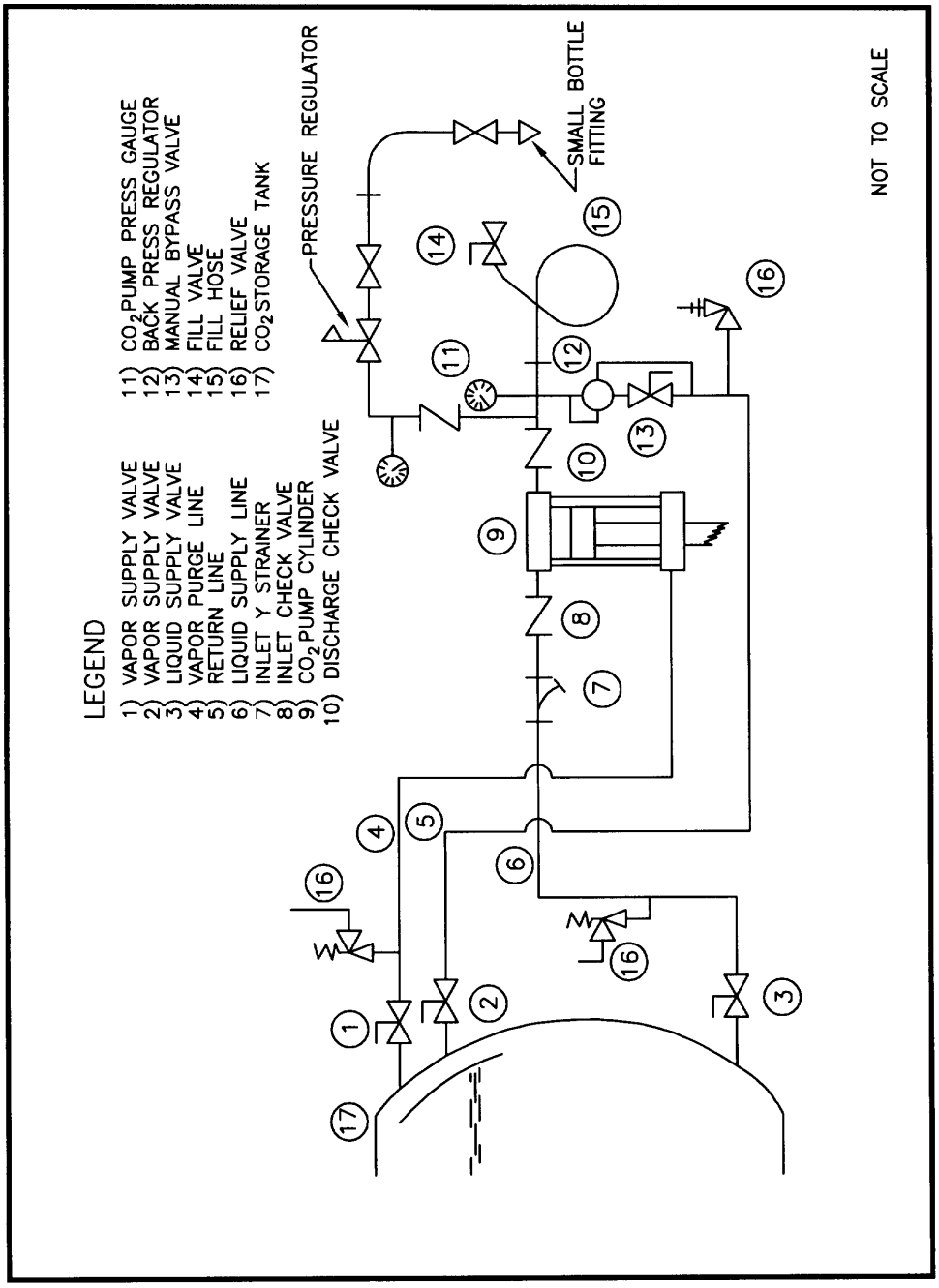


Figure I–7
21C12/21C12A CO_2 Legend

APPENDIX J
PROPANE

Clearance Requirements	J-1
Propane Gas Train at Facility/Device Interface	J-2
Symbol Interpretation/Identification	J-3
Waterbath Vaporizer With Liquid Pump	J-4
Steam Heated Vaporizer With Liquid Pump	J-5
Waterbath Vaporizer Without Liquid Pump	J-6
Steam Heated Vaporizer Without Liquid Pump	J-7

APPENDIX J (Continued)

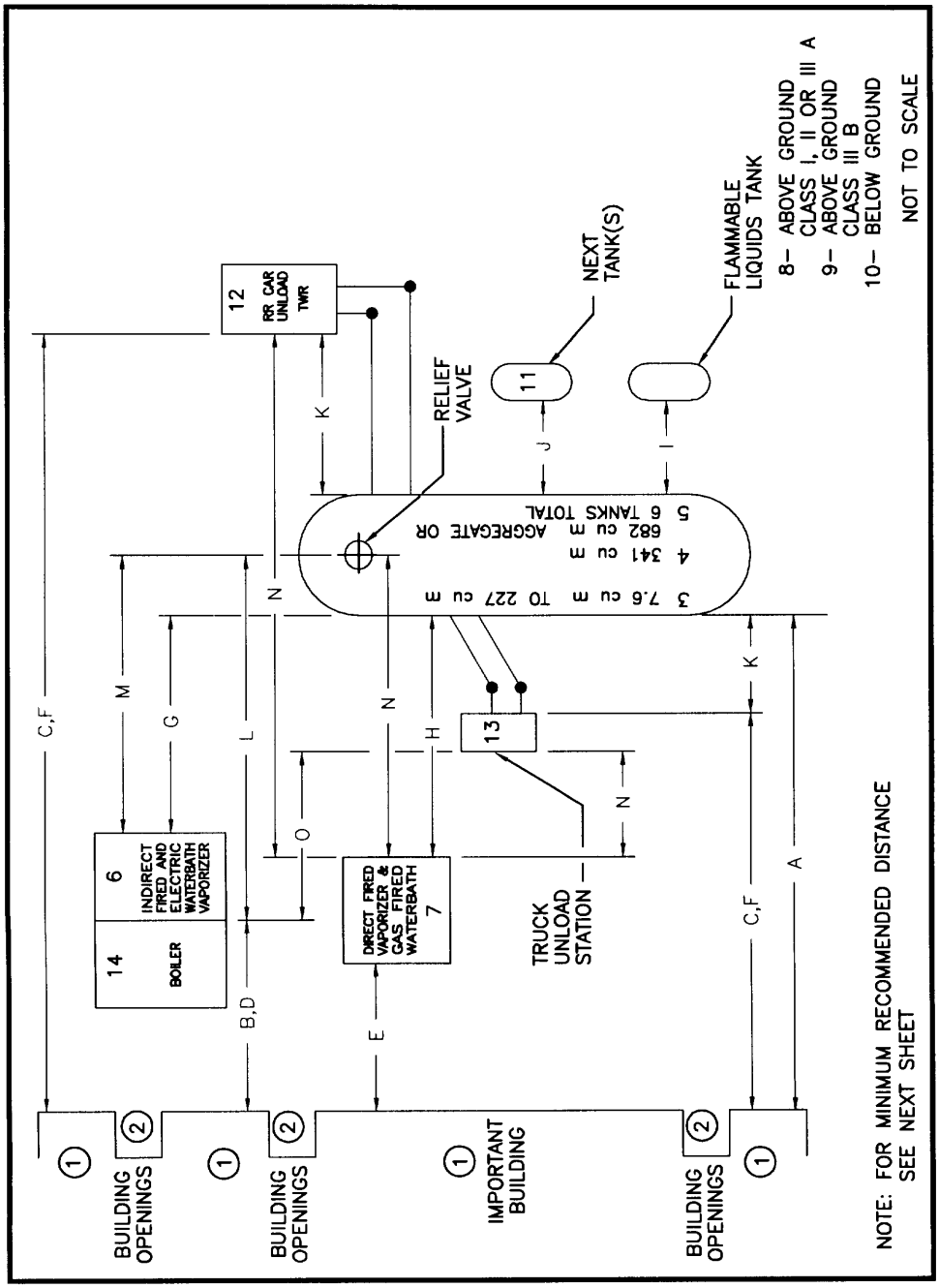


Figure J–1A
Clearance Requirements

APPENDIX J (Continued)

MINIMUM RECOMMENDED DISTANCE		
DIMENSION	POINT TO POINT	DISTANCE, mm
A	1 to 3 [a]	22 860
	4 [a]	45 720
	5 [b]	60 960
	5 [c]	106 680
B	6	6096
C	12	60 960
	13	15 240
D	2 to 6	6096
E	7	15 240
F	12	60 960
	13	22 860
G	3,4,5 to 6	1524
H	7	4572
I	8	30 480
	9	15 240
	10	6096
J	11 [d]	22 860
K	12	22 860
	13	15 240
L	14	22 860
M	6 to 15	15 240
N	7 to 12,13,15 [e]	22 860
O	13 to 14	22 860

NOTES:

a. FOR SINGLE TANKS ONLY. TREAT MULTIPLE TANKS AS NO. 5
b. FOR BUILDINGS WITH HYDRANT PROTECTION.
c. FOR BUILDINGS WITHOUT HYDRANT PROTECTION.
d. 1524 mm FOR TANKS WITHIN A GROUP.
e. FOR TANKS SMALLER THAN 758 L, 7620 mm.

Figure J–1B
Clearance Requirements

APPENDIX J (Continued)

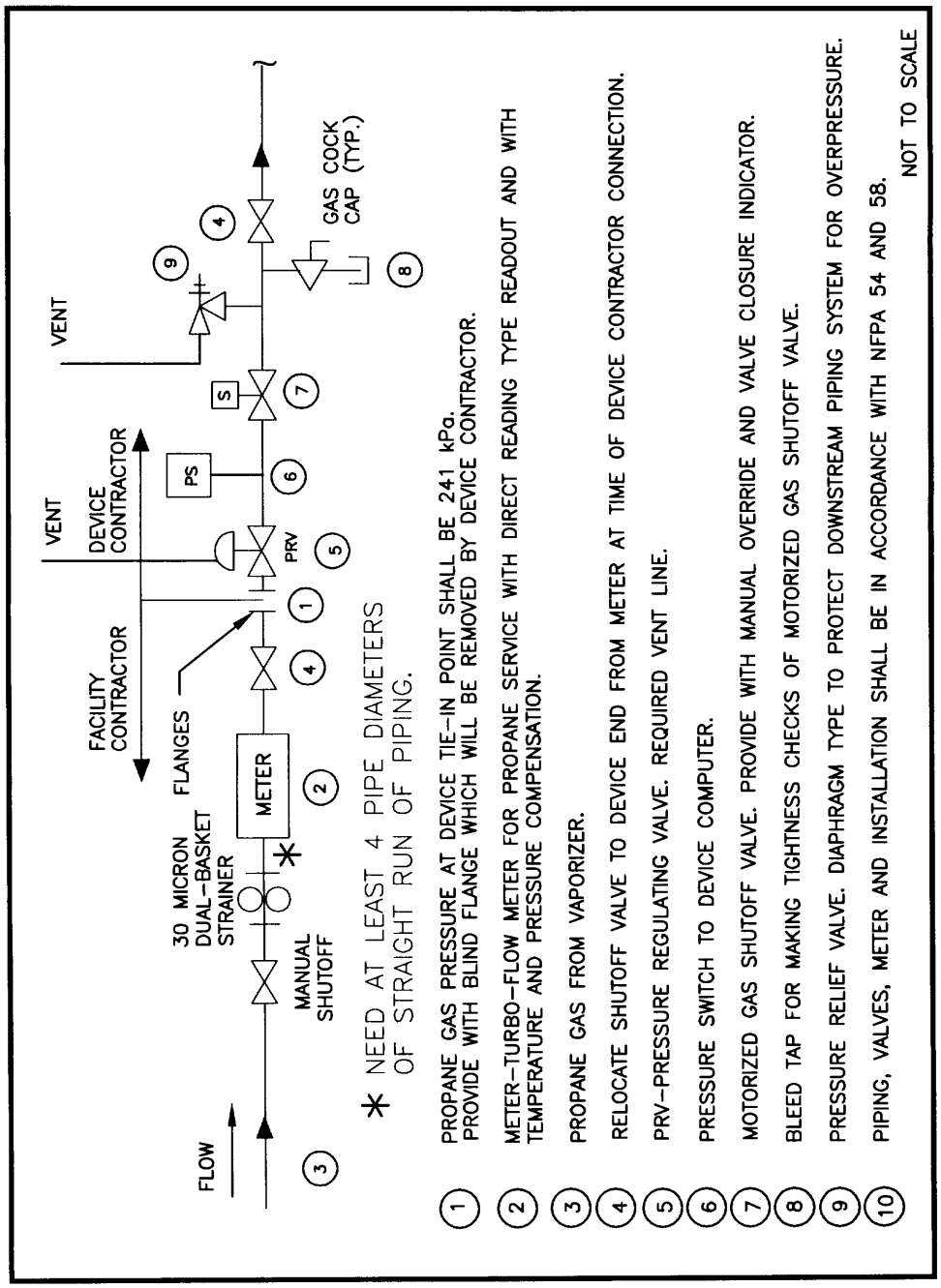


Figure J-2
Propane Gas Train at Facility/Device Interface

APPENDIX J (Continued)

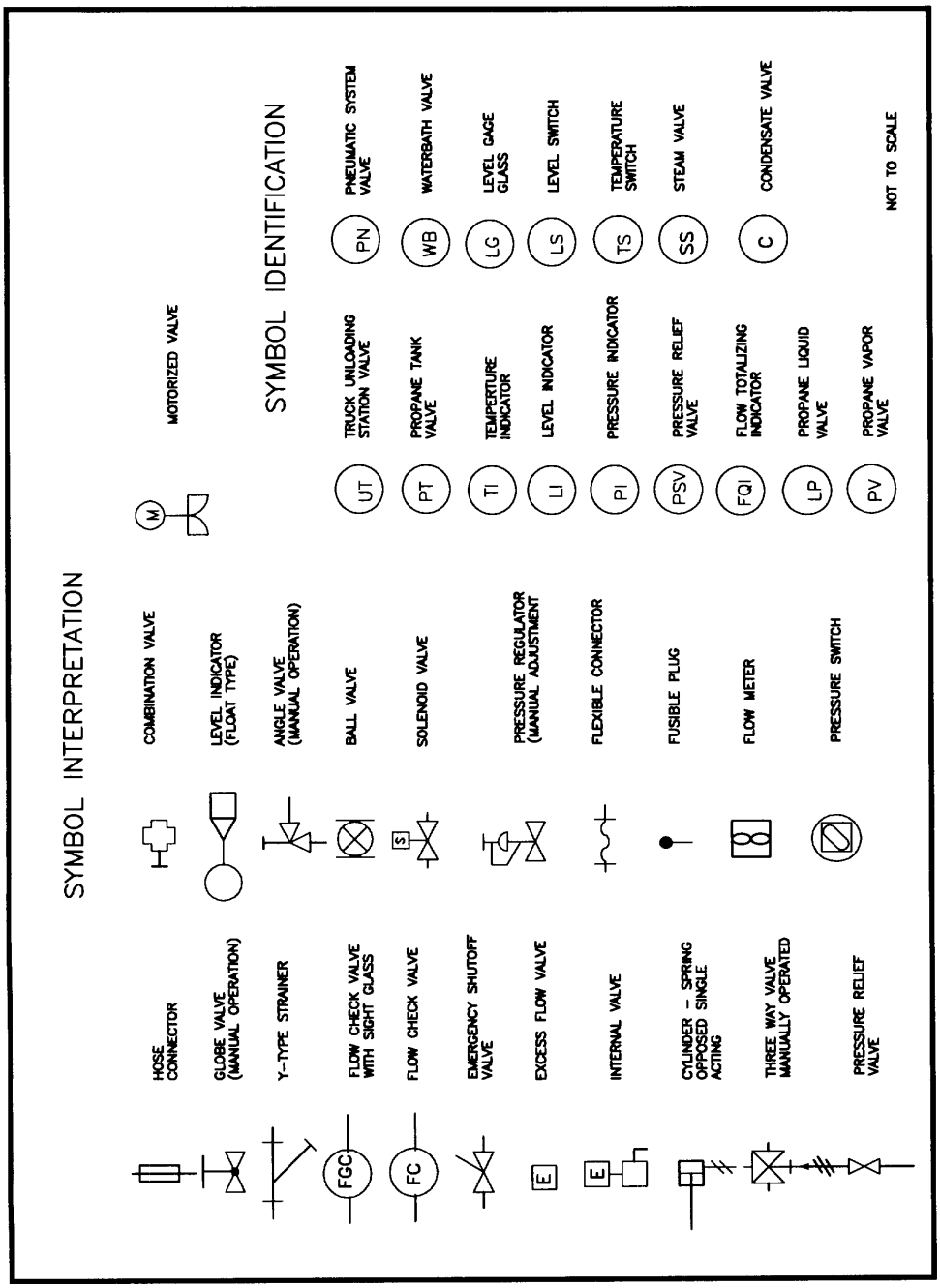


Figure J–3
Symbol Interpretation/Identification

APPENDIX J (Continued)

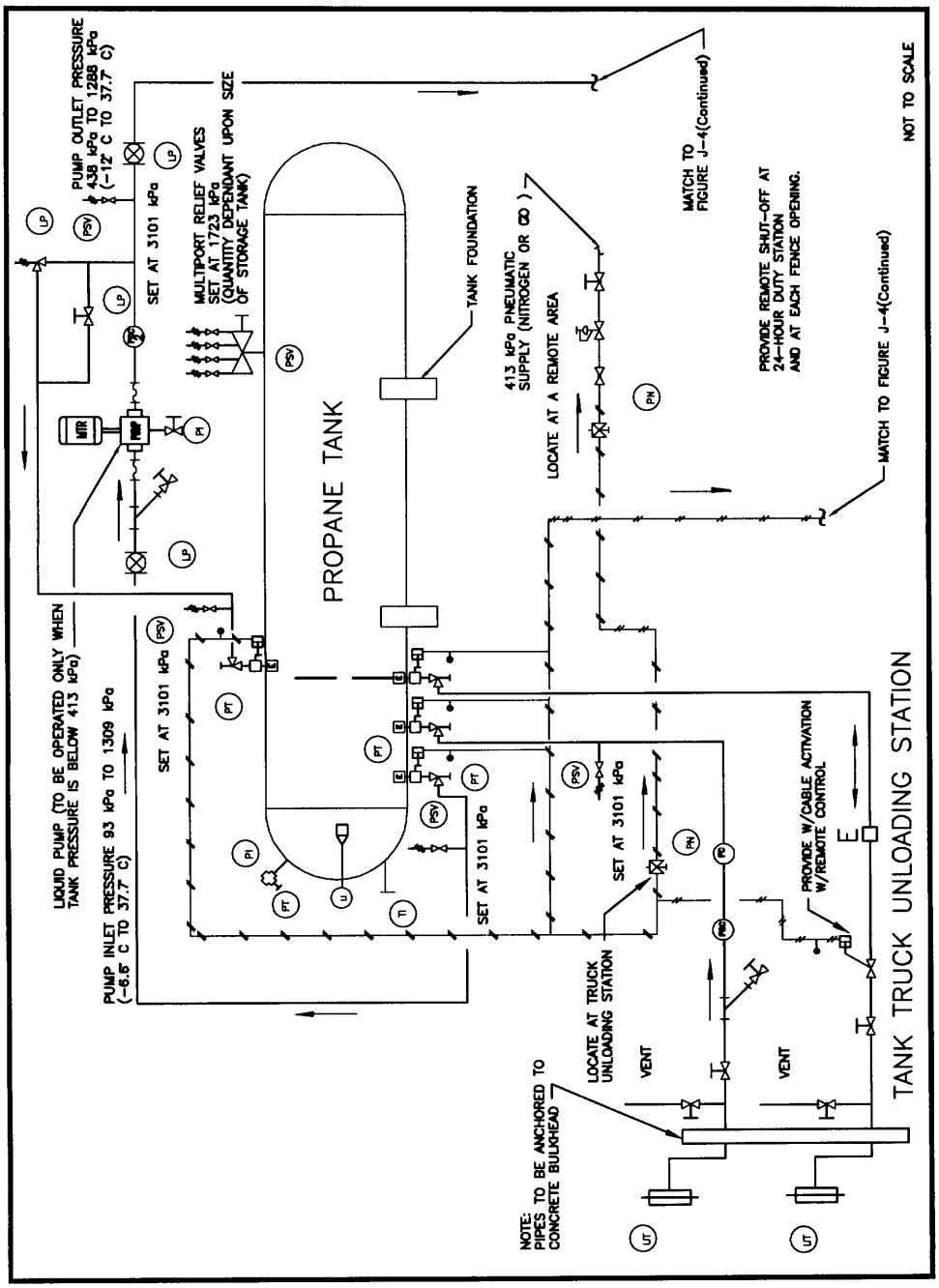


Figure J-4A
Waterbath Vaporizer with Liquid Pump

APPENDIX J (Continued)

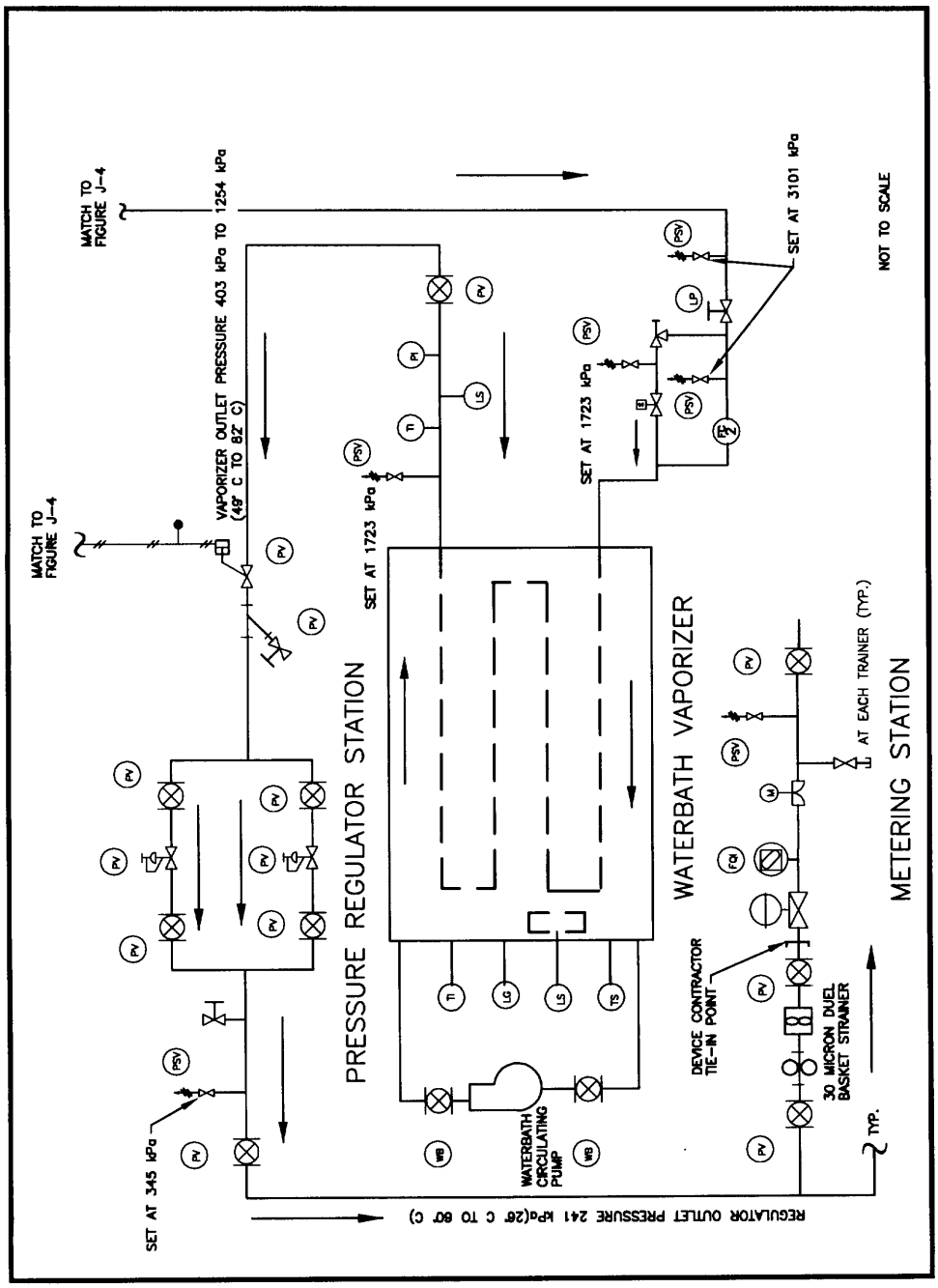


Figure J–4B
Waterbath Vaporizer with Liquid Pump

APPENDIX J (Continued)

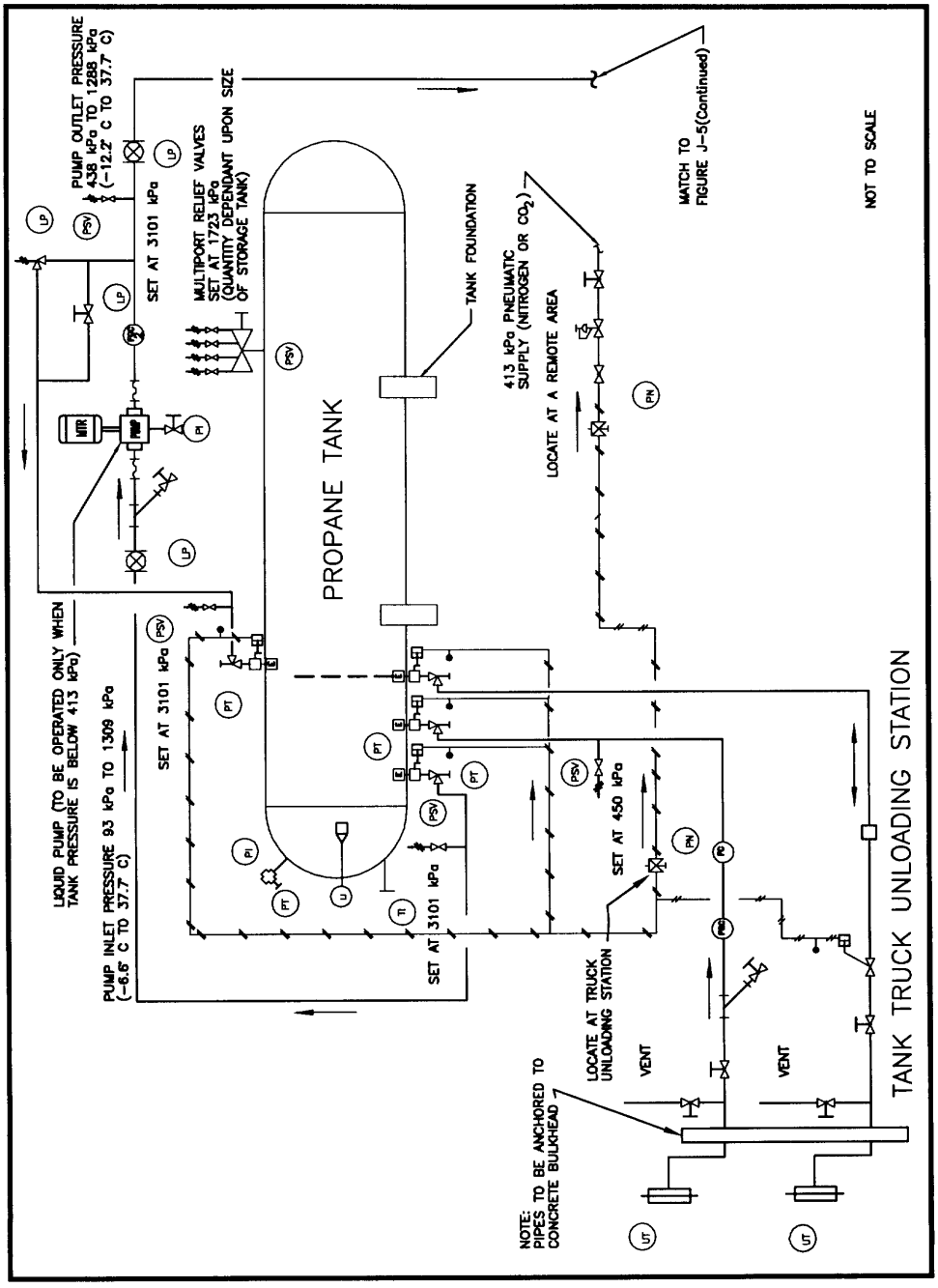


Figure J-5A
Steam Heated Vaporizer with Liquid Pump

APPENDIX J (Continued)

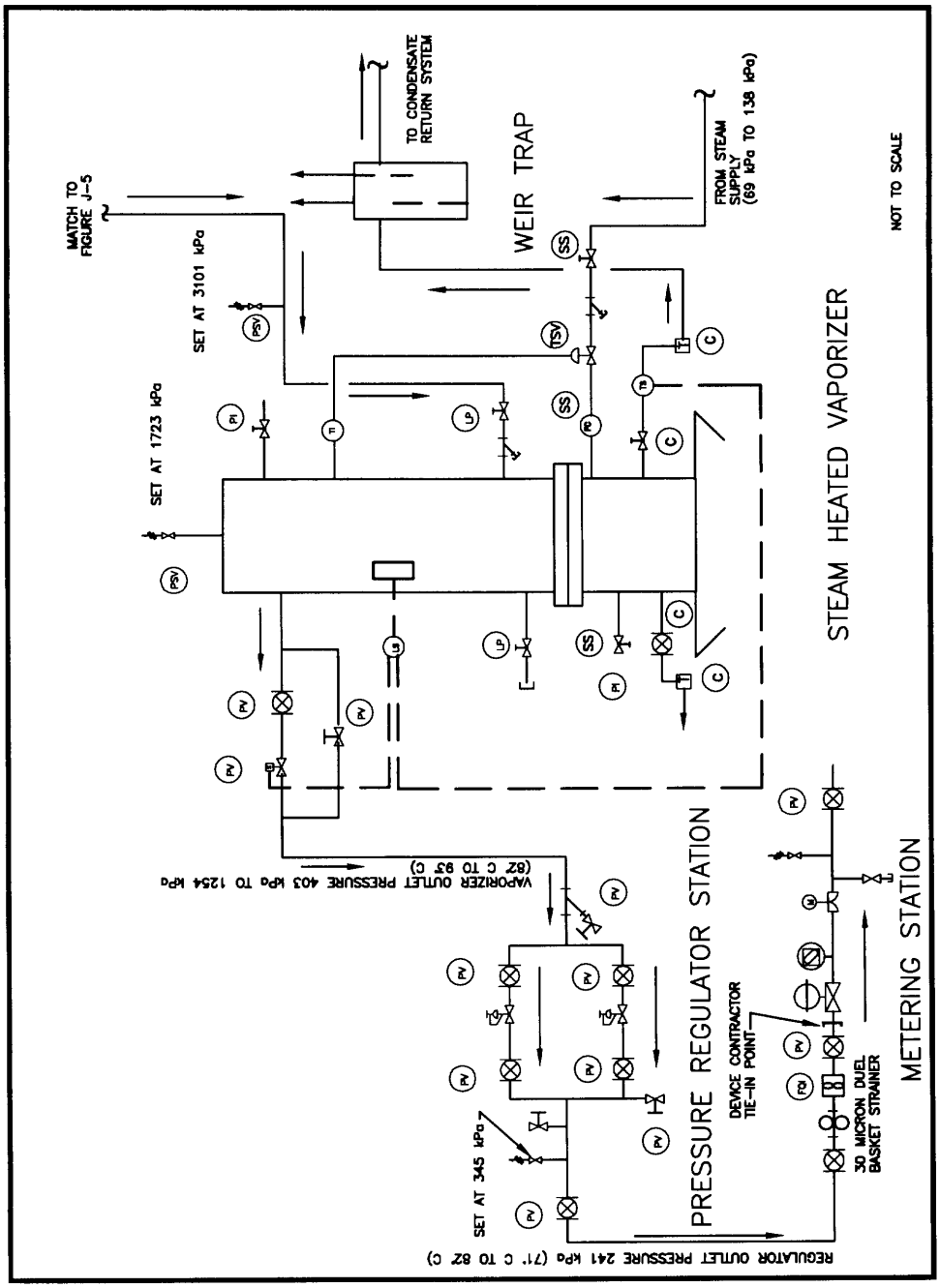


Figure J-5B
Steam Heated Vaporizer with Liquid Pump

APPENDIX J (Continued)

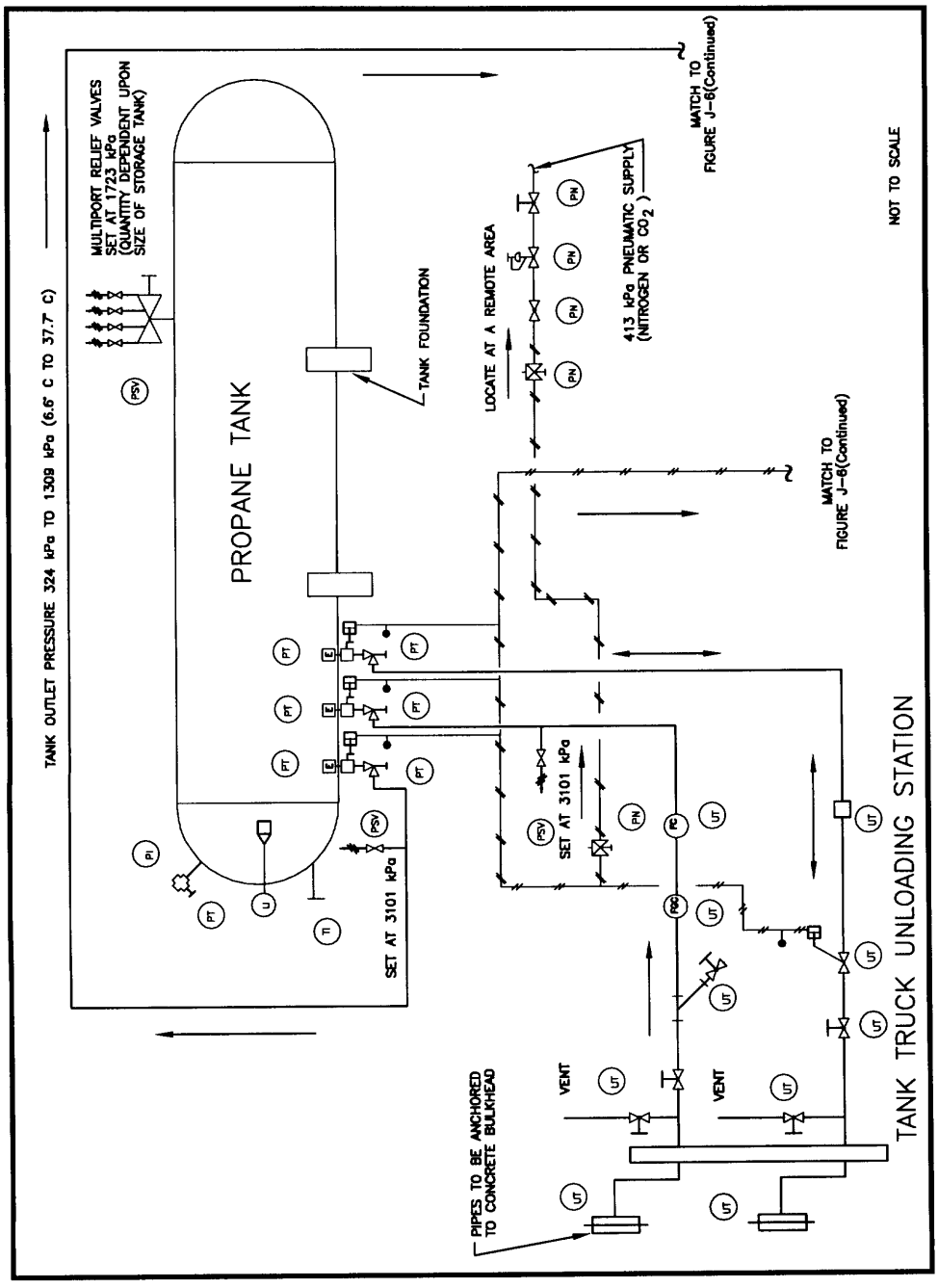


Figure J-6A
Waterbath Vaporizer Without Liquid Pump

APPENDIX J (Continued)

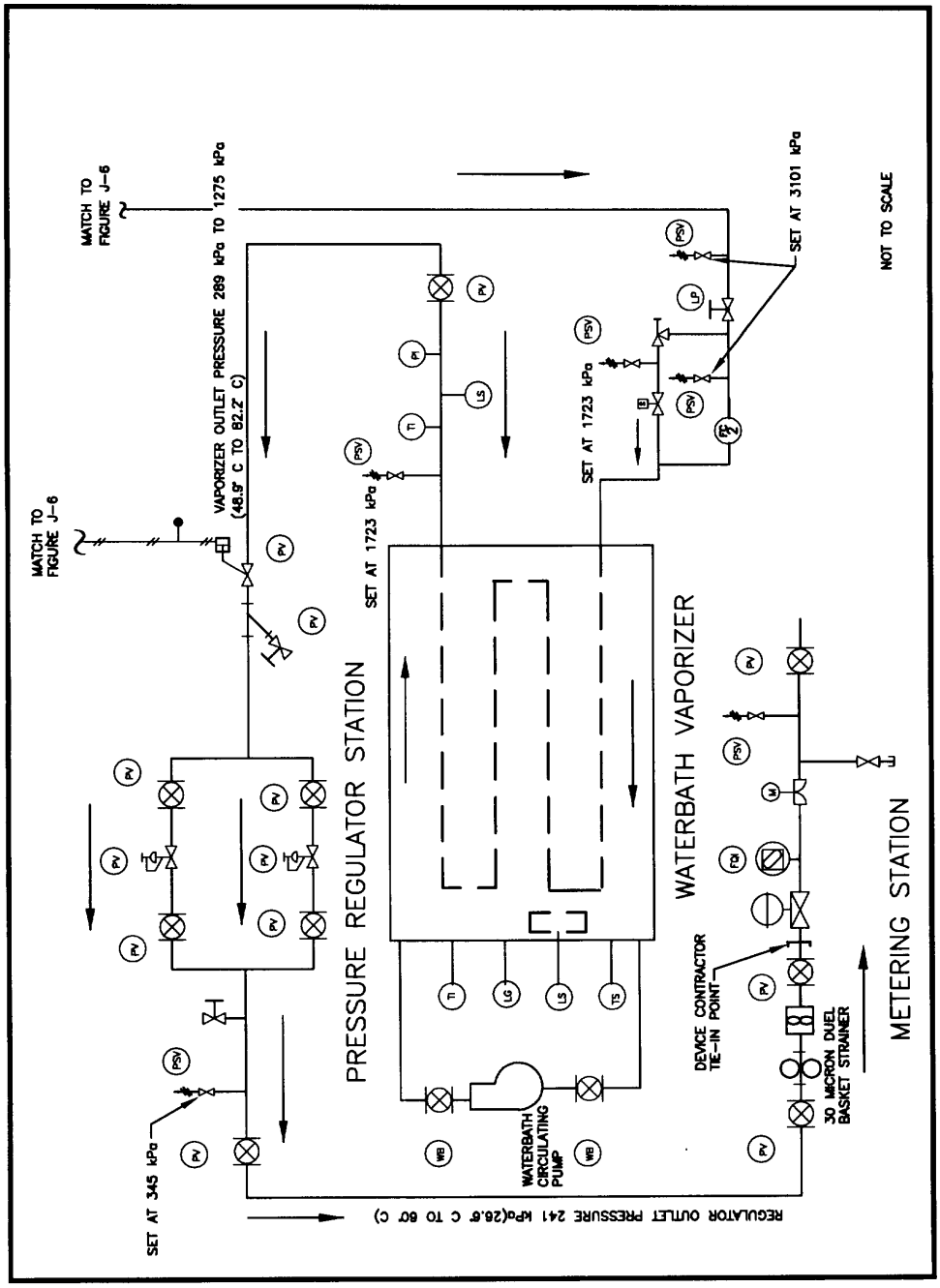


Figure J-6B
Waterbath Vaporizer Without Liquid Pump

APPENDIX J (Continued)

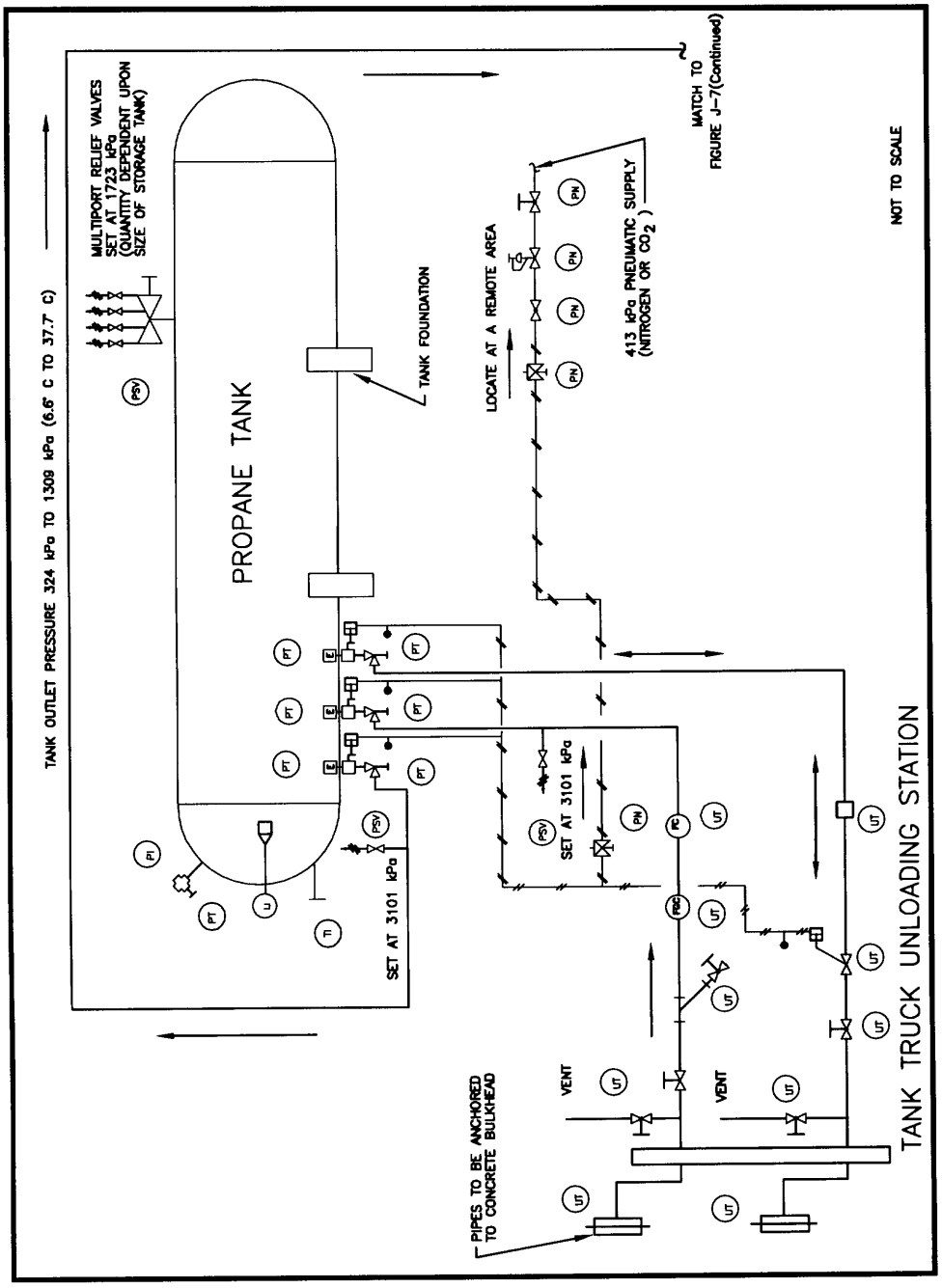


Figure J–7A
Steam Heated Vaporizer Without Liquid Pump

APPENDIX J (Continued)

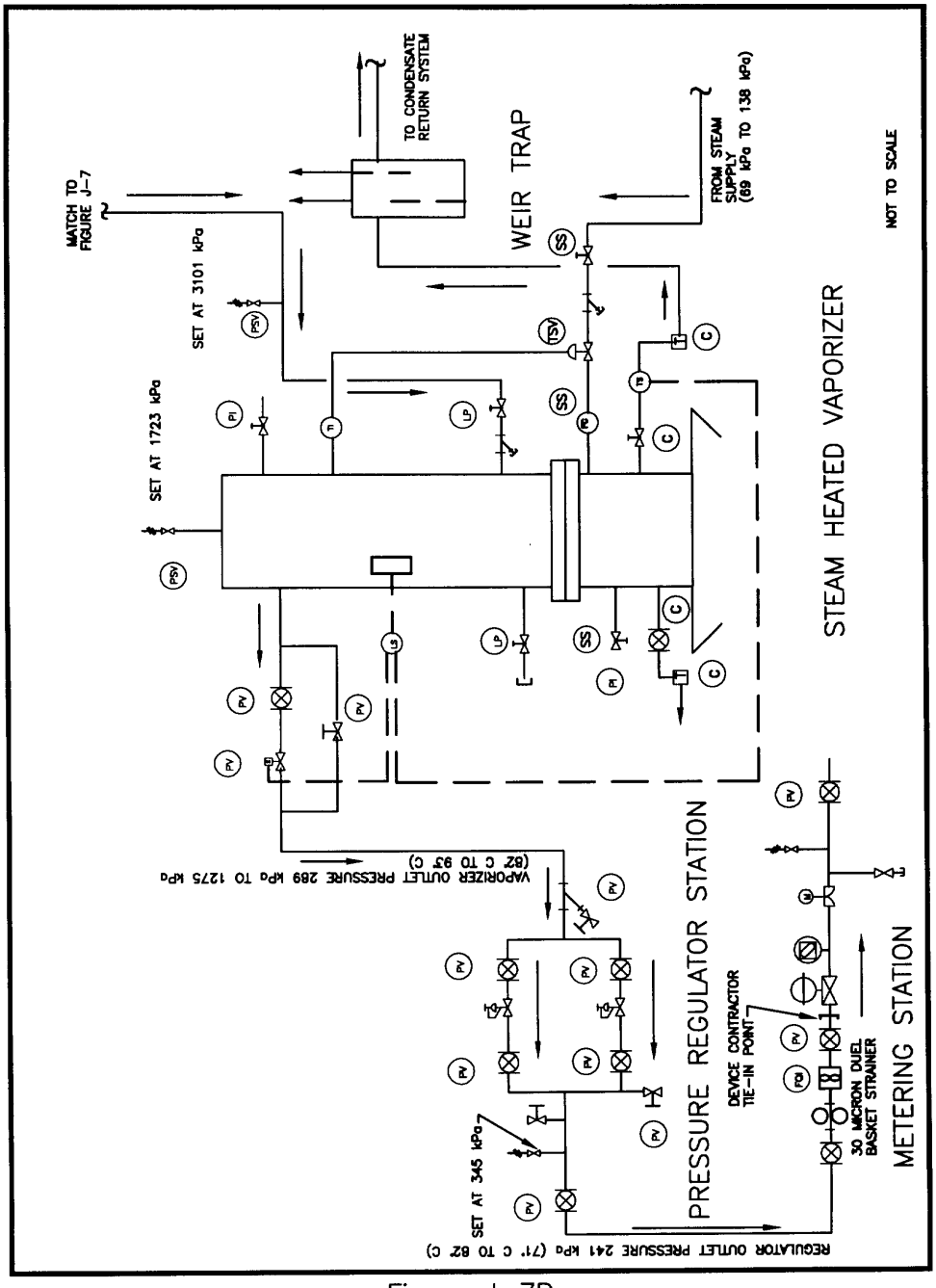


Figure J-7B
Steam Heated Vaporizer Without Liquid Pump

REFERENCES

NOTE: THE FOLLOWING REFERENCED DOCUMENTS FORM A PART OF THIS HANDBOOK TO THE EXTENT SPECIFIED HEREIN. USERS OF THIS HANDBOOK SHOULD REFER TO THE LATEST REVISIONS OF CITED DOCUMENTS UNLESS OTHERWISE DIRECTED.

FEDERAL/MILITARY SPECIFICATIONS, STANDARDS, BULLETINS, HANDBOOKS, AND NAVFAC GUIDE SPECIFICATIONS:

Unless otherwise indicated, copies are available from the Naval Publishing and Printing Service Office (NPPSO), Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

FEDERAL SPECIFICATIONS

BB-A-1034	Compressed Air, Breathing.
ZZ-H-451	Hose, Fire, Woven-Jacketed Rubber or Latex or Rubber-Coated Fabric-Lined With Couplings.

MILITARY SPECIFICATIONS

MIL-E-24091	Extinguisher, Fire, Portable, Potassium Bicarbonate, Dry Chemical, Cartridge-Operated Type.
MIL-E-24269	Extinguisher, Fire, Carbon Dioxide, 15 Pound, Portable, Permanent Shutoff, Navy Shipboard Use.
MIL-H-24580	Hose Assemblies, Synthetic Rubber, Noncollapsible, Firefighting.
MIL-H-24606	Hose Assemblies, Chlorosulfonated Polyethylene Impregnated, Double Synthetic Jacket, With Couplings, Firefighting and Other Water Service.
MIL-W-25038	Wire, Electrical, High Temperature and Fire Resistant.

MIL-F-29046 Flooring Raised, General Specification for.

NAVFAC GUIDE SPECIFICATIONS

NFGS-15484 Medical Gas and Vacuum Systems.

HANDBOOKS

MIL-HDBK-1012/1 Electronics Facilities Engineering.

MIL-HDBK-1190 Facility Planning and Design Guide.

NAVY MANUALS, P-PUBLICATIONS, AND INSTRUCTIONS:

OPNAVINST 5090.1 Environmental and Natural Resources Protection Manual, Chapter 6, Air Pollution Abatement.

NAVSHIPS Technical Manual Chapter 9930.

DM-22 Petroleum Fuel Facilities.

NAVMAT P-9290 System Certification Procedures and Criteria Manual for Deep Submergency System.

OTHER GOVERNMENT DOCUMENTS AND PUBLICATIONS:

DEPARTMENT OF LABOR

29 CFR 1910 OSHA Safety and Health Standards for General Industry (Labor OSHA Industry Reg. 2206).

(Unless otherwise indicated, copies are available from Occupational Safety and Health Administration, 200 Constitution Avenue NW, Washington DC 20210.)

DRAWINGS

BUREAU OF SHIPS (BUSHIPS)

803-1645097	Hatch W.T. Raised Quick Acting 36" x 42" - 5 P.S.I. Arrangement.
804-5184163	Trunk Safety Nets.
805-1400064	WTQA Doors - 18" x 36", 6 Dog Arrangement.
805-1624089	Hatch W.T. Raised Individually Dogged 36" x 60" With Scuttle-15 P.S.I. Arrangement.
810-1385834	Water Fog 1-1/2-inch Ball Type.

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

608-4674414	Mounting Fire Hose Rack and Access.

NAVSHIPS

803-1385712	Valve, Hose Globe and Angle.
803-5184129	Steel Balanced Door.
804-1749235	Thermally Insulated Ladder Rungs for Escape Trunks From Machinery Spaces.
805-1400066	Doors W.T. (Individually Dogged) Medium Steel.
805-1400074	Galvanized Steel, Without HASP Assembly.
805-1749113	Inclined Ladders Aluminum Assemblies.
805-860089	Metal Hose Rack Assembly and Details.

810-4444647 Syringe Spanner Navy Fire Hose.

MARE ISLAND

612-1889964A1 Emergency Air Breathing Device.

612-1889964A2 Emergency Air Breathing Device Models.

(Unless otherwise indicated, copies are available from Naval Engineering Drawing Support Activity, Portsmouth, NH 03804-5000.)

NON-GOVERNMENT PUBLICATIONS:

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

Industrial Ventilation Guide.

ACGIH 2080 Industrial Ventilation, A Manual of Recommended Practice.

(Unless otherwise indicated, copies are available from the American Conference of Governmental Industrial Hygienists (ACGIH), 6500 Glenway Avenue, Bldg. D-7, Cincinnati, OH 45211-4438.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B31.3 Chemical Plant and Petroleum Refinery Piping.

Unless otherwise indicated, copies are available from American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018.)

AMERICAN PETROLEUM INSTITUTE (API)

API 2510 Design and Construction of LP Gas Installations at Marine and Pipeline Terminals, Natural Gas Processing Plants, Refineries, Petrochemical Plants, and Tank Farms.

(Unless otherwise indicated, copies are available from the American Petroleum Institute (API), 1220 L Street NW, Washington, DC 20005.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A36	Structural Steel.
ASTM A242/A242M	Standard Specification for High-Strength Low-Alloy Structural Steel.
ASTM 588/A588M	Standard Specification for High-Strength Low-Alloy Structural Steel With 50 psi (345 Mpa) Minimum Yield Point to 4 in. (100 mm) Thick.

(Unless otherwise indicated, copies are available from American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

Boiler and Pressure Vessel Code.

(Unless otherwise indicated, copies are available from American Society of Mechanical Engineers (ASME), 345 East 47th Street, New York, NY 10017.)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C506	Backflow Prevention Devices--Reduced Principle and Doublecheck Valve Types.

(Unless otherwise indicated, copies are available from American Water Works Association (AWWA), 6666 West Quincy Avenue, Denver, CO 80235.)

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS B2.1.005	Standard Welding Procedure Specification (WPS) for Gas Metal Arc Welding of Austenitic Stainless Steel.

AWS B2.1.006 Standard Welding Procedure Specification (WPS) for Gas Metal Arc Welding of Carbon Steel to Austenitic Stainless Steel.

(Unless otherwise indicated, copies are available from American Welding Society, Inc. (AWS), 550 N.W. LeJeune Road, Miami, FL 33126.)

FACTORY MUTUAL RESEARCH CORPORATION (FM)

Loss Prevention Data.

(Unless otherwise indicated, copies are available from Factory Mutual Research Corporation (FM), 1151 Boston-Providence Turnpike, P.O. Box 9102, Norwood, MA 02062.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 12 Carbon Dioxide Extinguishing Systems.

NFPA 24 Installation of Private Fire Service Mains and Their Appurtenances.

NFPA 54 National Fuel Gas Code.

NFPA 58 Storage and Handling of Liquefied Petroleum Gases.

NFPA 70 National Electrical Code.

NFPA 78 Lightning Protection Code.

(Unless otherwise indicated copies are available from National Fire Protection Association (NFPA), Batterymarch Park, Quincy, MA 02269-9904.)

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

Industrial Duct Construction Standards.

(Unless otherwise indicated, copies are available from Sheet Metal and Air Conditioning Contractors' National Association, Inc., (SMACNA), P. O. Box 221230, Chantilly, VA 22033-1230.)

UNDERWRITERS LABORATORIES INC. (UL)

UL 595	Marine-Type Electric Lighting Fixtures.

(Unless otherwise indicated, copies are available from Underwriters Laboratories Inc. (UL), 333 Pfingsten Road, Northbrook, IL 60062.)

GLOSSARY

AFF. Above finished floor.

AFFF. Aqueous film-forming foam.

APC. Aqueous potassium carbonate.

BOD. Biological oxygen demand.

CBR. Chemical biological radiation.

CNO. Chief of Naval Operations.

COD. Chemical oxygen demand.

CSHS. Combined submarine hose station.

CV. Aircraft carrier deck.

DD. Destroyer deck.

DTC. Data terminal cabinet.

EAB. Emergency air breathing.

EFA. Engineering field activity.

EFD. Engineering field division.

EMI. Electromagnetic interference.

EPA. Environmental Protection Agency.

FR. Foam reel station.

FS. Foam hose station.

FTC. Fleet Training Center.

HCFF. High capacity fog foam generator.

HS. Hose station.

HVAC. Heating, ventilating, and air conditioning.

LANTNAVFACENGCOM. Atlantic Division, Naval Facilities Engineering Command.

MBAS. Methylene-blue-active substance.

MILCON. Military construction.

NAVFACENGCOM. Naval Facilities Engineering Command.

NAVMAT. Naval Material Command.

NAWCTSD. Naval Air Warfare Center Training Systems Division.

NIOSH. National Institute for Occupational Safety and Health.

OBA. Oxygen breathing apparatus.

PFE. PKP fire extinguisher.

PKP. Purple potassium powder.

POTW. Public owned treatment works.

SHS. Submarine hose station.

SP. Stand pipe.

TAR. Twin agent reels.

TDS. Total dissolved solids.

TLV. Threshold limit value.

TPP. Triphenyl phosphate.

TSS. Total suspended solids.

TTO. Total toxic organics.

WTQA. Watertight quick-acting.

CUSTODIAN
NAVY - YD2

PREPARING ACTIVITY
NAVY - YD2

PROJECT NO.
FACR-1180

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2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

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3. DOCUMENT TITLE FIREFIGHTING SCHOOL FACILITIES

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
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a. NAME COMMANDER LANTNAVFACENGCOM CODE 403	b. TELEPHONE (*Include Area Code*) (1) Commercial (2) DSN (757) 322-4243 262-4243
c. ADDRESS *(Include Zip Code)* *1510 GILBERT STREET* *NORFOLK, VA 23511-2699*	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340

UFC 4-179-02
5 March 2020
Change 1, 13 March 2025

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SMALL ARMS RANGES

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **\1** ... **/1/**)

Change No.	Date	Location
1	13 Mar 2025	Multiple CCRs, allowed granular rubber traps for all Services, and clarified the criteria for prohibiting A/C in most indoor ranges.

This UFC supersedes MIL-HDBK 1027/3B, dated November 1992 and ETL 11-18 dated November 2018.

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FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States, its territories, and possessions is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

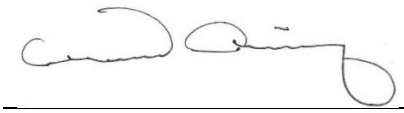
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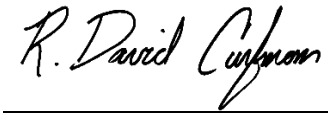
- Whole Building Design Guide website https://www.wbdg.org/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

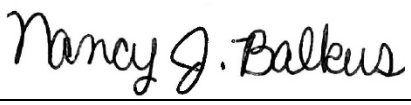
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UNIFIED FACILITIES CRITERIA (UFC)

NEW SUMMARY SHEET

Document: UFC 4-179-02, Small Arms Range Criteria.

Superseding: Navy MIL HNDBK 1027/3B and Air Force ETL 11-18.

Description: This UFC-4-179-02 replaces the superseded documents above and provides Tri Service criteria applicable all new DoD indoor, outdoor, and steel close quarter combat small arms range facilities. This UFC establishes existing Army and USMC Surface Danger Zone criteria as Tri Service criteria and references other Department of Defense (DoD) range criteria where appropriate.

Reasons for Document:

- The new UFC updates and consolidates various service range guidance into one Tri Service document and addresses many areas not covered in existing DoD range criteria.
- The superseded documents included requirements that were inconsistent between each other and other service practices.

Impact:

This unification effort will result in more consistent requirements across DoD and will increase DoD range safety, improve training, and reduce costs in the following ways:

- Provides new and updated criteria that is consistent throughout DoD and a centralized source to share and apply lessons learned.
- Improves indoor range ventilation designs which in turn reduces the chance of overexposure to airborne contaminants.
- Improves indoor range noise attenuation designs which in turn reduces the impacts of harmful noise to personnel at the range.
- Highlights exterior noise concerns and thus reduces noise to neighboring areas.
- Increases awareness of indoor range options and capabilities. This allows for facilities that improve training to warfighters.
- Provides criteria on steel CQC facilities which is currently absent in DoD.
- Provides suppliers with consistent standards thus simplifying procurement of range equipment for both DoD and contractors.

Unification Issues:

General:

Several service specific planning and layout requirements are included since:

- The Army has extensive planning criteria for outdoor ranges. The Air Force has detailed planning requirements for the indirect support area of indoor ranges. The Navy has no separate range planning criteria.

- Training requirements vary between the services, and this dictates different range requirements and layouts.

Outdoor ranges:

The Army, Navy, and USMC use DA PAM 385-63 and MCO 3570 for SDZ criteria. The Air Force uses horizontal distances listed in these criteria but different distances for the vertical component of the Surface Danger Zone. A separate table with vertical components is included for Air Force use.

Services have different access, signage, and marking requirements. A statement is made to use service installation guidance.

The Army, USMC, and Air Force allow machine gun training on tube ranges. These tube ranges do not support traverse firing that is required for maritime machine gun training. A statement is made not to use tube ranges for Navy machine gun qualifications.

Indoor Ranges:

\1\ /1/

The Air Force requires a raised floor in the range control booth. The other services do not. A note is included to use raised floors on Air Force projects.

CQC Facilities and Shoothouses:

The Army allows an option to glue splatter protection directly to the ballistic panels in steel shoothouses. The Navy requires an air gap between steel panels and the splatter protection to facilitate inspections and to increase the life of the splatter protection. Service specific guidance is provided.

The Army uses Shock Absorbing Concrete (SACON) as an option for ballistic walls and does not require a ballistic roof when an SDZ waiver is obtained. The Navy only uses steel shoothouses with steel ballistic panels and overhead ballistic containment. This criteria only covers steel shoothouses with a ballistic roof and refers to Army when designing SACON shoothouses.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This Unified Facility Criteria (UFC) provides requirements for DoD small arms range facilities.

1-2 APPLICABILITY.

This UFC follows the same applicability as UFC 1-200-01, paragraph 1-3, for indoor, outdoor, and steel Close Quarter Combat (CQC) small arms range facilities (also known as shoothouses).

1-3 OTHER CRITERIA.

1-3.1 General Building Requirements.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-3.2 Antiterrorism and Security.

UFC 4-020-01 supports the planning of DoD facilities that include requirements for security and antiterrorism. Use UFC 4-020-01 in conjunction with UFC 4-010-01 to establish the security and antiterrorism design criteria that will be the basis for DoD facility designs. All DoD facilities must also comply with Geographic Combatant Commander antiterrorism construction standards for antiterrorism requirements.

1-3.3 Sustainability.

For indoor ranges, the indirect support areas must meet UFC 1-200-02. The design of the training and direct support areas is driven by containment and ventilation criteria and must meet UFC 1-200-02 to the extent practical.

1-3.4 Service Specific DoD Range Criteria.

- AR 350-19.
- AR 350-52.
- DA PAM 385-63.
- TC-25-8.
- MCO 3570.1.
- FC 4-179-03F.

- AF 36-2654. **\1** (Soon to be replaced with DAFI31-131 and DAFMAN31-131 V1) **/1/**

1-3.5 Army Ranges.

Range layouts, target distances, lane widths, target systems, and baffle effects are standard and defined by the Training Circular TC 25-8. Specific range design requirements are as defined in the Range Design Guide (RDG).

1-3.6 Non-Standard Ranges.

For non-standard ranges that do not have applicable criteria in this UFC, consult with the specific service range subject matter expert.

1-4 CYBERSECURITY.

All facility-related control systems (including systems separate from a utility monitoring and control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service Implementation Policy.

1-5 BEST PRACTICES.

Appendix A contains best practices.

1-6 WEAPONS AND AMMUNITION.

Appendix B contains a general description of common weapons and ammunition used by DoD.

1-7 GLOSSARY.

Appendix C contains acronyms, abbreviations, and terms.

1-8 REFERENCES.

Appendix D contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

CHAPTER 2 GENERAL

2-1 PLANNING.

Design ranges to meet the need of the intended training. Consider the number of shooters and firing lanes, anticipated weapons and ammunition, target systems, target distances, scoring accuracy required, shooting directions and angles, and components necessary to maintain and support the range. Establish a team to review range requirements and develop the project. The team composition will depend on the service but in general should include service range experts, weapons and range safety officers, organizational range safety personnel, trainers, industrial hygienists, activity planners, project managers, fire protection and environmental personnel, and others that will be involved in operations and maintenance of the facility. For outdoor ranges plot the proposed Surface Danger Zone (SDZ) and check for conflicts early in the planning phase. Check aircraft operations and contact the Federal Aviation Administration (FAA) if there is a vertical weapon component that could endanger aircraft.

2-2 BASIS OF DESIGN.

For the initial design submittal include a separate document outlining the parameters and assumptions on which the range design is based. All range design parameters should be provided or verified by the service's range safety program. This information will help ensure the range is operated and maintained with appropriate restrictions and should include:

All Ranges:

- The most powerful rounds in terms of energy and maximum distance.
- A sketch for indoor ranges and a Geographic Information System (GIS) map for outdoor ranges showing location of all firing lines, target lines, direction of fire, and left and right limits.
- Maximum target distance provided.
- Target systems.
- Assumptions used for sizing range support areas including the number of targets, weapons, and students.

Outdoor Ranges:

- A Surface Danger Zone (SDZ) map provided by the government annotated to show the location of SDZ enforcement features including topography, range fencing, base limits, signage, and road barriers.
- A list of recommended best management practices.

Indoor Ranges and CQC Facilities:

- A sketch showing the location and maintenance access to all range equipment and controls including targeting systems, ventilation equipment, filters, trap equipment, dust collection system, bullet collection components, and lighting controls.
- A floor plan showing live fire areas with direction of fire and any limitations imposed such as areas or walls not designed for live fire.
- A floor plan showing range support functions such as classrooms armories, offices, simulators etc.
- Bullet trap and ventilation operation and maintenance manuals provided at end of project.

2-3 MATERIAL.

2-3.1 Concrete.

All concrete that may receive bullet strikes must be minimum 3500 psi (24 MPa). Structural design may require higher strengths.

2-3.2 Ballistic and \1\ Abrasion Resistant (AR) /1/ Steel Plate.

Ballistic steel plate and AR Steel Plate must be tested in accordance with ASTM E10-08, meet MIL-A-46100, and certified as having the following Brinell Hardness (HBW):

- AR500: HBW between 470 and 544.
- AR525: HBW between 500 and 544.

In addition, require:

- Certifications for all ballistic steel plates.
- **\1** Only steel bullet trap component exposed to bullet impact are required to meet both ASTM E10-08 and MIL-A-46100 certification requirements.**/1/**
- Connection made in such a manner as to maintain ballistic properties.
- All cuts made in a manner that does not alter or reduce hardness.
- Ballistic integrity maintained across all joints.

2-3.3 Splatter Protection for Overhead Baffles and Safety Ceiling.

Splatter protection must have spacers providing minimum 1-1/2” (38 mm) air gap between splatter protection and the underlying material with the exception that Army ranges may have splatter protection glued directly to the underlying material. Splatter

protection material must be fire resistant and must not contain any metal or metal fibers, excluding fasteners. Design splatter protection to allow for removal and replacement without damage to the splatter protection, spacers, or underlying material. Choose from among the following:

- 0.375 in. (9.5 mm) two-ply rubber conveyor belt material. Must not contain any metal.
- 2 in. (50 mm) thick vulcanized rubber.
- 2 in. (50 mm) cold-pressed ballistic rubber.
- Minimum 0.75 in. (19 mm) fire-retardant plywood.
- Other material may be used when approved.
- Acoustic material with tests results showing material can stop splatter from rifle rounds after striking underlying steel plates.
- Spacer material may be wood, light-gauge steel channels, or recycled plastic lumber.

2-3.4 Splatter Protection for Steel CQC Facilities.

Choose splatter protection options that provide:

- Containment of splatter within wall.
- Capability to easily remove and replace to allow inspection of ballistic steel.
- Ease of maintenance.
- Fire resistance.

For Navy projects, use spacers that provide a 1.5-in. (37 mm) air gap between steel and splatter protection to reduce damage to backside of splatter protection and simplify removal for routine inspection of ballistic steel panels. Army facilities may have splatter protection glued directly to the ballistic panels.

2-4 AIR FORCE RANGES.

The Air Force allows only outdoor non-contained, machine gun tube, or fully enclosed indoor ranges for new construction. The following applies to Air Force indoor and outdoor small arms ranges.

2-4.1 Firing Line Positions and Platforms.

All small arms ranges should have a minimum of seven positions at the firing line. Additional positions may be added in increments of seven. The width of the firing

position must be at least 5 ft. (1.5 m) center-to-center. The firing line must be located on a stable horizontal surface with a clear distance that is at least 14 ft. (4.3 m) in depth for the length of the firing line. For most ranges, the firing platform is a concrete slab on grade. For ranges that have fighting positions dug in the ground, sandbags, or other definite structures to identify the firing line, the firing platform can be an earth surface. For special weapons, Combat Arms (CA) personnel will specify the number of firing positions and the widths of each position based on training requirements.

2-4.2 Position Numbering.

Number each firing position beginning from the left when facing the target line. The numbers must be at least 8 in. (200 mm) tall and displayed on rectangular backgrounds attached to the position barricade or other location that is clearly visible to all shooters and range officials. Mark odd-numbered positions with white numbers on a black background. Mark even-numbered positions with black numbers on a white background.

2-4.3 Position Barricades.

Install a wooden barricade, or equivalent, in the form of a cross at the left edge of each firing position with the following requirements:

- The nominal dimensions of the wood horizontal member must be the 2 in. (50 mm) by 6 in. (150 mm).
- The top surface of the horizontal member must be 48 in. (1220 mm) above the floor with a 12 in. (300 mm) resting surface on each side of the post.
- Post member may be nominal 2 in. (50 mm) by 6 in. (150 mm) or 4 in. (100 mm) by 4 in. (100 mm) wood.

2-4.4 Firing Line.

Paint a red line a minimum of 4 in. (100 mm) wide on the leading edge of the firing line on the target side. For ranges without firing line platforms or concrete floor, a firing line may be marked in red on the downrange side of the firing positions with treated timber embedded along the firing line. If not painted in red, this can also be a line of safety cones or other method that clearly marks the location. This is the stationary firing line and must be continuous for the full length of all firing positions. For move and shoot courses, the firing line is relocated downrange as appropriate for the training scenarios.

2-4.5 Light Anti-Tank Weapons (LAW) and 40 mm Grenades.

See Chapter 3 paragraphs on “Surface Danger Zones”.

2-5 ARMY AND USMC RANGES.

For planning Army ranges follow AR 350-19. Army ranges must be approved and included on the installations Range Complex Master Plan (RCMP).

- Use US Army TC 25-8 and DA PAM 385-63 for range layout.
- Use the RDG for range design details, standard features, and target system interface.

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CHAPTER 3 OUTDOOR RANGES

3-1 PLANNING AND DESIGN.

Safety is the primary concern when selecting a site for an outdoor small arms range. Other critical concerns include training capability, compatible use, travel distance, location of utilities, and unexploded ordinance (UXO) risk assessment.

3-2 SURFACE DANGER ZONES.

Surface Danger Zones (SDZs) include both horizontal and vertical components and will be developed by the Government during the planning phase in accordance with DA PAM 385-63/MCO 3570. The designer should familiarize themselves with the SDZ as it impacts the location and layout of the firing lines, target lines, berms, supporting features, and downrange features. Orient the SDZ horizontal and vertical components to minimize the effect of range operations on populated areas, watercraft operations, public waterways, aircraft ground and air operations, and land uses within the maximum range of the ammunition. Available land for the SDZ controls the type and size of the range. Consider future expansion when choosing the site and developing SDZs. As weapons and ammunition improve, they are often more powerful than their replacements and therefore require larger SDZs. All mapping must be done using a geographic information system (GIS).

3-2.1 Air Forces Ranges.

The Vertical Danger Zone (VDZ) component of the SDZ will be developed using Table 3-1. For VDZ in excess of 200 ft. (61 m) in height, coordinate with the local airfield manager. In some cases, Light Anti-Tank Weapons (LAW) and 40 mm grenade launchers are employed adjacent to, or overlapping, the small arms range footprint. For specialized weapons such as the LAW and 40 mm grenades on outdoor non-contained small arms ranges, DA PAM 385-63 will be used to develop surface danger zone and range design criteria.

Table 3-1 Air Force Minimum VDZ Height Requirements

Weapon/Caliber	DOD Identification Code (DODIC)	Ammunition Nomenclature	Minimum VDZ Height[5] Feet (Meters)
Pistol, 9 mm (M9, M11, GLOCK 19) and Submachine Gun, 9 mm (MP5 and UZI)	A363, A360	Cartridge (Ctg), 9 mm Ball NATO and Cartridge 9 mm Ball Parabellum (M882, M1)	2215 (675)
Pistol, 9 mm (M9, M11, GLOCK 19)	AA16	9 mm Ctg Frangible (MK254-0)	2215 (675)[1]
Pistol, 9 mm (M9, M11, GLOCK 19)	AB13, AB14	9 mm Blue (Red) Marking Ctg (M1041)	328 (100)[4]
Handgun, .44 magnum		Commercial Local Purchase	2965 (904)[2]
Shotgun, 12 Gauge	A011, AA51, AA82	Ctg 12 Gauge (GA) Shotgun 00 Buckshot, Frangible, Non-Lethal Fin Stabilized (M19/M162, M1012)	1083 (330)
Shotgun, 12 Gauge	A023	Ctg 12 GA 1 OZ Slug	2706 (825)[2]
Shotgun, 12 Gauge	AA52	Ctg 12 GA Non-Lethal Crowd Control (M1013)	328 (100)
Rifle/Carbine, 5.56 mm (M4, M4A1 and all M16 series weapons)	A071, A068	Ctg 5.56 mm Ball, Ctg 5.56 mm Tracer (M193, M196)	3347 (1020)
Rifle/Carbine/Automatic Rifle, 5.56 mm (M4, M4A1, all M16 series weapons and M249)	A059, A063/Linked A062, A064, AA01	Ctg 5.56 mm Ball, Ctg 5.56 mm Tracer (includes ball, tracer, armor piercing [AP] and AP tracer linked) (M855, M856, M995)	3674 (1120)
Rifle/Carbine, 5.56 mm (M4, M4A1 and all M16 series weapons)	AA68	5.56 mm Plastic (M862)	328 (100)[4]
Rifle/Carbine/Automatic Rifle, 5.56 mm (M4, M4A1, all M16 series weapons and M249)	AA40/Linked AA85	Ctg 5.56 mm Frangible Ball and Ctg 5.56 mm Frangible Linked	3347 (1020)[1]
Rifle/Carbine/Automatic Rifle, 5.56 mm (M4, M4A1, all M16 series weapons and M249)	AB09, AB10/Linked AA85	5.56 mm Blue (Red) Marking Ctg/Blue (Red) Linked Marking Ctg (M1042)	328 (100)[4]
Rifle/Carbine/Automatic Rifle, 5.56 mm (M4, M4A1, all M16 series weapons and M249)	AB67, AB66	5.56 mm, XM1037 Short Range Training Ammunition (SRTA) (Includes Single Round and Linked) (M1037)	656 (200)[4]

Weapon/Caliber	DOD Identification Code (DODIC)	Ammunition Nomenclature	Minimum VDZ Height[5] Feet (Meters)
Rifle/Machine Gun, 7.62 mm (M110, M14, MK14 EBR, M21, M24 and M240)	A122, A130, A140, A146, AB50/ Linked A168, A127, A128, A131, A143, A151, A164, A165, A168, A257	Ctg 7.62 mm Ball (M80) and Ctg 7.62 mm Tracer (M62) (Includes Linked and Ball/Tracer Linked) (M80, M62, M276, MK319-0)	4478 (1365)
Rifle/Machine Gun, 7.62 mm (M110, M14, MK14 EBR, M21, M24 and M240)	AA11	Ctg 7.62 mm NATO M118 Special Ball (M118)	4856 (1480)
Machine Gun, 7.62 mm (M240)	AA37, AB60	7.62 mm, M973/M974 Short Range Training Ammunition (SRTA) 4/1 and (Includes Ball Linked) (M973 and M974)	656 (200)[4]
Rifle, .50 caliber (M107)	A525, A552, A571, AA50, A606, A605	Ctg Cal .50 Ball, Tracer, Armor Piercing (AP), AP Incendiary (I) and API Tracer (Mark 211 Mod O, M2, M1, M10, M33, M17, M8, M20)	6365 (1940)
Machine Gun/Rifle, .50 caliber (M2)	A530, A532, A533, A543, A545, A546, A555, A557, A564, A575, A576, A584, A602, A606, A641, AA06	Ctg Cal .50 Ball, Tracer, AP, Incendiary (I), API and API Tracer Linked (M8 API, M2 AP, M20, M1, M33 Ball, M2 Ball, M17, M10, M17, Spotter Tracer)	6365 (1940)
Grenade Launcher, 40mm (M203, M320)	B470, B472, B506, B508, B509, B519, B535, B536, B537, B538, B542, B546, B568, B576, B584	40mm Ctg, HE, HEDP, TP, Practice, Smoke, Illumination (M381, M384, M385, M386, M406, M407A1, M430, M433, M441, M661, M662, M583A1, M992, M713, M715, M716, M781, M918)	708 (216)[3]
Grenade Launcher, 40mm (M203, M320)	BA06	40mm Ctg Non-Lethal Sponge (M1006)	328 (100)
Grenade Launcher, 40mm (M203, M320)	B534	40mm Ctg, Multi Projectile (M576)	246 (75)
Machine Gun, 40mm Linked (MK19)	BA30, B542, B576, B584, BA32, BA21, BA12	Ctg 40mm Linked HEDP, TP, Practice, Mixed (M430/M918/M385/M385A1/M918 & M385/ MK281)	1565 (477)[3]
Light Anti-armor Weapon (LAW), 35mm Sub-Caliber (M72-Series LAW)	H708	Rocket, 35mm, Practice (M73)	666 (203)[3]

Weapon/Caliber	DOD Identification Code (DODIC)	Ammunition Nomenclature	Minimum VDZ Height[5] Feet (Meters)
LAW, 66mm RKT HEAT (M72-Series LAW)	HX01	Launcher, Rocket, 66mm (M72 Series)	3116 (950)[3]
LAW, 84mm RKT HEAT (M136 [AT-4])	C995	Rocket, HE 84mm M136 AT-4 (M136)	3116 (950)[3]

[1] same as ball
[2] calculated plus 1.25 safety factor
[3] From DA PAM 385-63
[4] From SRTA ballistic graph - General Dynamics Ordinance
[5] Historical data based on 30° projectile trajectory plus safety factor

3-2.2 Access Restrictions, Warning Signs, Markers, and Flags.

Use service specific installation criteria.

3-2.3 Surface Danger Zones Over Navigable Water.

Use DA PAM 385-63/MCO 3570.1 when shooting over navigable water. A U.S. Army Corps of Engineers permit and citation in 33 CFR Part 334 are required.

3-2.4 Baffled Ranges.

When approved, overhead baffles can reduce the size of the SDZ but require special consideration that are not addressed in this UFC:

- Containment: Baffles designed to completely block line of sight out of the range may be used to eliminate direct fire from leaving the range but may not necessarily contain ricochets, ground skips, and splatter from leaving the range.
- Surface Danger Zone: The size and shape of the SDZ will need to be established on a case-by-case basis by the Government.
- Air movement: Baffles can significantly block natural air flow and increase potential for exposure to lead and other airborne contaminants. Unlike indoor ranges where negative pressure can be achieved, any ventilation system on baffled ranges will be influenced by outdoor air movement.

3-3 TYPES OF OUTDOOR RANGES.

Outdoor ranges may be configured in various ways to accomplish training goals.

3-3.1 Single Fixed Firing Line.

These ranges have one fixed firing line with targets placed along one or more target lines downrange. A moving target system may also be provided to vary target distance.

3-3.2 Multiple Firing Lines.

These ranges vary target distances using multiple firing lines used for shooting at one target line at the end of the range.

3-3.3 Maneuver Areas.

Maneuver ranges allow fire and movement in multiple directions. These ranges may or may not have permanent firing positions or firing trails. They may have single or multiple targets or target arrays. The complexity of maneuver ranges varies significantly. Simple maneuver ranges train movement and firing while moving techniques to individuals and teams. Complex maneuver ranges train movement, engagement, and support techniques to larger, or multiple, maneuver elements using a variety of weapons and weapon systems. Maneuver ranges often use Short Range Training Ammunition (SRTA), Standard Operating Procedures (SOPs) or Observer/Controllers to limit the firing locations and target engagement in order to limit SDZs.

3-3.4 Skeet and Trap Ranges.

Skeet and trap ranges are a type of outdoor recreational range that are typically limited to shot size Number 7.5 and smaller. Follow the United States Army Corps of Engineers (USACE) Centers of Standardization (CoS) Outdoor Sports Facility Standard.

3-4 SITING.

3-4.1 Mandatory Requirements and Issues to Address.

- The range must be accessible by road. Vehicle access is required to the range area for maintenance, grass mowing, emergencies, and delivery of weapons and ammunition.
- Travel distance to the range.
- Storm water management.
- Protection of wetlands, ground water, and surface water.
- Suitability of terrain.
- Historical and archaeological features.
- Previously contaminated sites, including unexploded ordnance contamination.
- Endangered species habitat.

3-4.2 Considerations.

When siting and orienting the range consider:

- Allowing for future expansion.
- Orienting north to south to minimize glare for the shooters.
- Orienting the firing away from sensitive and inhabited areas.
- Taking advantage of existing impact areas and natural backstops.
- Eliminating drainage structures on the range surface whenever possible.
- Using natural drainage with no flowing water courses near the range floor or impact berm.
- Avoiding areas that are subject to flooding.
- Minimizing noise to surrounding areas both on and off the installation. Noise models such as those provided in the Army's Range Management Toolkit (RMTK) may be used to develop potential noise contours.
- Taking advantage of any natural barriers and base restricted areas to prevent access by personnel and animals to the SDZ.
- Taking advantage of any natural topography such as hills and mountains to help contain rounds.
- Selecting site to minimize grading of range surface to produce a smooth surface of homogeneous material. A rocky surface will increase ricochets.
- For areas where wind predominantly blows in one direction, orienting with wind blowing downrange.
- Taking advantage of local topography to assist with runoff removal.
- In cold climates minimizing snow drifts and ice buildup and facilitating snow removal on range.

3-5 SUPPORT FACILITIES.

Supporting facilities include roads, drainage structures, and utilities. Design and locate these features to protect them from direct fire.

3-5.1 Roads and Parking.

Design for access by all vehicles that will use the range. Provide surfaced all-weather connector roads from the installation road network to the range complex. Provide range access roads that approach the range complex from behind the firing line and outside the SDZ.

3-5.2 Utilities.

3-5.2.1 Electricity.

Size service to accommodate power requirements for target systems, lighting, support facilities, and range maintenance.

3-5.2.2 Telephone and Radio Communication.

Include two forms of communication between the Range Control Facility, Range Safety Officer (RSO), instructors, beach guards, and any others involved in the operations of the range and security of the SDZ. For Army, follow DA PAM 385-63 and installation's SOPs.

3-5.2.3 Water.

Coordinate with the local utility and Designated Fire Protection Engineer (DFPE), as defined in UFC 3-600-01 to determine requirements. Consider fire protection, drinking, hand washing, and sanitary uses. If a water system is not feasible, consider a well and tank system. If this is not feasible, consider portable fire protection such as fire extinguishers or tanker trucks as required by the DFPE in collaboration with the installation fire department.

3-5.2.4 Restroom Facilities.

Restroom facilities are required adjacent to or within a reasonable distance from the range. Where sewage and running water are not feasible, other options such as composting or commercial portable latrines may be used.

3-6 GEOMETRY FOR NAVY AND AIR FORCE RANGES.

Typical geometry for a flat rectangular outdoor range may be adjusted when necessary to accommodate different types of training.

3-6.1 Measurement Control.

For vertical control define the firing line floor surface (FLFS) elevation as 0.00 and set other features based on this. Base horizontal control on measurements taken from the rearmost firing line (FL).

3-6.2 Target Centers.

Locate the center of the target at an elevation between the upper limit of fire (ULF) equal to 6 ft. (1.8 m) above FLFS for standing shooting and lower limit of fire (LLF) equal to 6 in. (152 mm) above FLFS for prone shooting.

3-6.3 Lanes.

Lane widths vary depending on weapons and training requirements. Establish lane width as necessary to safely support intended training.

3-6.4 Range Length.

Locate target lines as necessary to accommodate intended weapons and training.

3-7 GEOMETRY FOR ARMY RANGES.

Refer to TC 25-8 and the RDG for standard Army range layouts.

3-8 RANGE COMPONENTS.

Locate and design components to avoid direct fire and the creation of potential ricochet hazards.

3-8.1 Drainage.

Design positive grading to direct runoff away from the firing lines and prevent flooding at the target line(s) and access roads. Avoid using drainage structures on the range surface when possible. When the length of the slope or natural terrain require using drains between target lines and firing lines, trench drains or subsurface gravel drains should be located on the forward edge of the impact berm or bullet trap. Design inlets so that no hard-flat surface will be exposed to shooters and provide enough protection to account for heavy bullet impacts and erosion.

3-8.2 Floor Surface.

Design the surface to be smooth and graded to drain away from targets. Side to side grading should be minimal except on ranges where defilade or obstructions are desired for training. Transverse firing line grading should match target line transverse grading. Allow enough fore and aft distance to support the type of training conducted. Clearly mark firing lanes on the surface to match the targets. Depending on the number of personnel to be supported, the following surfaces may be considered at the firing line:

- Ground firmly compacted with mown grasses.
- Sand or fine gravel, with shooting mats for prone shooting.
- Wood decking of enough thickness and supporting members to avoid deck movement.
- Concrete pad topped with cushioning material.

3-8.3 Benches.

Continuous benches or individual trays may be provided to hold ammunition and weapons. Place trays to allow safe weapons handling.

3-8.4 Bleachers.

Bleachers and covered shelters may be provided outside the SDZ behind the firing line for training and briefings.

3-8.5 Obstacles.

Mock-up roofs, windows, doors, and other training structures may be provided at the firing line to meet training requirements.

3-8.6 Range Safety Officer Position.

Where possible, provide the Range Safety Officer (RSO) position an unrestricted view of all firing lines and target lines from their control position.

\1 When outdoor range temperatures exceed 86 F (30 C) implement occupational safety procedure identified within the heat injury prevention plan. These measures may include drink water supply, increased break time, cooled or shaded rest area, and heat stress monitoring. See your Service's occupational safety office for detailed guidance and monitor your local Heat Stress Flag Status.

Note: 86F (30 C) threshold is taken from NIOSH Figure 8-2 and falls within the Lower risk level (Table C-1) within NIOSH Occupational Exposure to Heat and Hot Environments publication. **/1/**

3-8.7 Towers.

Tower requirements are service and training dependent. Elevated range towers may be necessary to provide proper visibility for the RSO.

3-8.8 Overhead Cover.

Overhead cover may be provided but is not required nor recommended in most cases. While it can provide some protection from direct sun and the elements, covering the firing line can also increase noise levels below and interfere with air movement needed to remove airborne contaminants away from shooters. When provided, design to reduce noise reflected down to the firing line and to minimize interruption of natural air movement.

3-8.9 Lateral Limit Markers.

Lateral limit markers indicate direction of fire limitations from the outmost firing and target positions. The right lateral limit is found by taking the line of sight from the right firing position at the most uprange firing line to the right most target downrange, and similarly for the left. For Army ranges, TC 25-8 and the RDG along with installation SOPs define the type, size and location of limit markers.

3-9 IMPACT BERMS.

Impact berms are required for Navy and Air Force ranges that are generally flat, fire in one direction, and have target distances of 200 yds. (182 m) or less. Impact berms:

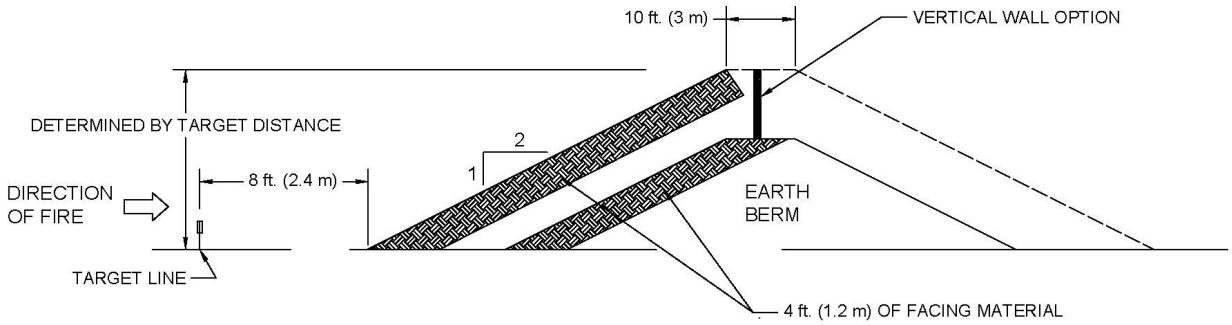
- Capture projectiles where they can be collected and removed more efficiently compared to ranges without impact berms.
- Significantly reduce the number of projectiles spreading out and landing downrange in the SDZ.
- Will not capture all projectiles because ground skips and ricochets will continue downrange.
- Will not reduce the length of the SDZ since the controlling round is at such an angle that its trajectory is well above the impact berm.

3-9.1 Geometry.

When required, design in accordance with Figure 3-1 and as follows:

- Slope: A slope of 2H:1V is recommended. A steeper slope of 1.5:1V may be used if a stable berm can be constructed that also allows future sifting of the soil.
- Width: Provide a total berm width equal to the firing line width plus the additional width necessary to cover a 5-degree dispersion angle from all firing positions.
- Top of Berm: Minimum 10 ft. (3 m) horizontal top on the berm.
- Toe of Berm: A minimum of 8 ft. (2.4 m) past the last target line.
- Minimum Height: 16 ft. (5 m) above the highest grade at the last downrange target line for ranges with target distances of 50 yd. (46 m) or less and 26 ft. (8 m) for ranges with target distances of 100 yd. (91 m) and greater. For ranges with target distances between 50 yd. (46 m) and 100 yd. (91 m), use a height that is prorated between the 50-yd. (46m) and 100-yd. (91 m) berm heights.
- Wall Option: A vertical wall may be provided on the top of the berm to reduce the berm height and footprint. The earth portion must be a minimum of 16 ft. (5 m). As a minimum, the wall should be solid 8 in. (203 mm) thick concrete. The foundation must have a minimum 4 ft. (1.2 m) of earth cover on shooting side of the berm. The direct line of fire from the prone position through the target point must impact the earth portion of the berm 3 ft. (1 m) below the exposed wall.
- See Butt Target Systems paragraphs for minimum berm height and toe of berm distance from target line when using that system.

Figure 3-1 Impact Berm



3-9.2 Berm Material.

Specify berm material in the design that will achieve and sustain a proper slope, promote vegetation growth, reduce the chance of ricochets, and allow for sifting to remove projectiles. Require the upper 4 ft. (1.2 m) of facing material on the impact side to be free from rocks and debris no greater than a No. 4 sieve – equivalent to 0.187 in. (4.76 mm) diameter mesh – that will not clog screens when sifting. A high clay content will help achieve a more stable slope, but too much clay in the upper layer will make it very difficult to sift and remove spent rounds in the future. Therefore, the facing material must not have more than 40% passing the No. 200 sieve.

3-9.3 Berm Construction.

Construct the berm in compacted horizontal lifts. Do not allow compaction up the slope of the berm face. Use benching and keying techniques to enhance slope stability when resurfacing or tying into an existing berm.

3-10 TARGET SYSTEMS.

The type of target system used will influence significant portions of the design. Choose systems based on the type of training anticipated. See individual service policy for procuring range target system equipment. A variety of target systems are available and new systems are under constant development. Current target systems include, but not limited to:

- Paper Targets on Wooden Frames: Paper targets can be mounted on simple wooden or other non-ricochet producing stands at the target line. They are typically used for 27.3 yd. (25 m) target distances or less because the time needed to walk downrange and score the targets.
- Butt Target Systems: Butt systems use paper targets secured to cardboard or plywood frames that are raised, lowered, and scored by personnel located downrange behind a protective berm. These systems are simple, reliable, and allow the shooter to remain at the firing line while

the targets are scored but are labor intensive because a downrange scorer is required for every shooter.

- LOMAH (Location of Miss And Hit) Targets: A computerized target system with sensors at the target end that detect the path of the projectile though the target and provide feedback to monitors at the firing line. These are generally very accurate but expensive and require significant maintenance to maintain calibration.
- Pop-Up Targets and Stationary Infantry Targets (SIT): These targets are raised and lowered remotely and can be either electric or pneumatic.
- Steel Targets and Knockdown Targets: Steel targets are typically used when accurate scoring within the target is not needed, only a hit or miss. Steel targets provide audible feedback and are designed to go down or spin when struck. Knockdown targets fall when struck. Knockdown targets can be steel but other versions are available. Steel targets and knockdown targets can be reset pneumatically, electrically, or by gravity. Check with service safety requirements when considering steel targets as they will impact target design, placement, and safe target distances.
- Turning Targets: These targets rotate on a vertical axis to present alternating target face and edge to initiate and cease firing. They can be designed with a friend face on one side and a foe on the back for shoot and no-shoot drills. Turning mechanism can be pneumatic or electric.
- Running Man and Moving Infantry Targets (MIT): Targets that move laterally or randomly on a track. Targets can present personnel and vehicle silhouette including armored vehicles and tanks. These targets are typically provided to supplement other target systems.
- Stationary and Moving Armor Targets: Targets that simulate a tank or other vehicle for live fire training and qualification programs.
- Mobile and Robotic Targets: A variety of targets are available that move on remote controlled vehicles.

NOTE: When using moving targets, it is critical to incorporate all shooting positions and angles when developing the SDZ.

3-10.1 Target Systems for Army Ranges.

For Army ranges, AR 350-19, TC 25-8, and the RDG define target types, control systems, interface, emplacements, protection, and procurement processes.

3-10.2 Target Line Grading and Protection.

Match grading at target line bases with firing lines when possible. Protect target support bases from direct fire by:

- Providing a target berm on the firing side.
- Burying below ground.
- Providing a protective wall designed to stop rounds but reduce ricochet potential.

3-10.3 Target Supports and Berms.

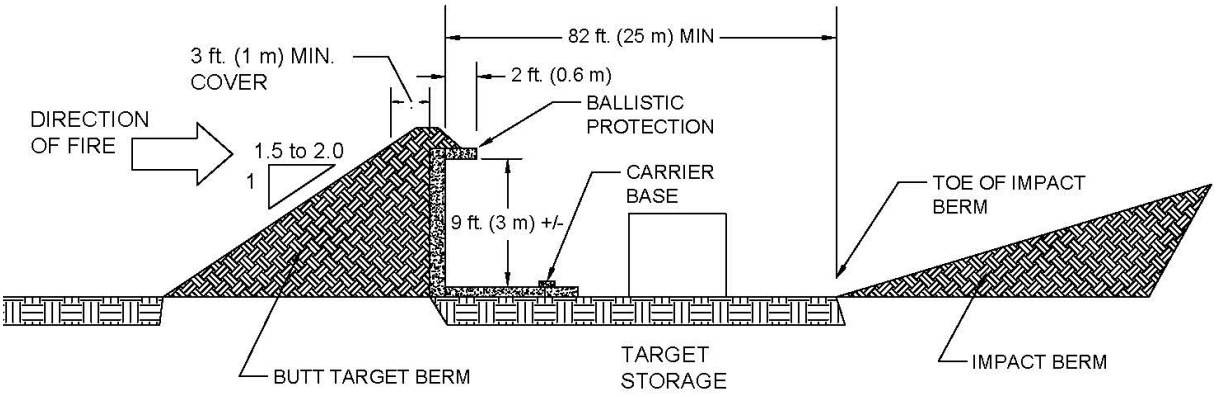
Target holders and bases should be designed to prevent ricochets and splatter. Earth berms can be placed in front of targets to protect target base and should be constructed from the same material as the impact berm.

3-10.4 Butt Target System.

Butt target systems allow manual scoring of targets by personnel downrange behind the target line and protected by a berm. Design in accordance with Figure 3-2 and as follows:

- Design butt target berm with a slope that is maintainable, typically 1.5 to 2.0H:1V and 3.0 to 4.0H:1V where erosion is a major issue.
- Provide an impact berm behind the target berm with a minimum height of 26 ft. (8 m) above the carrier base elevation.
- Toe of impact berm a minimum of 82 ft. (25 m) from the butt wall.
- A target storage facility protected from direct fire may be included between the butt system and the impact berm. Top of structure must be below all direct lines of fire and the top elevation of the ballistic protection in the pit.
- For Army Ranges, use the Known Distance (KD) Range section of TC 25-8 and the RDG for the design and construction details for this type of target system.
- For pit option, see the RDG.
- For USMC, meet the requirements of MCO 3570.1.

Figure 3-2 Butt Target System



3-11 PARALLEL RANGES.

When parallel ranges have SDZs that cover the firing line of the adjacent range, the ranges may be used concurrently when side containment is provided as follows:

- Earth Berm: Require an inside slope of 1V:1.5H or flatter with a minimum horizontal 6 ft. top width. Provide same material and compaction as required for impact berms.
- Concrete Wall: Require a minimum 8 in. (203 mm) thick concrete wall with a smooth, flat surface free of irregularities, form ties, and protrusions.
- Shock Absorbing Concrete (SACON): Design based on type of weapons and ammunition used.
- Wood and Gravel Walls: Timber and gravel filled wooden walls on new ranges are not recommended because of maintenance and integrity issues.
- Height: Require a minimum height of 10 ft. (3 m) above the highest elevation on either side where personnel could potentially be standing while either range is in use.
- Army ranges may require an SDZ deviation to allow concurrent use.

3-12 MACHINE GUN TUBE RANGE.

Training on machine guns up to 7.62 mm caliber may be provided using a 10-meter tube range. See Figures 3-3 and 3-4. These ranges incorporate range tubes that function as baffles to reduce the size and shape of the SDZ. Army ranges of this type require the same approval as other baffled ranges. Tube ranges are not suitable for:

- Machine guns over 7.62 mm caliber.

- Navy OPNAV 3591 machine gun training since they do not support the training requirements for traverse firing.

3-12.1 Surface Danger Zone.

The machine gun tube SDZ for all ammunition types less than 7.62 mm is 2296 ft (700 m) and the VDZ for all ammunition types less than 7.62 mm is 1640 ft (500 m). The reduction in the SDZ for 7.62 mm and greater ammunition will be determined by the Government. Army ranges require a deviation IAW AR 385-63.

3-12.2 Machine Gun Tubes.

For 10-meter machine gun tube ranges use concrete pipe with a minimum length of 24 ft. (7.3 m) and either round with a minimum 5 ft. (1.52 m) inside diameter or square with a minimum 5 ft. (1.52 m) inside dimension. Provide a reinforced concrete slab the length of the tubes to maintain joint integrity. The tubes may be constructed of sectional pieces if the spigot end of the bell spigot joint is pointed downrange. Tubes may be made of ASTM C75, Class V reinforced concrete pipe (RCP) requirements, or may be steel pipe of suitable thickness fabricated from rolled plates. The interior of the tubes must have a smooth continuous surface. Repair any lifting lugs or holes so the tube interior is smooth and does not produce erratic ricochets.

3-12.3 Drainage.

Slope the tubes approximately 6 in. (150 mm) towards the target line. Firing positions must be at least 12 ft. (3.7 m) apart, measured center-to-center. The end of the tube toward the shooter should touch the firing line.

3-12.4 Firing Platform.

Ensure that the firing tube placement and the firing platform height will place the muzzle of the machine gun at the approximate center of the tube height and at least 6 in. (150 mm) inside the tube. To achieve this, the platform may need to extend inside the tube approximately 3 in. (76 mm) depending on the tripod and weapon dimensions.

3-12.5 Berm Backstops.

For berm backstops, locate the berm no more than 150 ft. (45.7 m) from the firing line to the centerline of the berm. The minimum height of the backstop is established by determining where the highest point that a bullet could exit the target end of the tube and impact the berm. This line must intersect the berm no less than 6.5 ft. (2 m) from the top. Use same material as required for impact berms.

3-12.5.1 Optional Deflector Plate.

Locate the deflector plate at least 2 ft. (0.6 m) above the highest bullet impact point on the berm. The deflector plate may be either angled or vertical which will influence the reduction in the SDZ.

3-12.5.2 Optional Steel Traps.

Locate the trap at least 50 ft. (15m) away from the firing line. The line drawn from the firing point to the highest point that a bullet could exit the target end of the tube must intersect the top plate of the trap not less than 12 in. (300 mm) from the top, measured along the slope of the trap.

3-12.6 Noise.

Engineering solutions to reduce the noise levels from tube ranges are limited and may consist of sand bags along the bottom of the tube. Cement-based acoustical treatment may also be used. Additional sound attenuating materials can also be added to the interior surfaces of square tubes. Appropriate operational mitigation must be established to reduce the high impact noise exposure. For Air Force ranges, the impact of hazardous noise levels for tube ranges must be evaluated by the local Bioenvironmental Engineering (BE) and Civil Engineering (CE) offices.

Figure 3-3 Machine Gun 10-Meter Tube Range Layout

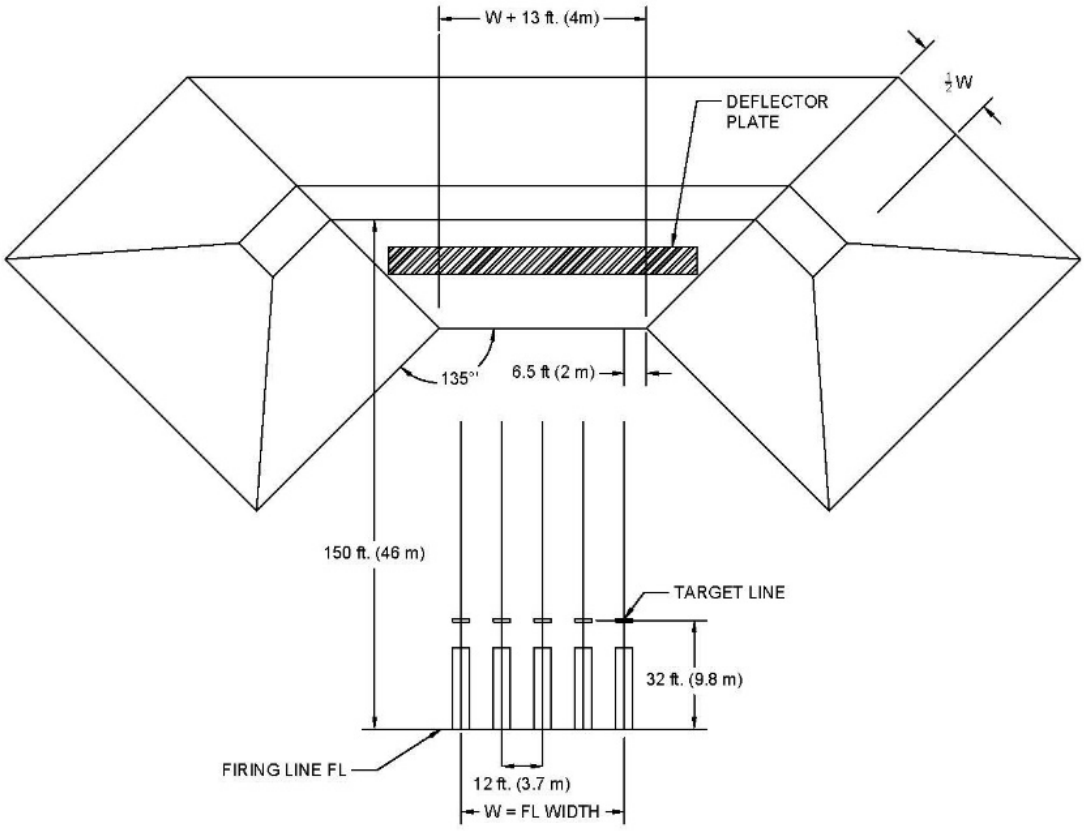
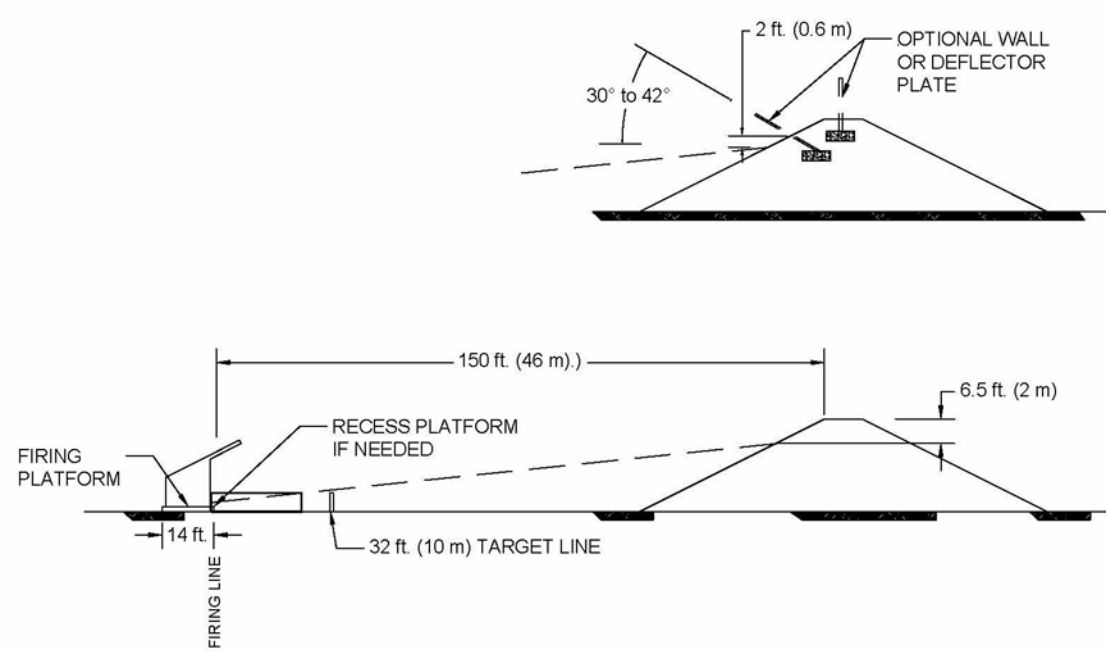


Figure 3-4 Machine Gun 10-Meter Tube Range Section



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CHAPTER 4 INDOOR RANGES

4-1 GENERAL.

Indoor ranges have open bays with shooting generally straight downrange into a bullet trap. Ballistic containment is provided by ballistic side walls, overhead baffles, and a bullet trap. Indoor ranges can be built using conventional or modular construction methods. A push-pull ventilation system supplies air from behind the firing line and exhausts at the trap end to move airborne contaminants downrange and away from personnel inside the range. Design and construct Army and Marine Corp indoor ranges IAW applicable portions of this UFC and the design and safety requirements found in DA Pam 385-63; the DA PAM controls in case of conflict.

4-1.1 Coverage.

The ballistic containment criteria in this chapter is intended for indoor ranges that support weapons and ammunition with energy up to 2,500 foot-pounds (3,390 Newton-meters) including handguns, 5.56 mm rifles, and 7.62 mm rifles. It does not support:

- Tracers, explosives or incendiary rounds.
- Armor Piercing (AP) rounds.
- 5.56 mm or 7.62 mm Enhanced Performance Rounds (EPR), (M855A1 or M80A1) **\1** may be used on granular rubber bullet trap or steel bullet traps upgraded and specifically certified by the manufacture for these more powerful EPRs. **/1/**

Design the range systems for the specific, worst-case rounds for these or other higher-powered weapons. The ballistic containment system includes baffles, floors, walls, splatter protection, and bullet trap.

4-1.2 Range Areas.

An indoor range facility can be divided into three functional areas:

- The training area between the rear uprange wall and the bullet trap where live fire occurs. The training area requires a ballistic envelope to contain rounds within the facility.
- The direct support area that includes the range safety officer’s office, entrance vestibules, storage areas immediately off the training area, and the area behind the bullet trap.
- The indirect support area and all other spaces including administrative, restrooms, classrooms, hallways, and other storage areas.

4-2 TRAINING AREA.

Define training requirements, ammunition, target distances, and maintenance issues prior to developing a floor plan. For ranges approaching 100 ft. (30.5 m) width and wider, the cost and size of structural components can increase significantly and should be taken into consideration when determining number of lanes and range width. Consider multiple bays to provide flexibility and reduce structural loads.

- Navy: The Navy standard qualification range has an 82 ft. (25 m) target distance with 4 ft. (1.2 m) lane widths. Note that while some Navy training only requires a 25-yard target distances, a 25-meter range provides additional capability and safety. For Naval Special Warfare indoor ranges, the layout is not standard and will vary depending on type of training supported.
- Air Force: Use Air Force Facility Criteria FC 4-179-03 for planning and layout of indoor ranges along with general requirements provided in Chapter 1. This Air Force FC provides general guidance on lanes and detailed planning requirements for the indirect support areas.
- USMC: Typical indoor ranges have either 82 ft. (25 m) or 164 ft. (50 m) target distances.
- Army: Base layout on training and installation specific requirements.

4-3 DIRECT SUPPORT AREA.

4-3.1 Range Control Booth.

4-3.1.1 Ventilation, Layout, and Sound Attenuation.

Include a ventilation system independent of the training area range ventilation system and a 2 ft. (0.8 m) wide, full-length work counter at the base of the window. Locate all range controls and utility panels in this area. Locate lighting and communications controls to allow adjustments while maintaining clear visibility downrange. Provide sound attenuation to allow personnel in the booth during live fire without the need of hearing protection as described by the noise paragraphs in this chapter.

4-3.1.2 Visibility.

Design range control booth to provide full line-of-sight visibility from a center seated position 4 ft. (1.2 m) behind a 4 ft. (1.2 m) high window to 4 ft. (1.2 m) behind the firing line on both sides and extending downrange to the target area. See Figure 4-1. Coordinate window level with that of the ventilation supply diffuser so the downrange view is not blocked by the diffuser when standing. Windows and doors within the booth must not restrict or distort the view downrange. Closed-circuit television monitors may be used to enhance, but will not replace, this requirement. Provide windows with views into the hallway behind and vestibules to the sides that allow monitoring of movement in and out of the training area. Use sliding closures or other method on the windows into

hallways and vestibules that can be used to completely block light from coming into the range control booth during low light conditions. For Air Force ranges, raise floor in booth a minimum 2 ft. (0.6 m) minimum above the range floor to promote visibility downrange and to all range entry points.

4-3.2 Airlock Vestibules.

Entrance vestibules with doors at either end are required to allow movement in and out of the range without disturbing the air balance of the range. A minimum of one vestibule for ranges with seven lanes or less, and two vestibules for ranges with more than seven lanes is required. Place vestibules adjacent to the Range Control Booth with windows to allow monitoring of movement from the booth. All doors into the training area must swing outward from range to help seal doors under negative pressure. Seal around doors and place sweeps at bottom to provide an airtight closure.

4-3.3 Vacuum Storage.

Include a storage area with direct access to the training area for portable High Efficiency Particulate Air (HEPA) vacuum and equipment storage.

4-3.4 Brass Storage.

A 55-gallon drum may be placed next to side wall behind firing line for brass storage immediately after collection.

4-4 TRAINING AND DIRECT SUPPORT AREA LAYOUT.

The width of the range is determined by the number of lanes, width of lanes, and the space provided against each side wall. The length of the range is determined by the distance behind the firing line, the target distance, the depth of the bullet trap, and the space behind the bullet trap. The height of the range is determined by the clear height between floor and bottom of the ceiling baffles, the ceiling baffle height, and the distance above the baffles needed for structural and mechanical systems. Make all surfaces downrange in direct line of fire non-reflective when lasers are allowed in training.

Use Figures 4-1, 4-2, and the following minimum distances:

- Range Control Booth: 10 ft. (3 m) front to back.
- Get Ready Area: Table 4-1.
- Target Distance: As required for training. Do not extend target system into the trap.
- Bullet trap: Approximately 27 ft. (8.2 m) – coordinate with trap manufacturer.
- Maintenance Area: Minimum 6 ft. (1.8 m) behind bullet trap. Verify there is enough space in maintenance area for all trap components,

compressors, and other hardware. This is area must not be used for storage.

- Clear Height: Table 4-1 for minimum distance. May need higher ceilings if vehicles are used in training.
- Distance between top of baffles and bottom of roof: As needed, including space for structural components and ventilation ductwork.
- Distance between edge lanes and side walls: Minimum 2 ft. (0.6 m). This distance is needed to help achieve proper airflow and prevent shooting near side walls.
- Lane Width: Minimum 4 ft. (1.2 m). Service and training requirements may dictate wider lanes.
- Avoid interior columns when possible. If provided, include a 2 ft. (0.6 m) buffer between column and lanes.
- Safety Ceiling: Extend ballistic coverage to 4 ft. (1.2 m) behind firing line.

Figure 4-1 Standard Range Layout

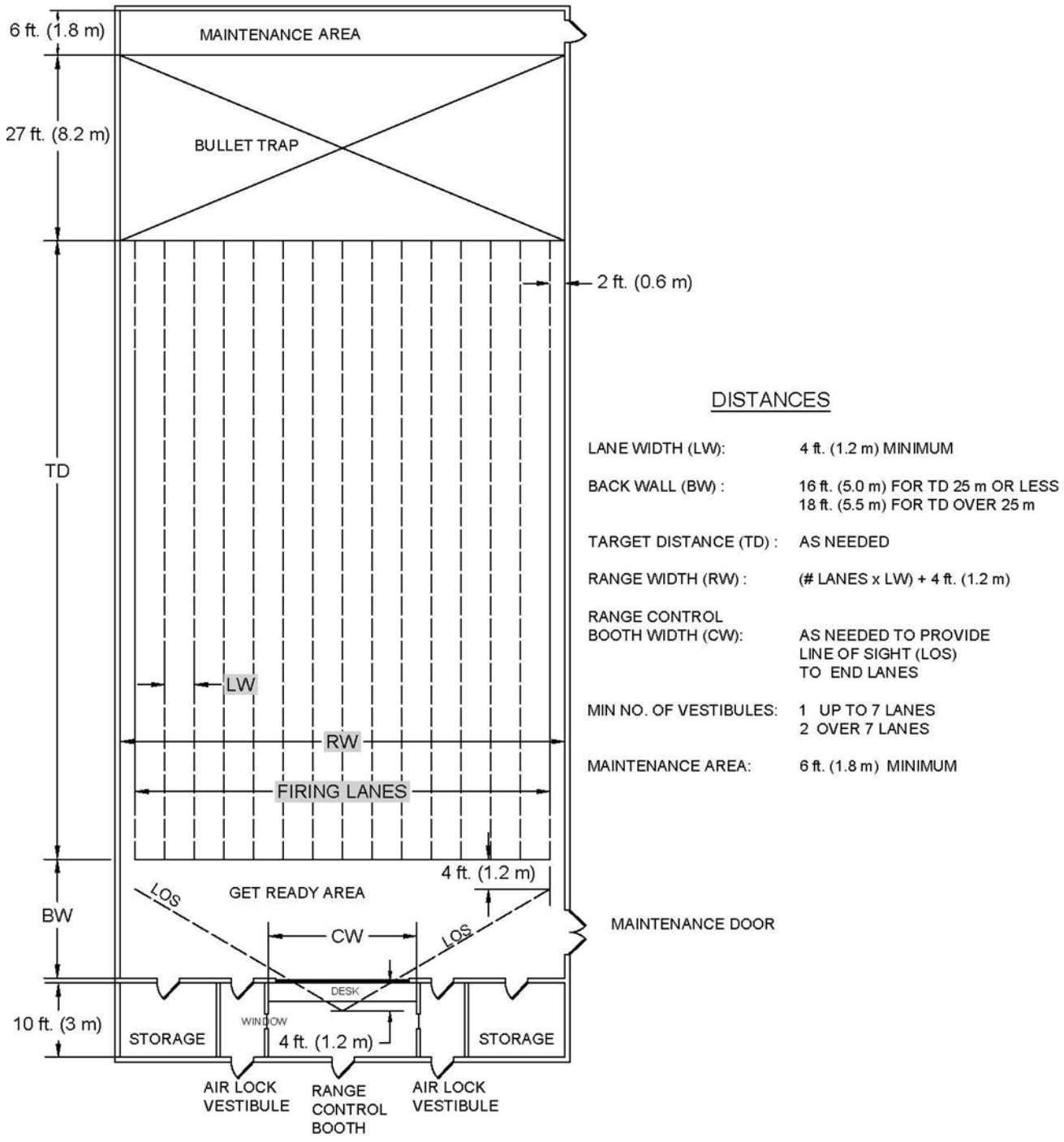
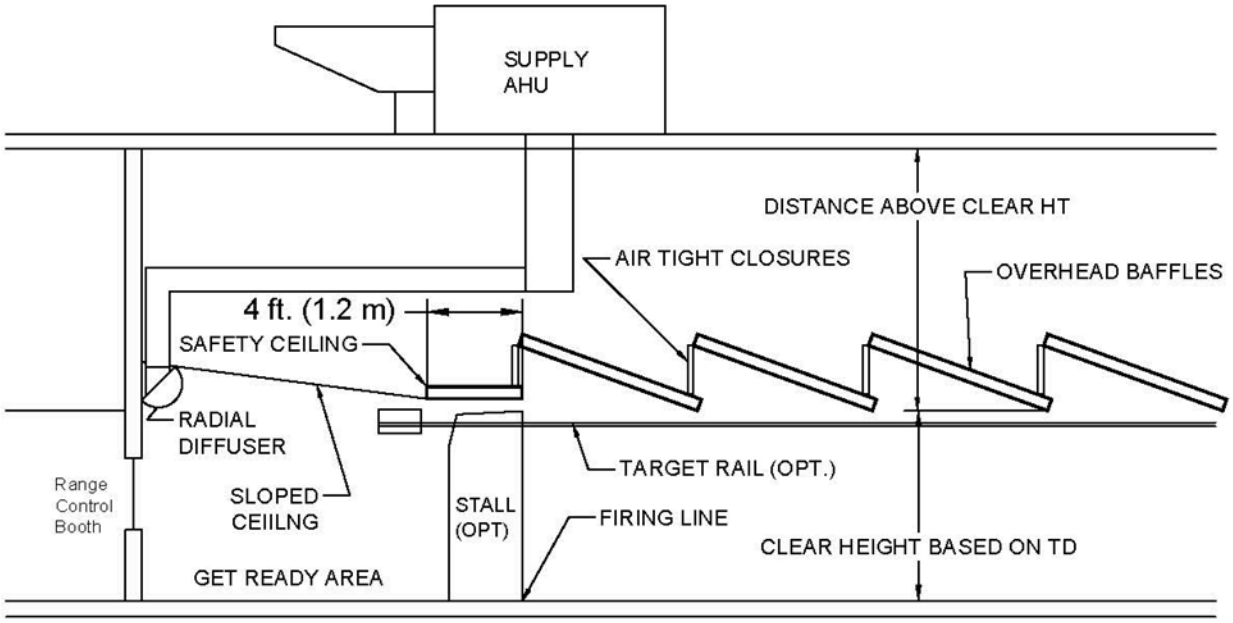
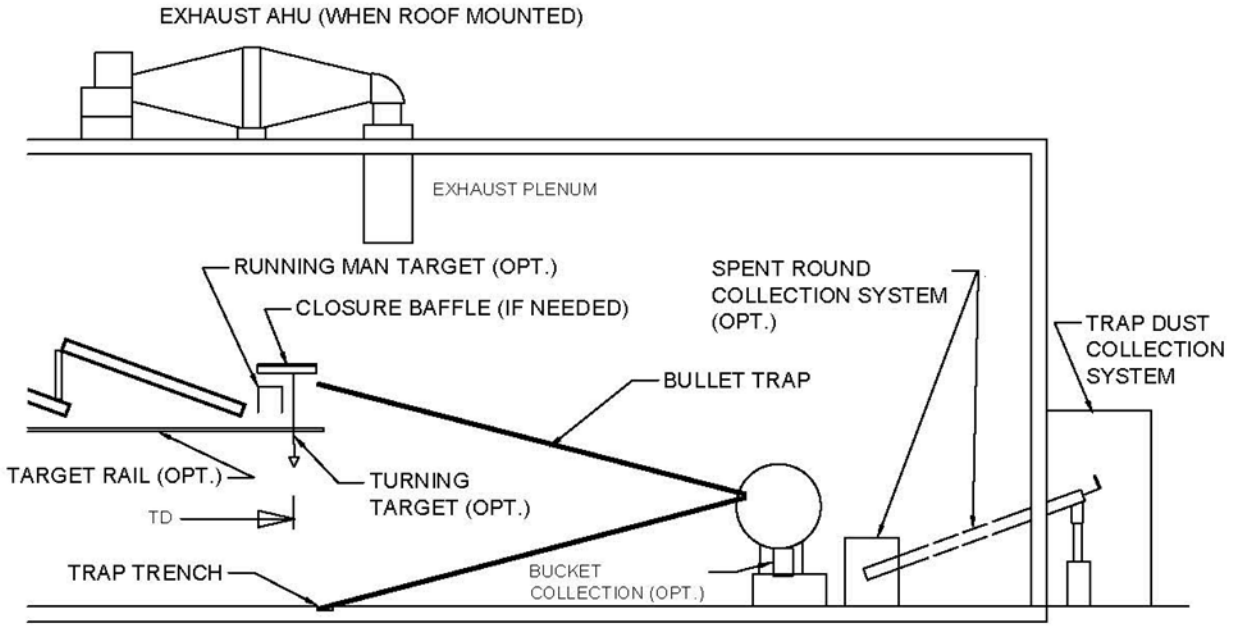


Figure 4-2 Standard Range Section.



UPRANGE



DOWNRANGE

Table 4-1 Range Heights and Get Ready Area Distances.

Target Distance (TD)	Clear Vertical Height	Get Ready Area (Backwall to FL)
Up to 82 ft. (25 m).	8 ft. (2.4 m)	16 ft. (5 m)
Over 82 ft. (25 m) up to 165 ft. (50 m).	10 ft. (3 m)	18 ft. (5.5 m)
From 165 ft. (50 m) to 328 ft. (100 m)	12 ft. (3.7 m)	18 ft. (5.5 m)

4-5 INDIRECT SUPPORT AREAS.

4-5.1 Required Indirect Support Area.

The following areas are required:

- Administrative Area: This area contains offices for the range safety officer, instructors, and maintenance personnel along with file and shelf storage for operations data and maintenance records.
- Restrooms, Shower, and Locker Room Areas: Size restrooms based on occupancy and range use. Size shower and locker based on range staff.
- Laundry: For range laundry use only.
- General Storage: Provide adequate storage for targets, filters, tools, and maintenance equipment.
- Maintenance and Storage area.

4-5.2 Other Indirect Support Areas.

The following areas may be necessary:

- Brass sorting: Include table with raised perimeter and holes to collection buckets or drums underneath.
- Classrooms: This includes space to conduct classroom training prior to live-fire and after-action debriefings.
- Weapons Cleaning Area: This space accommodates workbenches, degreasing tanks, and spray hoods. Exhaust hoods and vapor proof electrical fixtures may be required. Provide a lavatory with potable water and eyewash in the immediate area.
- Arms and Ammunition Storage: **\1** Comply with DODM5100.76, Physical Security of Sensitive Conventional Arms, Ammunition, & Explosives

(AA&E) and any Service supplements to this DoD manual and **/1/** UFC 4-215-01 Armories and Arms Rooms. When provided, include an issue and clearing area adjacent to the weapons storage and cleaning area.

- Break Room: Room for meals and breaks with space for refrigerator, sink, countertops, microwaves, coffee machines, table, and chairs. Provide signage that prohibits food inside the training area.
- Weapons Simulator Room: Design to accommodate anticipated system. These rooms may require raised flooring, compressor area, darkened or no windows, and a small control room. Signs must clearly mark room as simulation weapons only, with no lethal ammunition allowed.

4-6 FIRE PROTECTION.

The training area and trap area do not require a sprinkler system. Coordinate with the DFPE early in the design process for detailed requirements for the rest of the building. Provide 2-hour fire rated construction separating the training and direct support areas from indirect support areas.

4-7 COLLECTION, TEMPORARY STORAGE, AND DISPOSAL.

Design for the collection, storage, and disposal of:

- Brass, typically recycled.
- Supply filters, non-contaminated.
- Exhaust filters, contaminated after use.
- Filters from the dust collection system, contaminated after use.
- Dust captured in the dust collection system.
- Vacuum waste, contaminated.
- Trap collection waste, contaminated.
- Projectiles captured in trap collection system.

Note: Contaminate refers to material with lead, copper, and other compounds typically at levels that classify them as hazardous waste for storage and disposal purposes.

4-8 STANDARD INDOOR RANGE FEATURES.

Design a ballistically contained structure that:

- Contains all shots from each intended firing location, at all respective targets, for all weapons and calibers based on the intended training in the facility.

- Provides airtight connections between walls and roof to prevent air leakage into the range that can interfere with the ventilation system's negative pressure.
- Seals all utility connections leading into the range.
- Provides proper detailing and door hardware for an airtight closure.
- Provides a maintenance double door behind the firing line.
- Provides at least one maintenance double door in the area behind the bullet trap. Two double maintenance doors, one on each side, may be necessary to provide access to all heavy items and equipment.

4-9 MULTIPLE BAYS.

To increase flexibility and reduce spans, ranges may be divided into separate bays with structural walls extending the length of the range from floor to roof that prevent air movement between bays. Ranges that have a partial dividing wall or an interior row of columns are not multiple bay ranges. Design each bay to operate independently from adjacent bays with separate and independent:

- Ventilation systems and controls.
- Bullet traps and trap related equipment.
- Target systems.
- Range control booths.

4-10 CEILING, WALLS, AND DOORS.

Design walls to reduce noise transmission to adjacent occupied spaces and to withstand negative and positive pressures that would be encountered should the ventilation supply or exhaust fans fail. Walls must provide an airtight enclosure to maintain negative pressure inside the range as required for range ventilation. Seal any penetrations in wall including ductwork and utility penetrations.

4-10.1 Uprange Ceiling and Wall Behind Firing Line.

Slope suspended ceiling from back wall to edge of safety ceiling behind firing line to provide a gradual transition for supply air movement to firing line. Place removable suspended ceiling panels along the width of the back wall under ventilation balancing dampers for maintenance access.

4-10.2 Ballistic Side and Downrange Walls.

Make side walls and the downrange wall behind the bullet trap a minimum of:

- Concrete: 8 in. (203 mm) thick using either cast in place, tilt up, or precast construction. Structural design and internal thermal insulation may dictate

thicker walls. If internal cavity is provided, the interior section must meet the minimum thickness requirement. Walls must be smooth and flat with no protrusions, indentions, cavities, exposed steel, or any other feature presenting a ricochet hazard.

- Steel: Minimum 0.375 in. (9.5 mm) AR500 steel plate.
- Provide splatter protection on steel and concrete up to 8 ft. (2.4 m) above the floor and a minimum of 16.4 ft (5 m) down range of all firing positions, except do not place any splatter protection within 10 ft. (3 m) of the bullet trap. This is to allow inspection of the wall where it is most susceptible to bullet strikes.

4-10.3 Wall Joints.

Provide complete ballistic integrity across joints. For side walls, this includes joints from finished floor up to the highest point of the ceiling baffles. For the downrange wall behind bullet trap, this includes up to 12 ft. (3 m) above finished floor. Ballistic integrity can be accomplished using keyed construction joints or by placing 0.375 in. (9.53 mm) thick AR500 steel plate over the joint. When used, design plate to protect the joint and reduce chance of ricochets by:

- Flush mounting plate to wall.
- Placing a 45-degree bevel on the leading edge of the plate that faces the shooter, with the plate fitted securely to the wall with no gaps over 0.0625 in. (1.6 mm) between plate and wall.

4-10.4 Downrange Doors.

Avoid doors between the firing line and bullet trap, but they may be necessary on large ranges to meet Fire and Safety codes. When placed downrange past the firing line, doors and door hardware must meet UL 752 Level 8 protection standard. This includes doors on back wall behind the trap so that rounds cannot escape during a trap failure. Doors behind the bullet trap that are located on the side walls are not required to meet this UL level. Use locking hardware, panic hardware, or magnetic door locks to ensure personnel do not inadvertently enter during live fire events. For doors on the side wall between the firing line and bullet trap, a wall baffle must be placed just uprange of door extending from the floor to the height of the door to reduce the chance of an errant shot striking the door hardware.

4-10.5 Maintenance and Vehicle Entrance.

For each bay, include a 6 ft. (1.8 m) wide maintenance double door uprange at least 4 ft. (1.2 m) behind the firing line. A larger door may be required if vehicles will be used in training. These doors are not operated during training and therefore do not require a double airlock vestibule.

4-11 FLOORS.

Concrete floors must be level with a smooth finish, without any protrusions or irregularities.

- Seal all floor joints and design to minimize ricochet potential.
- Locate longitudinal floor joints between firing lanes. Provide backer material when necessary to support sealant.
- Sawed control joints more than 0.25 in (6.3 mm) wide are not permitted.
- Traditional chamfered construction joints are not permitted.
- Surface seal floor with a waterproof sealant to facilitate cleaning.
- Use non-reflective flat or flat satin sealant when range is designed to allow lasers.

Steel floors may be 0.375 in. (9.5 mm) AR500 steel plate with support to prevent sagging.

- Provide a slip-proof coating.
- Do not apply any surface on the flooring that prevents the bullets from reaching the bullet trap or that will entrap firing residue and hinder the cleaning of the range floor.

4-12 RANGE MARKINGS.

Provide permanent range markings as required by the service. Use nonreflective paint when designing for laser use. The following are recommended:

- 4 in. (100 mm) wide red floor stripe across the width of rear uprange firing line.
- 4 in. (100 mm) wide black stripe across the width of the range in front of the trap at the last target line.
- 4 in. (100 mm) wide vertical black stripes up both side walls with critical target distances starting at the floor and extending 4 ft. up the wall. Provide 4 in. (100 mm) letters above this line indicating distance with units in either yards or meters depending on training requirements. For ranges with fixed firing lines and movable targets, the distances must be measured starting at the firing line. For ranges with a fixed target line at the trap end, the distances must be measured from the target line back towards the firing lines.

- Lane markings at the firing line and the last target line are to be coordinated with users on size and type of markings. For Air Force projects see Chapter 2.
- 4 in. (100 mm) wide yellow ready line 8 ft. (2.4 m) behind the firing line.

4-13 TARGET SYSTEMS.

Choose target systems based on the type of training anticipated and scoring accuracy required. The type of target system used will influence the floor plan, baffle design, and range height and must be considered in the design. Polices for procuring range target system equipment vary between services. All target systems must be designed to prevent ricochets and splatter from returning to shooters, with steel and other hard material angled and no blunt edges presented to the firing line. A variety of systems are available. Some options are presented below.

4-13.1 Static Target Stands.

Basic target stands allow for manual placement of target. Stands may be of wood, poly synthetic, steel angled away from line of fire, or other material designed to reduce ricochets.

4-13.2 Overhead Target Rail System.

Overhead monorail target systems have:

- Rigid overhead rails.
- Capability of 180-degree turning targets.
- Capability of moving and stopping target at all target distances.
- AR500 angled steel plate on front of carrier, target clamps, and connections between clamp and carrier designed for anticipated weapons and ammunition.
- Target rails approximately 7.5 ft. (2.3 m) above the finished floor.
- Ability to control single targets from individual lanes.
- Ability to control both single targets individually and all targets collectively from controls in the range control booth.
- Programmable target positions in both yards and meters.
- Programmable parameters including positions, start/stop times, and edge face targets.
- Drive system located behind the firing line using a cable system for moving targets.

Optional:

- Dimmable light illuminating target on target carrier.
- 360-degree target turning.
- Self-driven target carriers with internal motors and drive system.

4-13.3 Running Man Targets.

Running man targets are typically mounted on overhead rails that move targets left and right across the width of the range near the last target line. Running man targets can be either a single target system or a double system that runs two targets in opposite directions at the same time. Coordinate rail location with bullet trap, overhead baffles, other target systems.

4-13.4 Fixed Turning Targets System.

Turning targets are located at the trap end and have a target clamp on a vertical pivoting rod to rotate targets between face and edge. Clamps must hold targets securely but allow one-handed placement and removal of targets. The target clamp and vertical rods should be protected by 0.375 in. (9.5 mm) AR500 steel plate placed at an angle to extend life and help prevent ricochets. The unprotected components of the system must be placed behind overhead baffles to block line of sight from all shooting positions.

4-14 SHOOTING STALLS.

Shooting stalls may be used to provide shooting barriers, separate shooters, mount target controls, block ejecting brass from adjacent lanes, and limit ability of shooters to accidentally shoot sideways. Fold down or swing out tables and barricades may be included. Check individual service policy for requirements.

4-15 BARRIERS AND BARRICADES.

Training may require barriers or barricades and must be addressed in the design. Include storage space when they are not permanently affixed to the building. These may be portable wooden frames or features incorporated into shooting stalls. Other options include swing out barriers that fold flat to a side wall and barriers that can be temporarily attached to the wall and removed for storage when not in use. Check individual service policy for requirements and procurement policy. The following provides geometry for some service specific barrier and barricade requirements:

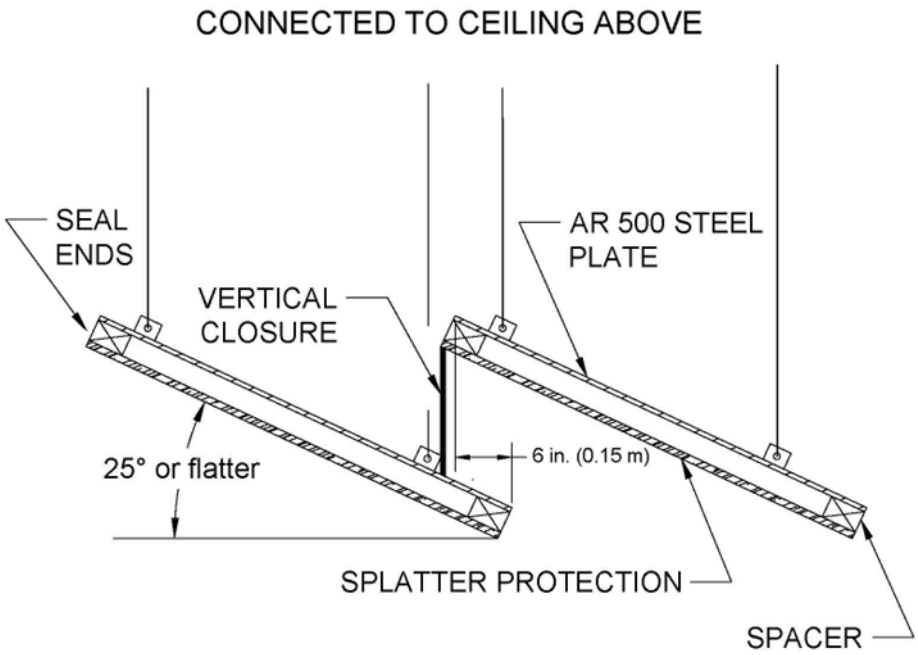
- Air Force: Position barricades as described in Chapter 2.
- Navy: Standing, low, and window barriers for Practical Weapons Courses in OPNAV 3591.

4-16 OVERHEAD BAFFLES AND SAFETY CEILING.

Design baffle system to provide complete overhead containment within the training area in accordance with Figure 4-3 and the following:

- Minimum 0.375 in. (9.5 mm) AR500 steel plate.
- Maximum 25-degree angle from horizontal.
- Minimum 6 in. (0.15 m) horizontal steel-steel overlap between adjacent baffles.
- Maximum 0.0625 in. (1.6 mm) mm) gap between steel plates for butt joints and 0.125 in (3.2 mm) where backing plate or lap joint is used.
- Non-ballistic vertical closure sections from the lower end of one baffle to the upper end of the next baffle downrange to prevent air from moving between open area below to space above baffles.
- Complete coverage from side to side with no gaps. This can be accomplished by using an AR500 plate connected to the side wall that overlaps with the overhead baffles.
- Provide intermediate support to prevent steel plates from sagging.
- Sealed off baffle section between steel plate and splatter protection to prevent the creation of a plenum that would allow air to move between training area below and ceiling space above. Spacers may be run in either direction provided ends are sealed between steel plates and splatter protection.
- Splatter protection provided on all baffle surfaces a minimum of 16.4 ft (5 m) down range of all firing positions.
- A closure baffle as shown on the downrange section in Figure 4-2 above may be required to complete ballistic protection when a running man target system is used.

Figure 4-3 Overhead Baffles



4-17 BULLET TRAPS.

Unless directed otherwise, all new indoor bullet traps must **\1** employ a commercial steel or granular rubber media **/1/** trap. Design the trap for the most powerful round to be used.

\1 A life cycle cost analysis of commonly manufactured bullet trap systems was commissioned by the AF and concluded in 2024. The analysis considered various factors such as installation cost, maintenance cost, benefits related to health, safety, and environmental stewardship, as well as other operational considerations over a projected 25-year period of analysis. The life cycle cost of a granular rubber bullet trap was found to be less than the cost of a steel bullet trap for most applications. The analysis was based on a loading rate of 55,000 rounds per year per lane, but also looked at the effect of fewer or more rounds. The life cycle cost of the steel and rubber traps equalized at approximately 136,000 rounds per year per lane. Above 136,000 rounds the steel trap begins to become a more cost-effective option. Although each bullet trap type depreciates over time, the granular rubber bullet trap system is the most economically viable bullet trap for many situations.
Compared to steel bullet traps, granular rubber traps:

- Take up less space.
- Cost less.
- Capture rounds more intact and thus reduce lead dust at the trap end.
- Can provide some limited reduction in sound reverberation time.

- Eliminates the impact noise of bullet impact against steel plates.
- Rubber traps require range to be shut down during bullet mining procedure whereas steel trap have integral bullet collection systems.
- Require more routine maintenance.
- Will fail if rubber levels are not maintained properly.
- Can ignite if not used and maintained properly.

NOTE: Rubber trap fires have caused significant damage on several DoD indoor ranges, mostly from lack of maintenance and the use of tracers ammunition, which should never be allowed within indoor ranges. Include the reapplication of fire retardant periodically during routine trap mining procedures.

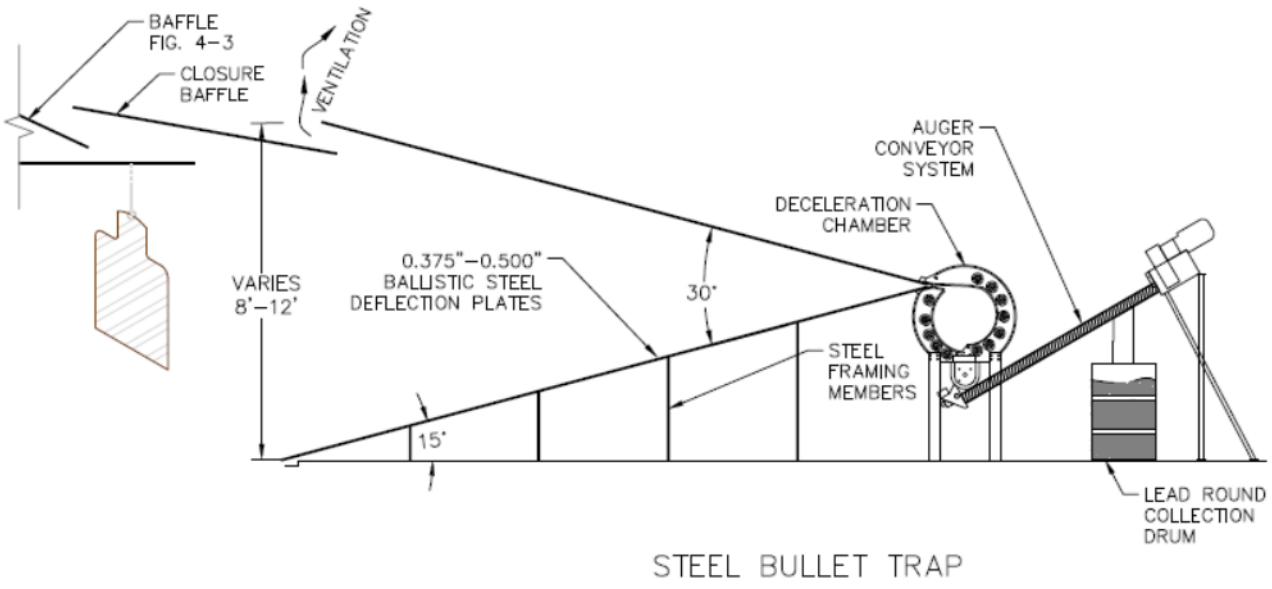
4-17.1 Steel Bullet Trap.

4-17.1.1 Steel Bullet Trap Requirements.

Steel traps must have:

- Minimum 0.375 in. (9.5 mm) thick AR500 ballistic steel plate tested in accordance with ASTM E10-08, meeting MIL-A-46100, and certified as having a minimum Brinell Hardness of 470. Required for all trap components that may be impacted by bullets. A thickness of 0.5 in. (12.7 mm) is recommended to increase the life of the plates.
- Capability to replace individual plates as they become worn or warped. All plates will eventually wear and warp depending on weapons, ammunition, and usage.
- Maximum lower ramp slope of 15 degrees off horizontal.
- Maximum slope of 15 degrees off horizontal for upper ramp plates immediately above the deceleration chamber. The upper ramp is typically hung from the roof.
- Continuous throat across the width of the trap with no vertical connector sections such that a rod placed inside the slot can move unimpeded across the width of the trap.
- Dust collection system to reduce dust at the trap end of the range. Provide forklift access to the dust collection drums.
- Spent round collection system. Provide forklift access to collection drums.

Figure 4-4 Steel Bullet Trap



4-17.1.2 Cantilevered Upper Ramp Support.

On existing ranges where a steel trap is being added, verify the roof can handle the additional load. Where the additional load of the trap cannot be supported, a structural cantilevered arm mounted to the floor behind the trap may be used. The cantilever option reduces roof load but takes up more floor space and increases cost. Account for the extra space required when using a cantilevered arm mount.

4-17.1.3 Dust Collection System.

The trap must include a system to capture and collect airborne contaminants at the deceleration chamber that provides:

- Noise levels below 80 dB when measured 10 ft. (1.2 m) from the system.
- Fans and filters located outside on back or side wall of range.
- Monitoring from within range control booth with indicators that show when system is running, filter status, and when dust collection drums are full.
- The ability to turn system on and off from within range control booth.
- A minimum volumetric flow of 500 cfm (14 m3/min) for every 10 ft. (3 m) of trap.
- Sealed ductwork that prevents the escape of dust.
- HEPA filters on the exhaust.

4-17.1.4 Spent Round Collection System.

Choose either a simple bucket system or mechanical system:

4-17.1.4.1 Bucket System.

Bullets fall from the deceleration chamber into buckets underneath. System must be sealed to contain lead dust and allow for easy removal and replacement with no special tools.

4-17.1.4.2 Mechanical System.

These increase complexity and cost over the bucket system but reduce the labor involved in collecting projectiles. These can be either:

- Auger Bullet Collection Unit: Spent rounds fall from the deceleration chamber into a sealed trough below. An auger pushes the bullets and fragments to one side of the room where another perpendicular inclined auger raises and drops them into a collection drum below.
- Drag Conveyor: Same as auger system except a conveyor belt is used to move spend rounds and fragments to the collection drum.

Include capability to monitor status of mechanical system and to turn system on and off from within the range control booth.

4-17.2 Granular Rubber Bullet Trap.

Do not reduce the range length when a rubber trap is chosen since it will eliminate the option of replacing the rubber trap with a steel trap in the future. Coordinate baffle and trap layout so that any round fired from any firing position will contact either 4 ft. (1.2 m) of rubber or an overhead steel baffle. As with a steel trap the overhead baffles must extend all the way into the trap to prevent any high angle ricochet from bypassing the overhead baffles of the trap backing. Design the trap frame to hold the weight of the trap, rubber, and 120,000 7.62 mm projectiles for every 4 ft. (1.2 m) of trap across the width of the range.

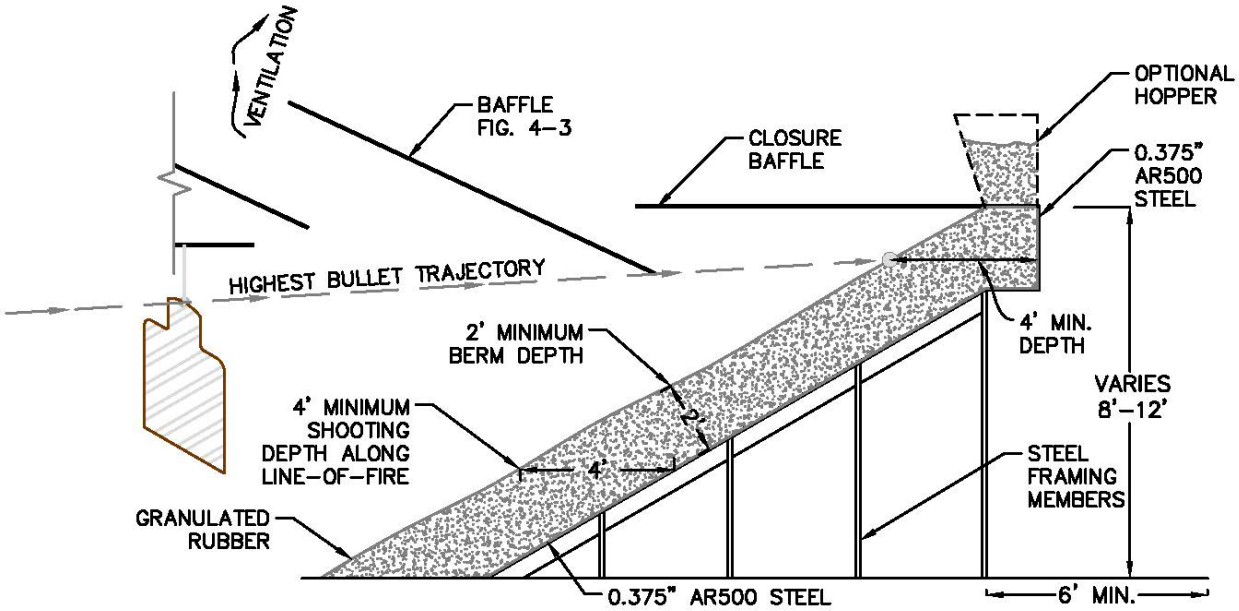
4-17.2.1 Design.

Design the trap to reduce the amount of rubber that spills onto the floor and include:

- Shredded rubber material with average diameter of 0.375 in. (9.6 mm) to 0.875 in. (22 mm).
- Clean chopped rubber that is 99.9 percent free of loose wire or exposed steel, by weight.
- Fire retardant and adhesion promotion treatment.

- Minimum 2 ft. (0.60 m) of rubber as measured perpendicular to the sloping face and a minimum of 4 ft. (1.20 m) of rubber measured horizontally, whichever is greatest.
- Trap base plate must be a minimum or .375 in (9.6 mm) AR500 steel plate.
- Plenum and roof vents above the trap area to collect and release dust, smoke, ammunition residue, and other contaminants.
- Coordinate with the local fire authority for design requirements that help contain smoke in the event of a fire including
- Vertical smoke barrier above the ceiling baffles across the width of the range towards the trap end to limit the movement of smoke up range.
- Fire protection plan showing recommended access to trap in the event of a fire.

Figure 4-5 Granular Rubber Bullet Trap



GRANULAR RUBBER BULLET TRAP

/1/

4-18 COMMUNICATIONS.

Include a loud speaker system between range control booth and range with volume control and capable of producing 110 dBA at the firing line. Locate as to not interfere with supply air flow. Include wall mounted handheld microphones for communication back to the range control booth, with one on each side wall and one on back wall below the range control booth window.

4-19 LIGHTING.

Design lighting system to reduce glare and provide independent lighting zones in accordance with Table 4-2 and:

- Locate downrange lights out of the line of fire. This can be accomplished by placing them behind the vertical section of the overhead baffles.
- Size and locate light and fixtures behind the firing line so they do not interfere with the supply airflow.
- Provide fully dimmable areas with flicker free lighting from 0 to 100 percent intensity levels.
- Locate lighting controls in the range control booth to allow adjustments with clear view of training area. Label controls to allow intuitive operation so that an operator unfamiliar with the system will be able to select and manipulate the controls accurately without any instructions.
- On ranges where training will occur using Night Observation Devices (NODs), all lighting, including emergency lighting, must be able to be turned completely off. Red lighting may be added downrange to assist visibility during low light training.

Table 4-2 Lighting Requirements

LOCATION	**FT CANDLES	TYPE
Range Control Booth.	60	Fully dimmable + dimmable red light.
Vestibules.	40	On/Off with switches in vestibule + range control booth.
Get Ready Area and Uprange Firing Line.	60	Fully dimmable + dimmable red light.
Target Area.	80	Fully dimmable.
Last Target Line.	100	Fully dimmable.
Area Behind Trap.	40	On/off.

** Measured at 4 ft. (1.2 m) above the floor.

4-19.1 Range In Use Lights.

Include a red Range In Use light above and outside vestibule entrances that indicate when range is in use. Light is on when range is operational. Locate switch in range control booth.

4-19.2 Security Training Lights.

Optional flashing lights may be required behind or above the firing line to simulate the flashing lights from security vehicles. Choose location to provide desired effect downrange while minimizing impact on ventilation air movement. Check with local security force for proper color and flashing effects.

4-19.3 Emergency Lighting.

For exit lighting, provide low profile lights oriented with smallest profile pointing downrange to minimize interruption of supply airflow.

4-20 NOISE.

Design range to meet:

- The maximum ambient and live fire noise levels in Table 4-3.
- Reverberation Time 60dB (RT60) less than 1.3 seconds as described in the sound decay rate testing paragraph below.

4-20.1 Noise to Adjacent Land.

Consider all notable sources of noise associated with the training facility when determining its layout. Noise transmitted outside of indoor ranges can be significant and depends on several factors including weapons and ammunition, thickness and material of walls and roof, roof to wall connections, and direction of fire. Air handling and dust collection systems can also produce significant noise. Noise transmitted outside of indoor ranges can be reduced through a combination of strategic layout, acoustic dampening characteristics of construction materials, and construction methods. The location of the range and the adjoining land use will determine the acceptable level of noise transmitted outside of the range.

4-20.2 Noise Inside the Training Area.

The training area design must incorporate acoustic control elements to reduce internal ambient noise levels and reverberation time. To meet these levels, the acoustic design should incorporate strategic layout, construction materials with acoustic dampening characteristics, and intentional construction method types. The seals on doors and windows should be tight to minimize the direct transmission of noise out of the firing range and into other interior rooms or occupied spaces of the facility. Absorptive acoustical surfacing will reduce the noise level in the range. Ambient noise does not

include the impulse noise generated by gunfire but does include other noise sources such as air handling and dust collection systems. Ambient noise levels are generally controlled by preventing the noise from reaching the occupied spaces. Some noise sources can be isolated from the occupied spaces. Walls with designated Sound Transmission Class (STC) ratings can also be used to separate noise generating equipment from occupied spaces. Extending partitions to the ceiling or roof level and sealing air gaps will reduce noise transmission.

Short duration impulse noise peaks created by gunfire will exceed the 85 dBA level and could exceed 160 dBA. Reflective surfaces in a range will reverberate noise during firing, extending the decay time of the noise.

4-20.3 Acoustical Treatment Locations.

Acoustic absorbing materials may be used behind the firing line and on the wall, ceiling, and ceiling baffle surfaces extending down range. Treat the ceiling baffle nearest to the firing line with acoustic absorbing materials as it is the most important ceiling baffle regarding noise levels behind the firing line. Floor areas of the range must remain bare concrete or steel. The floor behind the firing line may be covered with rubber or other acoustic mitigating materials so long as the materials are suitable for floor application and do not impede the removal of ammunition residue. Include the acoustic design calculations in the design analysis.

4-20.4 Acoustic Panels.

Acoustic panels may be installed on walls, ceilings, and baffles. Blown-on acoustic material and carpeting are not permitted due to the difficulty of cleaning accumulated ammunition residue. Acoustic materials must be nonflammable and not impede the vacuum removal of ammunition residue. Do not paint acoustic tiles or surfaces as paint significantly degrades the sound absorbing qualities of the acoustic surfaces. Acoustic panels often serve dual purpose to mitigate sound and provide bullet splatter protection.

4-20.5 Acceptance Testing.

For all new, addition, and modification projects that include modifications to the sound-absorbing materials within the range, acceptance testing must be performed by an independent acoustic specialist whose firm is a member of the National Council of Acoustic Consultants.

4-20.5.1 Sound Decay Rate Testing.

The acoustic design must include mitigation methods and construction materials to reduce the measured Reverberation Time 60dB (RT60) to less than 1.3 seconds in the 250 Hz, 500 Hz, 1 kHz, 2 kHz, and 4 kHz octave bands in accordance with ASTM E2235. Testing must be performed in accordance with ASTM E2235 with noise generating devices placed at the firing line. Aim device parallel with the line of fire when not using omni-directional devices. The contractor must provide certified test results showing that the reverberation time requirements are met.

4-20.5.2 Ambient and Live Fire Noise Level Testing.

The contractor must provide certified test results showing that the ambient and live fire noise levels within the range do not exceed levels shown in Table 4-3.

- All Ambient and peak noise level measurements must be taken with all range equipment on, including the air handling and dust collection systems, and no gun fire.
- All live fire noise levels must be taken with all range equipment on and with continuous gunfire from four Government provided shooters firing the maximum caliber design weapon, at full automatic if applicable, and using ball ammunition. Firing must be from the most uprange firing line without using suppressors.

Table 4-3 Maximum Noise Levels

	Maximum Ambient Noise Levels (dBA)	Maximum Live Fire Noise Levels (dBA)
Inside the Firing Range	75	Sound Decay Rate Test
Inside the Range Control Booth	60	85
Offices	45	55
Classrooms	45	55

4-21 RANGE VENTILATION.

In order to provide safe training and working environment, the ventilation system must limit exposure to airborne lead, copper, and other contaminants generated during small arms training. To achieve good air flow across the entire firing line, compliance with the following paragraphs is required. A recommended contracting strategy to help achieve these stringent requirements is provided in Appendix B.

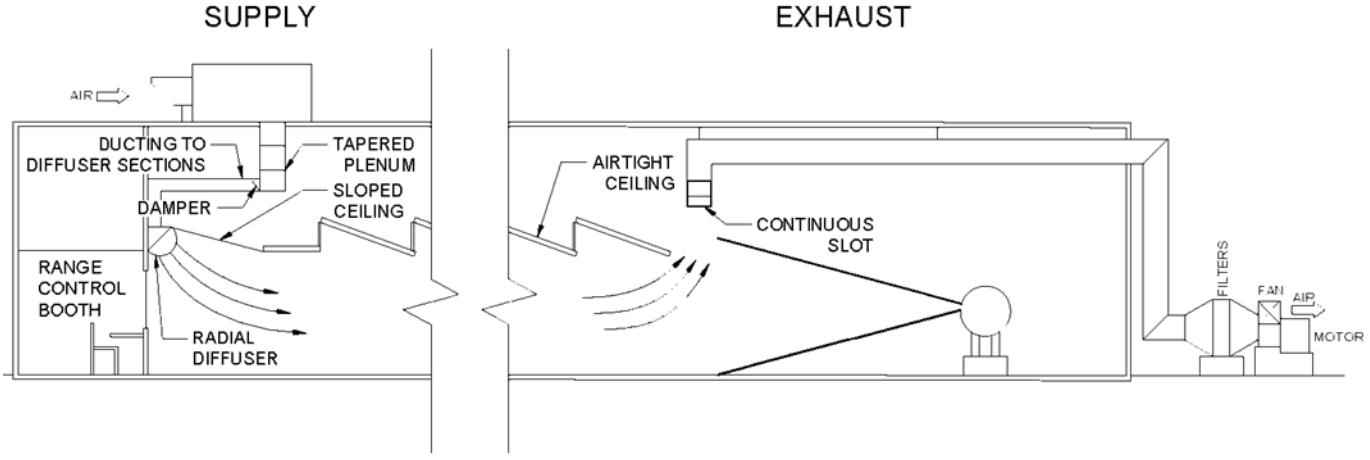
4-21.1 General Ventilation Requirements.

All ventilation system controls must meet the cyber-security requirements found in UFC 4-010-06. The training area ventilation system must be separate and independent from the support and administrative area ventilation system. Design the training-area ventilation system to meet the following:

- An air flow of 75 fpm (23 m/min.) at the firing lines meeting the acceptance standards included later in this section.

- 100 percent outside air with no recirculation.
- A negative pressure inside the range of -0.05 +/- .02 in (1.3 mm +/- 0.5 mm) of water column relative to the non-training areas in the range.
- Paired supply and exhaust units with each exhaust fan interlocked with one corresponding supply fan.
- The preferred location of the supply Air Handling Units (AHUs) is on the roof to reduce the amount of turbulence in the air before it reaches the supply plenums.
- The preferred location of the exhaust AHUs is on the ground to simplify filter changes.
- AHU motors limited to 75 horsepower or less.
- Variable Frequency Drives (VFDs) on all supply and exhaust AHU motors.
- Supply intake vents separated from exhaust outlets by a minimum 30 ft. (9 m).
- Location of exhaust ductwork coordinated with baffle and trap design to protect against direct hit and ricochets.
- Independent local control. Base-wide control systems may connect to the system for monitoring purposes but must not control or alter the system settings.
- Ductwork protection for all ranges within approximately one mile (1.6 km) of salt water bodies. Include a sprayed-on weather and corrosion resistant coating, such as the polyurea coating used to line truck beds, for all ventilation ductwork exposed to the environment. Consider for all other locations where corrosion is a problem. Choose material and thickness based on local conditions and ductwork material.
- See Figure 4-6 for a schematic range ventilation system.

Figure 4-6 Range Ventilation Schematic



4-21.2 Climate Control.

4-21.2.1 Heating.

Provide heat **\1** only in locations where the official DoD engineering weather data (UFC 3-400-02) 99% wet bulb temperature is below **/1/** 50 degrees F (10 degrees C). Specify design heating temperature and heating type. Chose a dry bulb discharge temperature between 65 and 70 degrees F (18 and 21 degrees C) that minimizes temperature differentials between winter and summer temperatures inside the range. Air-to-air heat exchangers may be included in cold climates when cost savings are supported by life cycle analysis.

4-21.2.2 Cooling.

Provide cooling only **\1** in locations where the official DoD engineering weather data (UFC 3-400-02) 1% wet bulb temperature is over 100 degrees F (37.8 degrees C). **/1/** Evaporative cooling may be considered if reduced temperatures do not drive humidity over 65 percent.

\1 When internal range temperatures exceed 86 F (30 C) implement occupational safety procedure identified within the heat injury prevention plan. These measures may include drink water supply, increased break time, cooling/rest area, and heat stress monitoring. See your Service's occupational safety office for detailed guidance and monitor your local Heat Stress Flag Status.

Note: 86F (30 C) threshold is taken from NIOSH Figure 8-2 and falls within the Lower risk level (Table C-1) within NIOSH Occupational Exposure to Heat and Hot Environments publication. **/1/**

4-21.3 Supply Distribution System.

Design system to provide:

- Supply air from the air handling unit through a continuous graduated plenum that is gradually tapered to produce an even pressure along the length of the plenum.
- A single or double duct with an adjustable damper leading from the tapered plenum to each diffuser section.
- Interconnected double wall radial diffuser sections at the top of the back wall above the viewing window, with each section a maximum 5 ft. (1.5 m) long. Design and size diffuser sections to provide enough surface and free area to smoothly transition air as it moves to the firing line. Radial diffusers may be half or quarter round.
- Noise from supply system limited to 70 dBA or less when measured at the most uprange firing line, with no whistling noise coming from the diffusers.

- Single stage Minimum Efficiency Reporting Value (MERV) 8 supply filters as a minimum.
- A supply filter system that prevents filters from being pulled into fan.
- Align dampers within the diffuser sections with lane dividers in order to facilitate testing and balancing.

For high debris areas, provide double stage supply filters consisting of a minimum MERV 8 filter followed by a MERV 13 filter. Take the direction of the prevailing local winds into consideration when selecting location and direction of supply intakes.

4-21.4 Exhaust System.

Design exhaust system to provide:

- An air volume of minimum 110 percent of the rated supply volume of air.
- An exhaust plenum located above and downrange of the trap entrance, with a semi-continuous slot at the intake spanning the entire width of the shooting lanes.
- Minimum exhaust duct velocities of 2000 ft./min (57 m/min).
- Air velocities of 350 to 450 fpm (10 to 13 m/min) across the filter media.
- A two-stage filtration system with a MERV 15 Bag filter no less than 26 in. long (66 cm) followed by a HEPA filter with a 99.95 percent efficiency rating.
- Three-stage HEPA rated racks, leaving one stage empty for future flexibility.
- AHUs sized to provide minimum 5 in. (127 mm) of external static pressure for filter loading over clean required static pressure.
- Factory HEPA rated filter housing for the HEPA filter.
- AHUs and filter housing with a minimum 4 ft. (1.2 m) clearance from all adjacent features.
- Filters capable of being removed and replaced by hand without any special tools or equipment.

4-21.5 Controls.

Incorporate a Direct Digital Control (DDC) system to:

- Initiate supply and exhaust fans at low speeds that ramp up to field adjustable levels as necessary to reach desired negative pressure inside the range.

- Provide gradual adjustments to power and prevent noticeable hunting and modulation of the AHUs.

Note: Values for adjustable parameters must be selected during design and adjusted during balancing as necessary to optimize air movement.

Incorporate the following:

- Two clearly labeled emergency red mushroom cutoff switches wired directly to the supply and exhaust VFDs and the heat enable that manually and safely shut off the entire ventilation system. Locate one switch in the training area behind the firing line and the other inside the range control booth.
- **\1\ /1/**
- A ventilation control panel located in the range control booth with diagnostic screen, an on/off switch, and three condition lights on the panels: Safe to Shoot, Warning, and Do Not Shoot. Locate panel such that all condition lights are easily visible from all positions inside the booth.
- Diagnostic screen that scrolls though all conditions, settings, and status.

Require all controls and logic necessary to produce the following light conditions:

(1) Condition-Green Safe to Shoot light:

- All systems are within operating parameters.

(2) Condition-Yellow Warning light:

- Pressure drop across exhaust pre-filter is past adjustable set point.
- Pressure drop across exhaust HEPA filter is past adjustable set point.
- Pressure drop across supply filters is greater than an adjustable set point.
- Range temperature is outside given adjustable set points.

(3) Condition-Red Do Not Shoot light. If any of these conditions occur, controls will sound alarm and shut down range ventilation system:

- Either supply fan or exhaust fan is off.
- Pressure differential for any of the air filters is outside extreme limits.
- Doors leading into the range from the air lock vestibule remain open for more than a given set point, with an adjustable set point initially set to 5 min.
- Door into trap area is opened.

- Any door leading into the range training area from outside is opened.
- Range pressure is outside the upper limit of zero in. of water and the lower adjustable limit for a given time limit initially set to 2 min.
- Supply static pressure is below adjustable limit.

4-21.6 Acceptance Testing.

Test all new ventilation systems and any system where modification or adjustments have been made that would impact airflow.

4-21.6.1 Controls.

Test all controls for proper operation including fan start up and initiation, emergency cut offs, control panel operation, and all light conditions.

4-21.6.2 Air Flow.

Uprange:

Take measurements at the most uprange firing line in the center of each lane at 1 ft. (0.3 m), 3 ft. (0.9 m), and 5 ft. (1.5 m) off the floor. Test with clean filter first, then block off portions of HEPA filters to simulate a yellow warning condition and retest. Acceptable readings for both scenarios are:

- No single reading under 50 fpm (15 m/min) or over 120 fpm (37 m/min).
- Each lane average between 60 fpm (18 m/min) and 90 fpm (27 m/min).
- Range average between 71 fpm (22 m/min) and 79 fpm (24 m/min).

Downrange:

- With clean filters and measurements taken at the most downrange position nearest bullet trap but no closer than 9 ft. (3 m) from trap, take three measurements at each lane at 5 ft. (1.5 m) off floor.
- Average of three lane readings must be between 50 fpm (15 m/min) and 80 fpm (24 m/min).

Retest as necessary until all acceptance standards are met.

Notes:

These acceptance test standards only apply to new ventilation systems and replacement of existing systems. For existing systems use NEHC TM 6290.99.

All meters can be unreliable when measuring non-ducted air flow of 50 fpm (15 m/min) and below. When 90 percent of the measurements along one line are acceptable, smoke tests should be used to verify the unacceptable readings. If the smoke tests

show steady air movement downrange at these locations, they should be considered acceptable.

4-22 RANGE OPTIONS.

4-22.1 Relocatable Ranges.

Relocatable ranges constructed of modular sections are designed to be disassembled and relocated using standard overland transportation to alternate locations as the training requirements change or are relocated. To provide this relocatable capability the relocatable modular range must meet all requirements for indoor ranges above with the following exceptions:

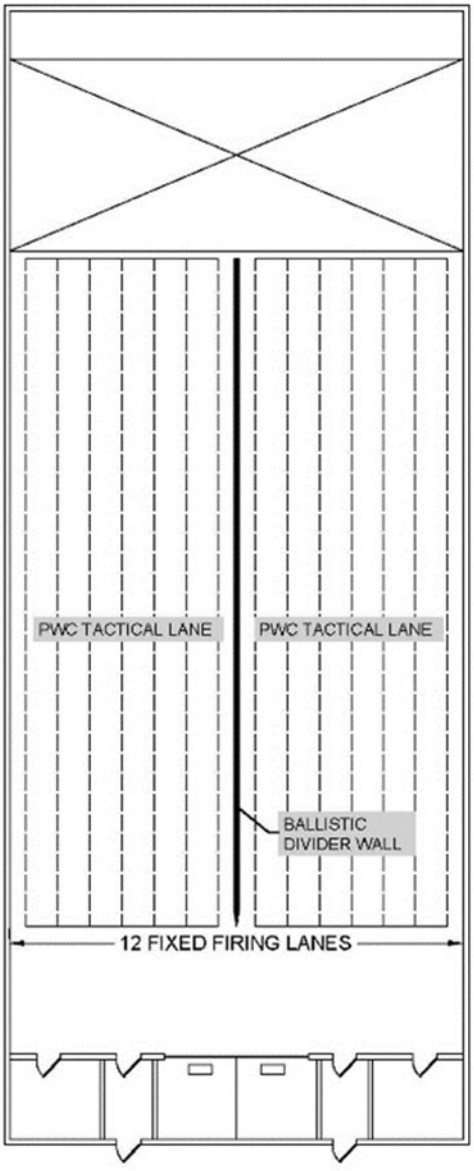
- Indirect Support Areas are not required.
- The range control booth may double as the air lock vestibule on small ranges with three or fewer lanes.
- Buffer between end lanes and side wall is not required and distance from back wall to firing line may be reduced to 12 ft. (3.6 m). These modifications are allowed because relocatable ranges can be sealed better than typical indoor ranges and this improves the airflow control.
- The range control booth back to front distance may be reduced to 8 ft. (2.4 m).
- The floor may be 0.375 in. (9.5 mm) AR500 steel plate with support to prevent sagging. Provide a slip-proof coating. Do not apply any surface on the flooring that prevents the bullets from reaching the bullet trap or that will entrap firing residue and hinder the cleaning of the range floor.
- For ranges with defined lanes where no angled shooting is allowed, a more compact steel trap may be used with 0.5 in. (12.7 mm) AR500 steel plates, a vertical throat with replaceable knife edged sides lined up with lanes and rated for the intended ammunition. The range ventilation exhaust may be routed though the trap to function as the dust collection system.
- **\1** When a granulated rubber trap is used, the additional space for a possible future steel trap is not required. **/1/**
- In lieu of concrete, the downrange wall behind the trap may use **\1** 0.375 in. (9.5 mm) **/1/** AR500 steel plate for ballistic containment.

4-22.2 Combination Fixed and Tactical Range.

A range with a ballistic center wall extending from the firing line to the base of the bullet trap can be used to increase flexibility by ballistically dividing the training past the firing line. An example is shown in Figure 4-7 that allows the range to operate as either:

- One 12 lane range with a fixed firing line to accommodate the Navy's OPNAVY 3591 rifle qualification course.
- Two tactical lanes with moving and shooting downrange at the same time to accommodate the Navy's OPNAV 3591 Practical Weapons Courses (PWC).

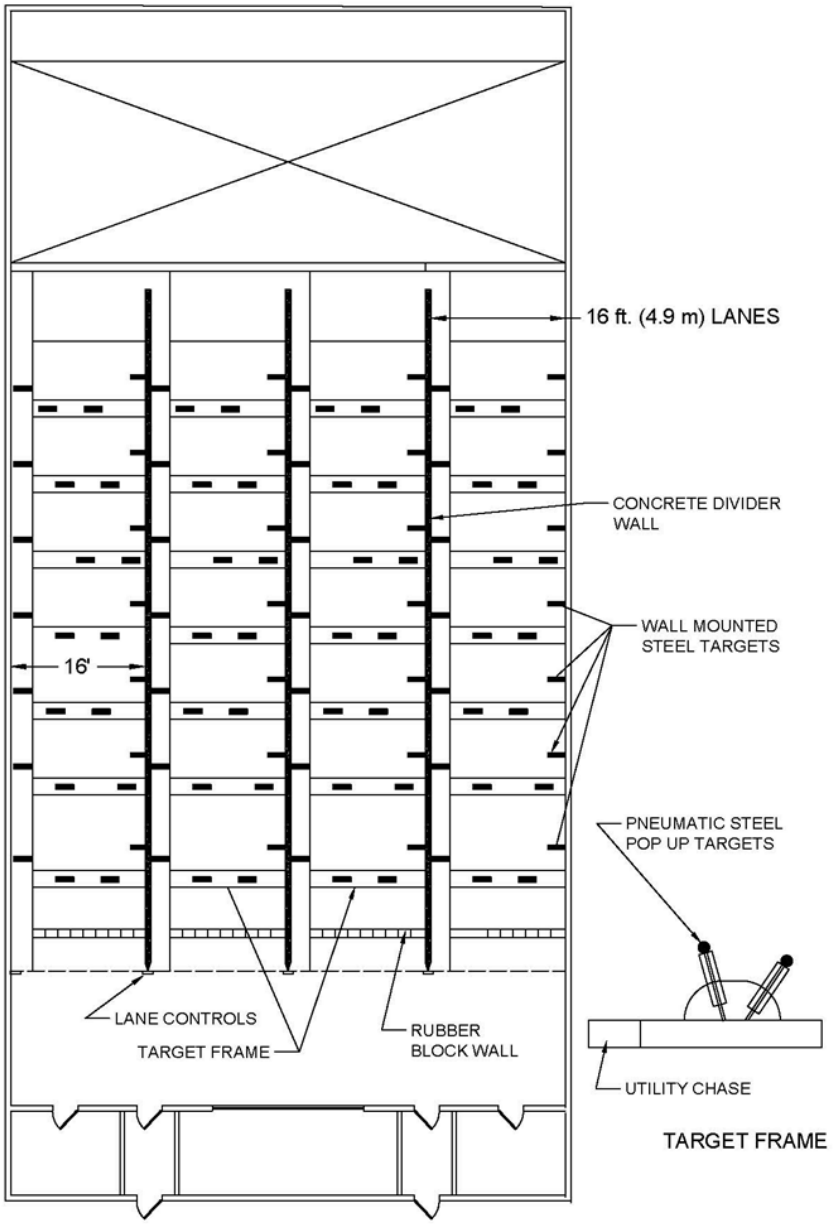
Figure 4-7 Range with Ballistic Divider Walls



4-22.3 Steel Reactive Range.

Advanced training with a knockdown steel target system provides immediate feedback to the shooters. One example is shown in Figure 4-8 but can be varied to meet training and maintenance objectives. This example has 16 ft. (5 m) wide lanes with a series of popup steel head plate targets in each lane. Limit ammunition to frangible rounds or as necessary to prevent rounds and splatter from coming back towards shooter and to minimize damage downrange. Design side walls and lane divider walls for direct hits and splatter where targets are placed near side walls. A control system and hit sensors can be designed to track and score hits. Protect target bases from direct hits.

Figure 4-8 Steel Reactive Range



4-22.4 Wide Angle Shooting.

Ballistic protection can be provided on side walls to allow shooting at angles of 180-degrees (side to side) or more. Downrange protection is provided by a bullet trap. There are several design options for protecting the walls with varying degrees of protection, space, and cost including:

- Placing 0.375 in. (9.5 mm) thick AR500 steel plates with splatter protection to a height of 8 ft. (2.4 m). This is only recommended when all rifle ammunition can be limited to frangible rounds.
- Covering the concrete side walls to a height of 8 ft. (2.4 m) with AR500 steel plate, with another wall in front consisting of a series of angled overlapping AR500 steel similar to a venetian blind trap and covered with splatter protection. The removable plates are sacrificial and should be sized and designed to meet the intended training and allow for easy removal and replacement. This is only recommended when all rifle ammunition can be limited to frangible rounds and rounds that do not have penetrators in the tip.
- Placing an 8 ft. (2.4 m) wall section designed with 0.375 in. (9.5 mm) AR500 steel plate, an approximate 2 ft. (0.6 m) air space, and a 12 in. (300 m) thick ballistic rubber block wall on the exposed shooting side. A wooden support system may be needed to secure the ballistic rubber blocks in place. The space is required to allow inspection of the underlying steel plates.
- Placing bullet traps along the side walls. This provides a high level of protection to the side walls but requires a significant amount of space.

CHAPTER 5 STEEL CLOSE QUARTER FACILITIES

5-1 GENERAL

Close Quarter Combat (CQC) facilities, also known as shoothouses, allow up to 360-degree shooting into ballistic walls. These structures can be built to simulate locations where close quarter combat training may be needed including residential, commercial, industrial, and shipboard environments. CQC facilities may have the following features:

- A full ballistic enclosure that contains all rounds within the facility.
- Ballistic walls with a separate ballistic roof above.
- No ballistic roof. – These are considered outdoor ranges and require a 360-degree SDZ or a waiver.
- Catwalks across the tops of the ballistic panels that allow RSOs to monitor training below.
- Ventilation provided by either a mechanical system, open eaves to encourage natural air movement, ceiling fans, or some combination of these.
- Non-ballistic walls and limited to non-lethal force-force rounds.

5-1.1 Applicability.

This chapter provides criteria for live fire CQC facilities that have steel ballistic walls, a ballistic roof, and limited to:

- Frangible rifle rounds and pistol rounds fired directly into ballistic walls. Note: Frangible rounds produce less airborne contaminants, have reduced ricochet potential, do significantly less damage to steel plates, and greatly reduce the chance of wall failure.
- Ball rounds without tungsten or steel penetrators fired into bullet traps as the primary impact surface, with ballistic walls providing secondary containment.
- Facilities with formal, documented, routine inspections of all ballistic steel plates. All live rounds have the capability to eventually penetrate any ballistic wall and therefore routine inspections are critical.
- Shooting and movement training. These facilities are not intended for multiple shooters firing multiple rounds in one area in a short period of time which can overwhelm the ventilation system.

For Army shoothouses, refer to the information contained in DA Pam 385-63, TC 25-8 and the RDG for training intent, standard shoothouse layouts, design information, instrumentation, support facilities, etc. In the event of conflicting information, these documents take precedence over this UFC for Army shoothouses.

5-1.2 Items Not Addressed.

This Chapter does not apply to CQC facilities and shoothouses where:

- Rounds with tungsten or steel penetrators, such as M855 5.56 mm and M855A1 5.56 mm, are allowed.
- Explosives are used. Explosives requirements are outside the scope of this criteria.
- Shock Absorbing Concrete (SACON) is used for the ballistic walls.

For these facilities follow service provided guidance.

5-1.3 Design.

The design must address:

- Ballistic containment.
- Targetry.
- Fire protection and alarms.
- Lighting.
- Laser use.
- Ventilation to provide a safe training and working environment.
- Maintenance and Storage.
- Noise reduction to the extent possible.

5-2 RANGE AREAS.

A CQC facility can be divided into two different areas:

(1) Live fire area where training occurs.

(2) Support area.

5-2.1 Live Fire Area.

Size area and design ballistic panel layout to support intended training. Careful coordination with trainers is critical to provide a combination of hallways, doors, room sizes, and other training features that maximize training value. Recommend panel layout be approved early in the design phase. Strategically placed movable or swap-out panels may be used to allow significant floor plan changes with minimal effort and panel adjustments. Options include:

- Ballistic panels hung on rollers that slide on a track system above.

- Pivoting panels. As an example, a selected panel that creates a dead end on a hallway in one scenario may be designed to pivot 180 degrees opening that hallway but creating a dead end on an adjacent hallway.
- Swap-out panels designed to allow simple switching between wall and door sections.

When incorporated, design movable and swap-out panels to:

- Maintain ballistic protection between panel, floor, and adjacent panels.
- Allow changes that can be made by two people within a reasonable time with simple hand operated equipment is recommended.

When movable or swap out panels are used, consider requiring mock up panel sections for approval before full scale installation by contractor.

5-2.2 Direct Support Areas.

Design must account for the following:

- Storage for targets, range equipment, and expendables such as splatter protection and spacers.
- Maintenance area for range equipment, targets, and expendables.
- Mechanical and electrical rooms.
- Control space for lights, monitoring, and recording systems.

Restrooms, lockers, and showers may also be provided to support personnel inside the CQC facility.

5-3 EQUIPMENT AND SPECIAL EFFECTS.

Equipment and special effects to enhance training may be incorporated into the design, including:

- Camera systems and two-way Public Address (PA) system throughout.
- Equipment to produce special effects including smoke, lighting, sound, and smells.
- Digital Video Recorder (DVR) systems for recording training and providing after-action review.
- Simulator equipment to project moving targets onto ballistic panels with cameras that can sense and record hit and misses.

5-4 TARGET SYSTEMS.

Target systems may include any of the following:

- Paper targets.
- Overhead rail targets.
- Popup targets.
- Three-dimension (3-D) Targets that are visible when using NODs.

5-5 ALARMS.

Provide audio and visual alarms activated by mushroom switches at key locations on walls and catwalk. Design system to provide the following results when activated:

- Lights and alarms turn on.
- Ventilation system shuts down.
- Special effects, when provided, turn off.
- Magnetic doors, when provided, unlock.

5-6 FIRE PROTECTION.

Each CQC facility is unique and fire protection requirements such as life safety and means of egress, sprinkler systems, fire alarms, and other passive and active systems will vary based on the mission and features of the individual CQC. Therefore, coordinate with the DFPE early in the planning and design process for fire protection requirements.

5-7 LIGHTING AND ILLUMINATION.

Select lighting and illumination based on training goals, requirements, and:

- Include dimmable lighting throughout.
- Locate all lighting above ballistic panels. One option is a grid tracked system just above the panels.
- Include illuminators at key locations on catwalks, exits, and in training area that will not interfere with the light spectrum of Night Vision Devices.

5-8 NOISE.

Design to reduce ambient noise and noise from gunfire to the extent possible. The requirements in Chapter 4 are not feasible and do not apply to the training area. For classrooms and administrative rooms, meet the noise requirements in chapter 4 for these rooms.

5-9 LASERS.

Design for laser use by eliminating all reflective surfaces inside the range. Provide a nonreflecting coating on all surfaces visible from the live fire area including:

- Walls and ceilings.
- Joists and beams.
- Ductwork.
- Door and other hardware.
- Housings for cameras and special effects equipment.
- Exposed piping and utility features.

Exceptions: Any part of any feature where a coating would interfere with its operation including sprinkler heads, lights bulbs, lens, and emergency switches.

5-10 BALLISTIC PROTECTION.

5-10.1 Ballistic Walls.

All wall surfaces subject to live fire must have ballistic panels composed of a minimum 8 ft. (2.4 m) tall and 0.5 in. (13 mm) thick AR525 steel plate with splatter protection covering all surfaces exposed to live fire. Minimize the need for welding and only allow techniques that do not reduce ballistic properties.

5-10.1.1 End Closure.

Design panels with ballistic steel end closures so that there are no panels with open sides or tops for ricochets to escape. This includes all panel tops, doors, and ends of termination panels. Closure must be minimum 0.375 in. (9 mm) AR525 steel plate.

5-10.1.2 Joints.

Provide complete ballistic protection across joints. Where ballistic steel panels cover concrete walls, plates may be bolted to the concrete using concrete anchor fasteners with a flat AR525 steel plate of same thickness as panel covering the joint.

5-10.2 Ballistic Roofs and Decking.

Design the roof to provide weather protection and ballistic containment consisting of either:

- Minimum 3 in. (76 mm) thick concrete.
- 0.375 in. (9.5 mm) thick AR500 Steel Plate.
- Bullet resistant fiberglass panels UL 752 protection level 8.

For multi-story CQC facilities, design deck between floors subject to direct fire on either side with a minimum 4 in. (150 mm) thick concrete, 0.375 in. (9.5 mm) AR500 steel, or ballistic equivalent.

5-10.3 Exterior Openings.

Design exterior openings subject to live fire to prevent rounds from escaping through a combination of:

- Controls and limitations.
- Lockable Level 7 UL 752 ballistic doors.
- Offset ballistic exterior walls covering exits.

5-10.4 Army Shoothouses

- Army shoothouses not designed to support EPR rounds require an exception to standard in accordance with AR 350-19.
- Army shoothouses do not require a ballistic roof; an SDZ deviation may be required.
- The ballistic walls are intended for secondary containment only, bullet traps or hot walls are required behind targets to capture the majority of rounds.
- Bullet traps must be designed for the specific rounds that will be fired in the facility.
- Moveable/sliding covers are an option for covering exterior openings.
- Other materials, as shown in DA Pam 385-63, are allowable for the shoothouse walls.

5-11 CATWALKS.

Catwalks may be included in the design when required to support the training or to provide the range safety officer with visibility and control. Design layout such that all rooms below are observable from positions on the catwalk. Provide stairs to the catwalk outside the ballistic panel enclosure. Where roof overhangs perimeter panels, consider locating the stairs outside the panels but inside the roof line. Retractable vertical ladders may be provided to allow floor access from catwalks above. Ladder should be in the raised position until needed. Catwalks can be supported from above to allow reconfiguration of the panels below in the future.

5-12 VENTILATION.

Consider maintenance and noise to adjacent areas when selecting location of ventilation equipment. Ventilation requirements in Chapter 4 do not apply. Design a mechanical ventilation system to:

- Create air movement within all rooms that clears smoke between training runs.
- Provide each fan with VFD and DDC controls tied to the control room to allow gradual start up and adjustment for obtaining optimal air movement.
- Limit all motors to 75 horsepower or less.
- Minimize noise and vibrations. Provide fans with vibration spring isolation that meet seismic requirements.
- Provide a Noise Criterion (NC) rating of less than 50 on exhaust grills during normal facility operations.
- Roof access to mechanical equipment that meets safety and force protection requirements.

Army ventilation requirements are contained in DA Pam 385-63.

5-12.1 Air Flow Requirements.

Design system to move air and clear smoke from all live fire rooms that meets the following:

- Top to Bottom Systems: A minimum cfm (m/min) to provide a vertical air velocity of 25 fpm (7.2 m/min) in all live fire areas.
- Over the Top and Open Eave Systems: Design system to clear smoke from all rooms within three minutes and all hallways within six minutes. To achieve this, the designer must specify a minimum cfm (m/min) based on the design and account for short circuiting, but as a minimum use 40 air changes per hour (ACH).

Note: A cfm selected based on 20 ACH will theoretically clear smoke within 3 minutes. Smoke will usually take much longer to clear due to short circuiting and inefficiencies.

5-12.2 Design Documents.

Design documents must include:

- Location and cfm for all AHUs.
- VFDs on all supply and exhaust motors.
- Roof penetrations and curb detail for all roof mounted equipment.

- Location and sizing of ductwork. Coordinate with catwalk and structural features.
- Location and sizing of supply and exhaust diffusers and registers.
- Filters location and requirements.
- Acceptance test requirements.

5-12.3 HEPA Filters.

The requirement for HEPA filters on the exhaust will be made on a case-case basis as determined by the responsible local environmental office. When HEPA filters are required, design as follows:

- Locate all exhaust AHUs on the ground.
- Provide two stage filtrations using a MERV 15 Bag filter no less than 26 in. (66 m) long followed by a 99.97 percent HEPA filter.
- Provide 3 stage HEPA rated racks, leaving one stage empty for future flexibility.
- Include 4 in. (100 mm) of external static pressure for filter loading in addition to that required for operating with clean filters.

5-12.4 Contractor Experience.

It is highly recommended that a range ventilation contractor, experienced in providing systems with similar requirements, is made responsible for the final design and construction of the ventilation system including controls and balancing. An approach similar to that recommended in Appendix B for indoor ranges can be used.

5-12.5 Acceptance Tests.

Acceptance tests must include the following:

- Air flows at supply and exhaust: Test and balance each supply diffuser and exhaust register against the design air flow. Provide acceptable readings based on system provided.
- Smoke Tests: With the system set in training mode with doors shut and the ventilation system turned on, release smoke into each room using smoke machines capable of filling rooms with smoke. Smoke in all rooms must show movement and signs of clearing and be completely clear within the time specified. Any rooms where smoke is stagnant or fails to clear room completely within time specified constitutes failure requiring the contractor to readjust and modify system until all rooms pass test.

5-13 ENCLOSED CQC FACILITIES.

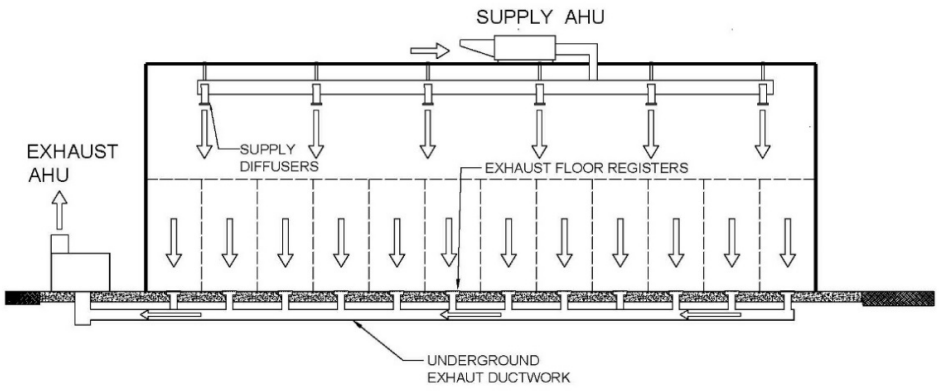
A concrete structure with a ballistic roof to prevent any round from leaving the facility. Ballistic steel panels with splatter protection must cover all surfaces subject to live fire. Multiple levels may be provided.

5-13.1 Top to Bottom Ventilation System.

Design a mechanical ventilation system that supplies air from the top and exhaust air through floor registers spaced a maximum of 10 ft. (3.0 m) on center. Floor registers must be flush with floor and a maximum of 0.25 in. (6 mm) openings to prevent brass from entering pit. Coordinate floor register layout with panel layout to minimize the number of walls on top of floor registers. See Figure 5-1.

Army ventilation requirements are contained in DA Pam 385-63.

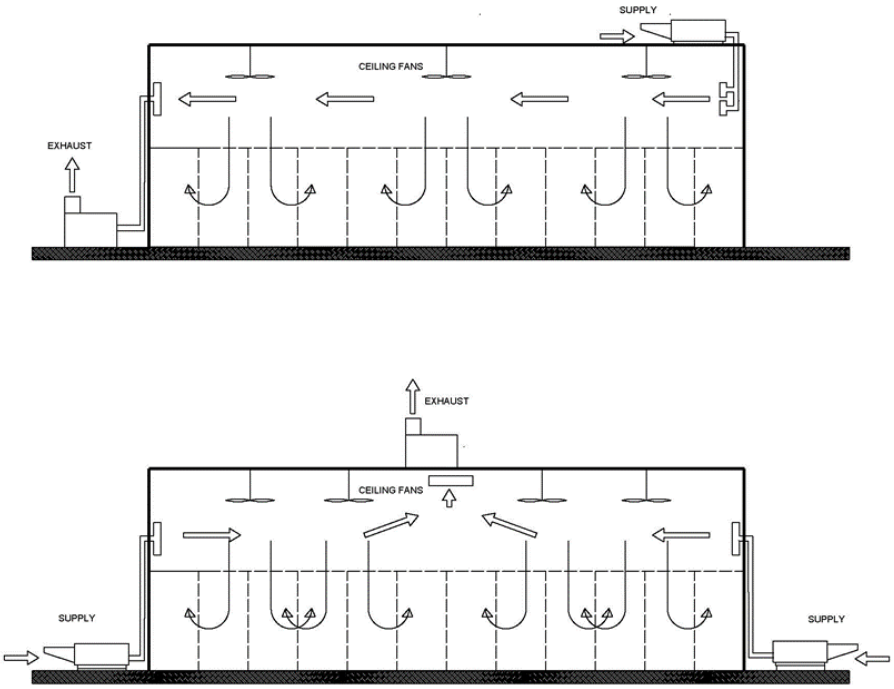
Figure 5-1 Top to Bottom Ventilation System Schematic.



5-13.2 Across-the-Top Ventilation System.

Design a mechanical system that moves air across the top of the panels with supplemental blowers or ceiling fans to push air down into the rooms below. AHUs can be roof or ground mounted. The schematics in Figure 5-2 show options for roof and ground mounted AHUs.

Figure 5-2 Across-The-Top Ventilation System Schematics.



5-14 CQC FACILITIES WITH OPEN EAVES.

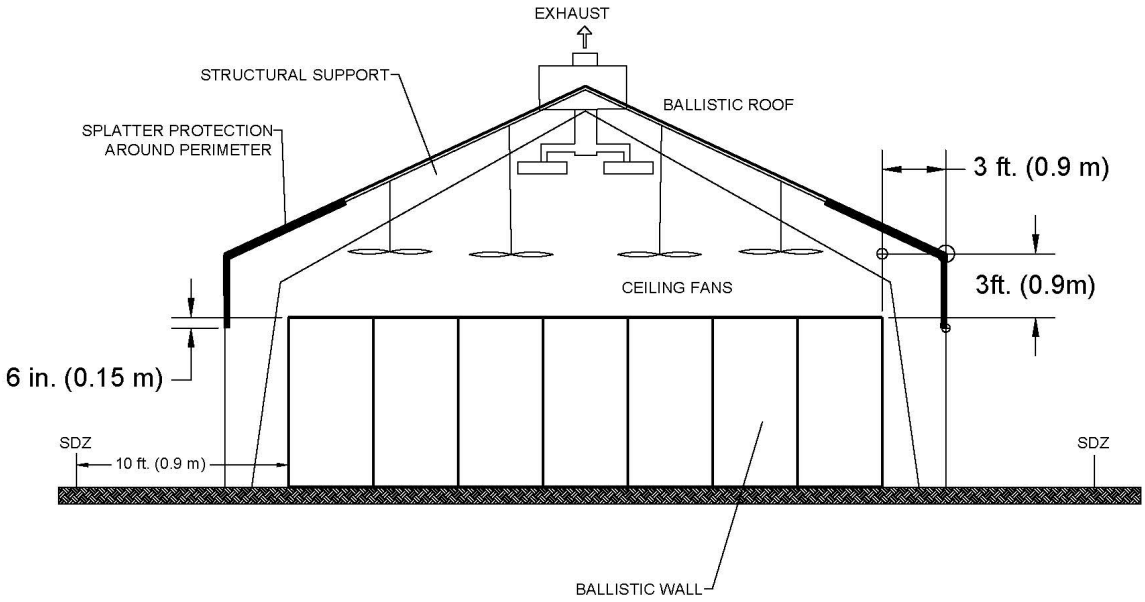
This facility has ballistic steel plates connected to a concrete floor, with splatter protection on all shooting sides. A separate roof structure is built over the ballistic walls with structural columns connected to the concrete outside the ballistic walls creating an open eave in between.

5-14.1 Minimum Distances.

As a minimum, provide the following clearances between ballistic roof and walls:

- Minimum 3 ft. (0.9 m) above ballistic walls.
- Minimum 3 ft. (0.9 m) away from ballistic walls.
- Roof sides extend a minimum 0.5 ft. (0.15 m) below height of ballistic walls.
- See Figure 5-3.

Figure 5-3 Ventilation System Supplemented with Natural Airflow



5-14.2 Ventilation.

Design system with open eaves to promote natural air movement supplemented with ceiling fans or blowers and exhaust fans pulling air from above.

Army ventilation requirements are contained in DA Pam 385-63.

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APPENDIX A BEST PRACTICES

This information is guidance and not requirements. The main purpose is to communicate proven system/facility solutions and lessons learned and may not be the only solution to meet UFC requirements.

A-1 INDOOR RANGE VENTILATION CONTRACTING STRATEGY.

Providing a ventilation system that limits exposure to airborne contaminants is challenging because:

- Range ventilation is a significant portion of the construction cost.
- Performance testing includes measuring airflow velocities at each lane and firing position and comparing them to strict acceptance standards, and this typically comes near the end of the project.
- Meeting the required average airflow velocity across the width of the range is relatively easy, but meeting airflow requirements at each lane and firing position can be very difficult.
- Numerous failures have occurred when inexperienced range ventilation contractors were used.
- When failures occur, it can be difficult to determine whether the problems are related to the design, construction, controls, balancing, or testing. It can be especially difficult when these responsibilities are split between several sub-contractors, which is typically the case.
- The problem persists with both full design and design-build projects.
- Should the system fail to meet the acceptance standards, it may be difficult and time consuming to resolve problems. Significant rework may be required.

Therefore, it is highly recommended that the contract documents only allow range ventilation contractors with proven experience meeting these or similar performance standards and require that this contractor be responsible for the final design, construction, controls, testing, and balancing of the system. In addition:

- Range experience alone should not be considered, it must be experience meeting similar performance requirements since the majority of non-DoD indoor ranges do not use these stringent standards.
- The acceptance testing should be witnessed by experienced government personnel or third parties to verify all tests are performed properly.

A recommended contracting strategy is provided below.

A-1.1 Phase 1 – Requirement Development.

For Design-Build (DB) projects, this is the Request for Proposals (RFP). For Design-Bid-Build (DBB) projects, this is the project design phase.

For DBB and DB projects, include the following in the contract documents:

- Power supply location, and verification that power is sufficient.
- Minimum air flow in cubic feet per minute (cfm) and cubic meters per minute (m3/min.) required for both supply and exhaust systems.
- General location of Air Handling Units (AHU), including whether they are roof or ground mounted. Require stair access to roof when AHUs are located on roof.
- General location of dust collection and spent round collection systems.
- General location of ductwork and diffusers.
- Filter and filter rack requirements.
- Heating requirements.
- Cooling requirements. Cooling is only required in extremely hot climates.
- Ventilation contractor’s experience requirements.
- Design requirements edited for the project, with all options selected or clarified as appropriate.
- Acceptance testing requirements.

For DBB projects, the additional detail below is required to allow coordination with other design disciplines:

- Location of AHUs. Provide estimated weights and electrical loads of all equipment.
- Power connection details.
- Location and general sizing of ductwork, dampers, and radial diffuser in enough detail to allow coordination and avoid conflicts with other design disciplines.
- Exact location of VFDs, control panels, and emergency cutoffs switches.
- Roof penetration and curb details shown for all AHUs and ductwork.
- Section at wall between range control booth and training area showing radial diffuser, ductwork to diffusers, viewing window, suspended ceiling, and structural ceiling.
- Stair access when exhaust AHUs are roof mounted.

Options to be selected and included in the Phase 1 stage:

- Location of supply AHUs: Locate on the roof when possible and centered with symmetrical ductwork leading to the supply diffusers.
- Location of exhaust AHUs: Locate on the ground when possible to allow easy replacement of HEPA filters. When located on the roof, stair access must be provided.

A-1.2 Phase 2 - Ventilation Contractor Requirements.

Make the ventilation contractor responsible for providing the final design, construction, controls, balancing, and final acceptance testing of the range ventilation system. Require that contractor to have completed a minimum of five indoor range ventilation projects with similar design and acceptance testing requirements, including 75 fpm (23 m/min.) air velocity when measured along the entire rear firing line and at least three different heights. During the bidding process the ventilation contractor is encouraged to submit a Request For Information (RFI) if, in their opinion, the Phase 1 design requirements will not result in a system that meets the performance acceptance tests.

Have the ventilation contractor provide:

Prior to starting work:

- Proof of previous experience, including contract documents from each project showing design and acceptance test requirements, along with final acceptance test reports.
- A confirmation that they can provide a system meeting the Phase 1 design and the acceptance testing performance requirements.
- Full design of ventilation system including duct design and supply, exhaust, and filter schedules.

At end of work:

- Prior to acceptance testing, a detailed testing plan for approval with a checklist and step-by-step procedures in a logical sequence.
- Acceptance testing performed in the presence of the Contracting Officer Representative. Provide all materials, equipment, and personnel necessary to perform the tests including smoke generators, air flow meters, communications, plan, and checklist.
- Operations and Maintenance manuals.
- A minimum 8 hours of on-site training covering operations, maintenance, and troubleshooting of the entire range ventilation system.

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APPENDIX B DOD WEAPONS AND AMMUNITION

A wide variety of small arms weapons and ammunition is used throughout DoD. Some common weapons and ammunition categories are listed below. The Army's Hazard Classification of United States Military Explosives and Munitions is a useful guide that provides detailed information on every DoD approved round including a unique identifier known as the Department of Defense Identification Code (DODIC).

B-1 WEAPONS.

- 12-gauge Shotguns.
- Pistols/handguns: 9 mm and .45 cal.
- Rifles : M4/M16 5.56 mm variants, M14 7.62 mm.
- Crew Served Weapons: M249 5.56 mm and M240 7.62.
- M2 .50 cal. Machine gun.

B-2 CATEGORIES OF SMALL ARMS AMMUNITION.

Most weapons can chamber different types of ammunition with different characteristics. Here are some different types of ammunition and typical uses:

- Short Range Training Ammunition (SRTA): These training rounds much shorter maximum distances than standard rounds allowing them to be used in areas where SDZs prohibit standard ammunition. Some SRTA rounds rely on light plastic projectiles to limit distance and others rely on projectile design to intentionally destabilize the flight path. These rounds are typically lethal and should not be confused with non-lethal training rounds.
- Frangible rounds: These training rounds are designed to disintegrate into tiny particles after impacting steel for minimizing penetration, reducing back splatter, and reducing damage to range components on indoor ranges and Shoothouses. They create more fragment and dust which may increase filter loading. These rounds are lethal and should not be confused with non-lethal training rounds.
- Reduced and zero lead content rounds: Some rounds are completely lead free. Other have small amounts of lead in the primer to prolong shelf life. These rounds can reduce or eliminate the chance of lead exposures and may reduce the costs of disposal of range filters and clean up debris. However, they may contain other potentially harmful compounds and therefore do not lessen range ventilation requirements.
- Non-lethal ammunition: These rounds allow force on force training (participants shoot at each other). They do not imply zero risk and serious injury can occur if not used properly. The DoD versions typically have small amounts of lead in the primer to increase shelf life.

- Rounds with steel penetrators: These rounds have steel penetrators to increase penetration through steel, but generally not to the extent of AP rounds.
- Armor Piercing (AP): These rounds have tungsten tips (or penetrators) to increase penetration through steel. These should not be allowed on indoor ranges, or on outdoor ranges with steel bullet traps or steel targets.
- Tracer rounds: Typically used in belt fed weapons loaded with standard rounds plus a tracer round every fourth or fifth link. Tracer projectiles contain a pyrotechnic making the trajectory visible and enabling the shooter to make aiming corrections. These should not be allowed on indoor ranges and shoothouses.
- Breacher Rounds: Shotgun slug or shot made especially for employment close range into door hinges.
- Multiple Properties: Some rounds have multiple characteristics such as being both lead free and frangible, or SRTA and frangible.

APPENDIX C GLOSSARY

C-1 ACRONYMS

AFCEC	Air Force Civil Engineer Center
AHU	Air Handling Unit
AP	Armor Piercing
AR	Army Regulation
AR	Abrasion Resistance (When used in conjunction with steel plate)
BIA	Bilateral Infrastructure Agreement
BMP	Best Management Practices
CCMCK	Close Combat Mission Capability Kit
CFR	Code of Federal Regulations
CQC	Close Quarter Combat
DA PAM	Department of the Army Pamphlet
dBA	A-weighted decibels
DB	Design Build
DBB	Design-Bid-Build
DDC	Direct Digital Control
DF	Direct Fire
DoD	Department of Defense
DODIC	Department of Defense Identification Code
EOD	Explosive Ordnance Disposal
EPR	Enhanced Performance Round
FAA	Federal Aviation Administration
FL	Firing Line
FLFS	Firing Line Floor Surface

GIS	Geographic Information System
HBW	Hardness Brinell Wolfram (Tungsten)
HE	High Explosive
HEPA	High Efficiency Particulate Air
HNFA	Host Nation Funded Construction Agreements
HQUSACE	Headquarters, U.S. Army Corps of Engineers
KD	Known Distance
LAW	Light Antitank Weapon
LLF	Lower Limit of Fire
LOMAH	Location Of Miss And Hits
LOF	Line of Fire
LOS	Line of Sight
MERV	Minimum Efficiency Reporting Value
MCO	Marine Corps Order
MIT	Moving Infantry Target
MOUT	Military Operations in Urban Terrain
NAVFAC	Naval Facilities Engineering Command
NOD	Night Observation Device
NOSSA	Naval Ordnance Safety and Security Activity
OSSHA	Occupational Safety and Health Administration
RCP	Reinforced Concrete Pipe
RDG	Range Design Guide
RFP	Request For Proposal
RMTK	Range Mangers Tool Kit
RSO	Range Safety Officer

RT60	Reverberation Time 60dB
SACON	Shock Absorbing Concrete
SAR	Small Arms Range
SAW	Squad Automatic Weapons
SDZ	Surface Danger Zone
SESAMS	Special Effects Small Arms Marking System
SOP	Standard Operating Procedures
SOUM	Safety of Use Memorandums
SOFA	Status of Forces Agreements
SRTA	Short Range Training Ammunition
STC	Sound Transmission Class
TC	Training Circular
UFC	Unified Facilities Criteria
ULF	Upper Limits of Fire
U.S.	United States
USACE	United States Army Corps of Engineers
UXO	Unexploded Ordnance
VDZ	Vertical Danger Zone
VFD	Variable Frequency Drive

C-2 DEFINITION OF TERMS

Close Quarter Combat (CQC) Facility: A live fire shoothouse that supports short-range training such as room-room clearing.

Crew Served Weapon: Any weapon system that requires a crew of more than one individual to function at optimum efficiency such as a belt fed machine gun.

Direct Fire: Fire delivered to a target within the line-of-sight of the shooter using the target itself as the point of aim.

Distance X: The maximum distance a projectile (to include guided missiles and rockets) will travel when fired or launched at a given quadrant elevation with a given charge or propulsion system.

Double Hearing Protection: Wearing earplugs in combination with noise muffs or noise attenuating helmets. Impulse noise levels can be so high that single hearing protection does not adequately protect hearing.

Dry Fire: Operating a weapon with no ammunition in the chamber. Not all weapons should be dry fired.

Firing Line (FL): The line which consists of firing points or positions, from which weapons systems are fired.

Firing Line Floor Surface (FLFS): The ground surface along the firing line.

Firing Position: The point or location at which a weapon system is placed for firing.

Indirect Fire: Fire delivered to a target when the weapon is not in line of sight with the target.

Line of fire (LOF): An imaginary line drawn from the shooting position to the target.

Live Fire: As used in this UFC, live fire includes use of any potentially lethal ammunition.

Lower Limit of Fire (LLF): An imaginary line consisting of the lowest point on all LOFs combined. This is often taken drawn a prone shooter firing at the lowest target.

Military Operations in Urban Terrain (MOUT) Facility: A mock town or city providing urban warfare training.

Navigable Waterway: Any body of water open to the free movement of marine vessels.

Officer in Charge (OIC): The officer, WO, or Non-Commissioned Officer (NCO) responsible for personnel conducting firing or operations within the training complex.

Partially Contained Range: This range has a covered firing line, side containment, overhead baffles, and a bullet backstop. Direct fire is totally contained by the firing line canopy, side containment, baffles, and bullet trap (no “blue sky” observed from firing positions). Ricochets and splatter are not contained.

Range Safety Officer (RSO): The officer, warrant officer (WO), or noncommissioned officer (NCO) who is the direct representative of the Officer In Charge (OIC) for insuring the adequacy of safety of firing, training operations, and ensuring compliance with laser range safety and local standing operations. Qualifications vary between services.

Reverberation Time 60dB: The time it takes for the sound pressure level to reduce by 60dB, measured after the sound source is abruptly switched off.

Shoothouse: See Close Quarter Combat (CQC) Facility.

Single Hearing Protection: Wearing either earplugs, noise muffs, or noise attenuating helmets.

Small Arms: For this UFC small arms includes all pistols, shotguns, rifles, carbines, submachine guns, light, medium, and heavy machine guns up to and including .50 caliber.

Sound Transmission Class: A rating used to compare the acoustical isolation of different barrier materials or partition constructions.

Surface Danger Zone (SDZ): The ground and airspace designated within the training complex (to include associated safety areas) for vertical and lateral containment of projectiles, fragments, and debris, and components resulting from the firing, launching, or detonation of weapons systems to include explosives and demolition.

Upper Limit of Fire (ULF): An imaginary line consisting of the highest point on all LOFs combined. This is often taken drawn from a standing shooter firing at the highest target.

Vertical Danger Zone (VDZ): For non-contained and partially contained ranges, the VDZ is the volume of airspace above the SDZ between the ground surface and the maximum ordinate of a direct-fired or ricochet round. The height of the VDZ varies with the weapon and ammunition fired. For fully contained ranges, the VDZ is the area between the SDZ and the upper limits of containment.

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APPENDIX D REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS

https://www.astm.org/

ASTM C75, *Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe*

ASTM E10-08, *Standard Test Method for Brinell Hardness of Metallic Material*

ASTM E2235, *Standard Test Method for Determination of Decay Rates for Use in Sound Insulation Test Methods*

CODE OF FEDERAL REGULATIONS (CFR)

https://www.gpo.gov/

29 CFR PART 1910.25 *Occupational Safety and Health Administration*

33 CFR 334 *Danger Zone and Restricted Area Regulations*

DEPARTMENT OF THE AIR FORCE

AFMAN 31-129, *USAF Small Arms and Light Weapons Handling Procedures*

AFI 36-2654, *Combat Arms Program*

AFMAN 36-2655, *USAF Small Arms and Light Weapons Qualification Programs*

ETL 11-18, *Small Arms Range Design and Construction*

FC 4-179-03F, *Air Force Indoor Small Arms Range*

DEPARTMENT OF THE ARMY

https://www.Armypubs.army.mil

Army Range Design Guide (RDG) Web Based tool - access provided by project sponsors

AR 350-19, *Army Sustainable Range Program*

AR 350-52, *Army Training Support System*

DA PAM 385-63, *Range Safety*

Range Managers Toolkit (RMTK) – check with sponsor

TC 25-8, *Training Ranges*

USACE Centers of Standardization (CoS)

Outdoor Sports Facility Standards, - check with sponsor

U.S. Army Defense Ammunition Center

Hazard Classification of United States Military Explosives and Munitions

DEPARTMENT OF THE NAVY

https://www.public.navy.mil

OPNAV 3591.F, *Small Arms Range Training and Qualification*

OPNAV 5100.27.B, *Navy Laser Hazard Control Program*

Navy Environmental Health Center

Technical Manual NEHC TM 6290.99, *Indoor Firing Ranges Industrial Hygiene Technical Guide*

Naval Facilities Engineering Command

Military Handbook 1027-3B, *Range Facilities and Miscellaneous Training Facilities Other Than Buildings*

ENVIRONMENTAL PROTECTION AGENCY

https://www.epa.gov/nscep

902-B-01-001, *Best Management Practices for Lead at Outdoor Shooting Ranges*

AP 42, *Compilation of Air Emission Factors*

MILITARY SPECIFICATIONS

Mil-A-46100, *Armor Plate, Steel, Wrought, and High-Hardness*

UNDERWRITER'S LABORATORY

https://www.ul.com

UL 681, *Installation and Classification of Burglar and Holdup Alarm Systems for Alarm System Installation*

UL 752, *Standard for Bullet-Resisting Equipment*

UL 2050, *National Industrial Security Systems - only distributed to those demonstrating relevant national industrial security involvement*

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/dod/ufc

UFC 1-200-01, *DoD Building Code*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

UFC 3-120-01, *Design: Sign Standards*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 4-010-01, *DoD Minimum Anti-Terrorism Standards for Buildings*

UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*

UFC 4-020-02, *DoD Security Engineering Facilities Design Manual,* (currently in draft and unavailable)

UFC 4-021-02NF, *Security Engineering Electronic Security Systems*

UFC 4-020-04A, *Electronic Security Systems: Security Engineering*

UFC 4-215-01 *Armories and Arms Rooms*

UNITED STATES MARINE CORPS

MCO 3570.1C, *Range Safety*

MCO P3350.10, *Policy and Procedures for Range and Training Area (RTA) Management*

Range Managers Toolkit (RMTK) – check with sponsor

FC 4-179-03F
1 April 2015
Change 2, 20 September 2021

FACILITIES CRITERIA (FC)

AIR FORCE INDOOR SMALL ARMS FIRING RANGE



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FACILITIES CRITERIA (FC)

UNITED STATES AIR FORCE
INDOOR SMALL ARMS FIRING RANGE

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Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**
1	8 July 2021	All references to ETL11-18 updated to UFC 4-179-02, *Small Arms Ranges*. New range size calculator added to Appendix B.
2	20 September 2021	Updated Figures B-2, B-3, and B-4.

FOREWORD

Facilities Criteria (FC) provide functional requirements (i.e., defined by users and operational needs of a particular facility type) for specific DoD Component(s), and are intended for use with unified technical requirements published in DoD Unified Facilities Criteria (UFC). FC are applicable only to the DoD Component(s) indicated in the title, and do not represent unified DoD requirements. Differences in functional requirements between DoD Components may exist due to differences in policies and operational needs.

All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the FC, the SOFA, the HNFA, and the BIA, as applicable.

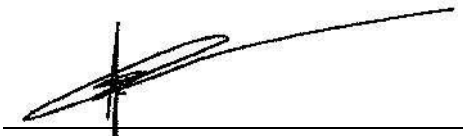
Because FC documents are coordinated with unified DoD technical requirements, they form an element of the DoD UFC system applicable to specific facility types. The UFC system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applicable to the Military Departments, Defense Agencies, and the DoD Field Activities. The UFC System also includes technical requirements and functional requirements for specific facility types, both published as UFC documents and FC documents.

FC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing criteria for military construction. HQ U.S. Army Corps of Engineers (HQ USACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet site listed below.

FC are effective upon issuance and are distributed only in electronic media from the following source: Whole Building Design Guide web site http://dod.wbdg.org/

Refer to UFC 1-200-01, *General Building Requirements*, for implementation of new issuances on projects.

AUTHORIZED BY:



JOE SCIABICA, SES
Director
Air Force Civil Engineer Center

FACILITIES CRITERIA (FC)

NEW SUMMARY SHEET

Document: FC 4-179-03F, *Air Force Indoor Small Arms Firing Range*.

Superseding: None.

Description: This FC provides guidelines for evaluating, planning, programming, and designing an indoor small arms firing range. The information in this FC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental United States (CONUS) and outside the continental United States (OCONUS). It also applies to the procurement of design-build services for the above-noted projects. Alteration and renovation projects should update existing facilities to meet the guidance and criteria within budgetary constraints.

Reasons for Document: This FC is the initial release to establish requirements for an indoor small arms firing range. It defines the criteria for determining appropriately sized, flexible, cost-optimized, durable, quality-designed facilities on a life cycle basis to support the mission. The plans presented in this FC are concepts only and are primarily intended to communicate functional user and adjacency requirements. A thorough compliance check of all other applicable criteria is required.

Impact: Use of this FC will facilitate and standardize the design of indoor small arms firing ranges throughout the Air Force. It will provide more complete and consistent project requirements and expedite the programming and design of facilities and reduce initial design cost.

Unification Issues: None.

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CHAPTER 1 INTRODUCTION

1-1 GENERAL INFORMATION.

1-1.1 Purpose.

This standard facility prototype design criteria was developed to assist Air Force programmers to prepare and validate DD Form 1391 requirements and to assist A-E design professionals with approved project-specific design requirements. It is a source of basic programming and functional information for a small arms firing range. **1**\ This standard is consistent with the Air Force Corporate Facilities Standards (AFCFS) and Unified Facilities Criteria (UFC). This standard, in conjunction with the AFCFS and UFC criteria, defines Air Force expectations for project programming and A-E design decisions. /**1**/

1-1.2 Objective.

The standard facility prototype design program defines consistent facility requirements across the Air Force enterprise to expedite delivery of a facility. This standard was designed in compliance with AFMAN 32-1084. The objective is to deliver appropriately sized, flexible, cost-optimized, durable, quality-designed facilities on a life cycle basis to support the Air Force mission.

1-2 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01*,* which provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism (AT), security, high-performance and sustainability requirements (comprehensive requirements are detailed in UFC 1-200-02), and safety. **1**\ Use this FC in addition to UFC 4-179-02, UFC 1-200-01, and the UFCs and government criteria referenced therein. /**1**/

1-3 REFERENCES.

Appendix A contains a list of related documents and references to use in conjunction with this FC. In general, use the latest available issuance of the reference.

1-4 INSTRUCTIONS.

1-4.1 Method.

The standard facility prototype was developed by determining personnel counts, allowable room sizes, adjacency diagrams between functional spaces, and overall facility space requirements. The standard facility prototype establishes Air Force criteria for the facility type. **1**\ Use the criteria in conjunction with other departmental publications and UFCs when programming and designing this facility type. /**1**/

Supplement this FC with a thorough review by individual program managers and operations staff.

1-4.2 Standard Facility Prototype Tools.

1\ This standard facility prototype consists of four parts to be used by programmers and A-Es:

1. Facilities criteria for standard prototype (this FC)
2. Interactive programming spreadsheet
3. Facility Building Information Modeling (BIM) drawings
4. UFC 4-179-02 /**1**/

1-4.3 Facilities/Design Criteria.

The FC document consists of three primary components:

1. Notional site
2. Composite facility adjacency diagram(s)/composite floor plan(s)
3. Modules with associated room data sheets

1-4.3.1 Notional Site.

The notional site presents a notional site plan diagram that indicates key site development criteria; it is not a site-specific solution. The information represents the land requirements to construct this facility and includes associated AT standoff distances and parking. Utilization of existing or shared parking is allowable and may reduce the total acreage required for the facility. Adapt the requirements to the specific site and location and comply with the applicable Installation Development Plan (IDP) and Area Development Plan (ADP) for facility siting.

1-4.3.2 Composite Floor Plans.

The composite floor plans are conceptual solutions that illustrate functional user and adjacency requirements. Plan variations may be rotated, flipped, or reversed to fit the actual site. A thorough compliance check of all other applicable criteria is required even when using the conceptual solutions provided in this FC.

1-4.3.3 Modules.

Spaces and rooms that are integrally related with a specific functional connection or operational flow are grouped into a module. Modules and the associated room data sheets identify specific criteria and additional detail for each functional area of the

facility as outlined in the space program sheets in Appendix B. Information is provided in a standard presentation and data sheet format and the required space adjacencies and modules are illustrated in figures.

The resulting shape of the facility assembled from the facility prototype modules must provide construction efficiencies obtained from building proportions and overall configuration. The building footprint shall be organized and well composed. The building design must comply with the installation facility standards (architectural compatibility plan) and the AFCFS. Modules shall not be deconstructed or altered except as indicated in paragraph 1-4.3.4.

1-4.3.4 Module Flexibility/Adjustments.

Utilization of the modules provided is highly recommended to maintain functional relationships, adjacencies, and allowed program areas. Modules contain fixed attributes that are essential to functional requirements. Modules may be rotated, flipped, and reversed to accommodate an overall composition or site issue. When the modules cannot be arranged to produce a constructible floor plan due to site constraints, their proportions may be adjusted to create a constructible plan. Manipulating the module shape must not result in an overall increase in square feet and/or reduce the functionality of any module or the required adjacencies in the composite plan.

Some modules are linked to space requirements that increase or decrease in size based on the personnel count and equipment for a particular mission. In these cases, increase or decrease the size of the module to match the revised scope calculation. This may sometimes require minor adjustments in other adjacent modules so they properly fit together to create a constructible facility floor plan. Spaces must comply with any critical dimensions indicated on module plans. Manipulate as few modules as possible to create a constructible facility. The resulting composite plan must respect the established module’s adjacencies and must not exceed the authorized project scope.

1-4.3.5 Room Data Sheets.

Specific requirements for each room, space, or area are provided on room data sheets that are located following their respective module. Information contained on the data sheets defines the functional and physical requirements for each of the spaces within the facility type.

1-4.4 Programming Spreadsheet(s).

This tool is provided in two formats. A PDF programming sheet is provided in Appendix B primarily as a reference and reflects the baseline standard facility program. The additional interactive programming sheet provides a tool for planners and programmers. It allows the input of authorized personnel positions and special purpose spaces. Updated inputs are automatically calculated and provide new required square footage

for each space and the overall facility size. A link is provided in Appendix B for access to the interactive programming spreadsheet.

1-4.5 Facility Drawings – BIM.

This component of the standard facility prototype tools includes both a PDF version and a Revit version of the modules, and rooms and composite floor and site plans. The spaces, rooms and modules shown reflect the baseline standard facility program spreadsheet in Appendix B. The drawings in this FC are exact copies of the larger BIM drawings and comply with the program scope. The BIM drawings provide a starting point for the digitization of building data and a starting point in the design and construction of a facility. BIM drawings are found at the link provided in Appendix B.

1-4.6 Additions and Alterations.

For additions and alterations to existing facilities, use the adjacencies, sizing/scope, and detailed requirements contained in the site diagrams, module drawings, and room data sheets to the maximum extent possible. The functionality and adjacency of the modules are still valid but may require some manipulation to accommodate the existing structure. Move non-structural walls to the greatest extent possible to open up space in existing facilities to make them more receptive to the placement of the modules. The planner and designer shall determine the most efficient means to balance the placement of modules within existing spaces or as a facility addition.

1-4.7 A-E Design Professionals.

The requirements set forth by this standard are the approved space programming and functional layouts in accordance with AFCFS. The Air Force Security Forces Center (AFSFC) must approve variations to functional and operational issues and deviations from core requirements.

CHAPTER 2 SITE AND OVERALL ADJACENCY

2-1 GENERAL FACILITY OVERVIEW.

The indoor small arms range that houses space to fire and train on weapons use is typically a one-story structure that works best as a standalone facility. All Air Force recruits and active personnel must have weapons training, both initial and ongoing certification. This facility provides a safe space to fire live rounds, train on weapon assembly, and clean and maintain weapons. It consists of a large, enclosed space for firing live rounds, student classrooms, weapons cleaning, weapons storage, administration area, and support spaces. Consult the AFCFS to determine overall quality standards for the facility type. This standard facility prototype is considered as a Group II or III hierarchy based on its actual location on the installation.

2-2 FACILITY USERS/OCCUPANTS.

The facility users are as follows:

- Able-bodied active duty, National Guard, and Reserve military personnel
- Able-bodied DOD civilians, contractors, and others as authorized
- Non-range, common areas shall be ABA compliant

2-3 SIZE DETERMINANTS.

1*\ The indoor small arms firing range size is generally driven by the installation's training requirement and mission. The 21-lane facility has been designated as standard. See paragraph B-1 for the range size requirements calculator tool. /1**/

2-3.1 Indoor Small Arms Firing Range Size.

Indoor small arms firing range sizes vary from 14-lane up to 56-lane facilities. For the purpose of this planning document, the minimum to maximum sizes were analyzed:

- Small, 14 lanes
- Standard, 21 lanes
- Large, 28 to 56 lanes (in increments of 7)

2-4 OPERATIONAL ASPECTS.

The hours of operation are driven by user and mission requirements.

2-5 NOTIONAL SITE.

The site diagram represents a notional layout to reflect site development requirements/criteria only. It is not an actual site design. Siting must comply with the IDP and ADP.

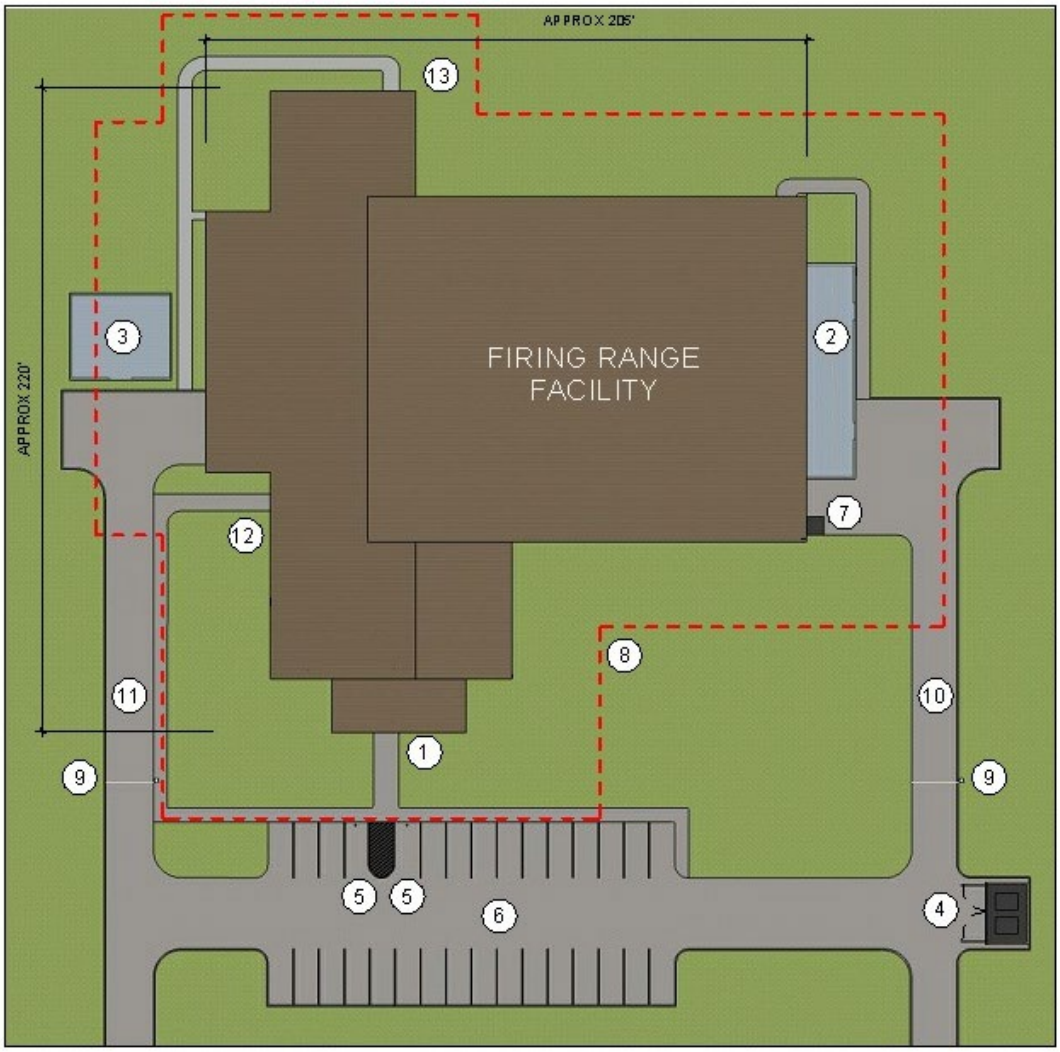
2-6 LOCATION DETERMINANTS (SITE SELECTION) OR SITE LOCATION AND ORIENTATION.

Several factors determine the most appropriate and cost-effective location for an indoor small arms firing range. The availability and capacity of required utilities and the mass/scale of the facility relative to adjacent structures and noise issues shall be analyzed.

2-6.1 Access.

The indoor small arms firing range's ideal location is in the vicinity of the main Security Forces Squadron facility. Locate the facility with main road access and away from any active pedestrian or populated areas. Provide parking and access drives as close to the facility as possible while complying with AT requirements in UFC 4-010-01. Separate service drives from privately owned vehicle (POV) parking.

Figure 2-1 Notional Site Diagram (21 Lane Facility)



SITE PLAN KEYNOTE LEGEND	
1	PRIMARY BUILDING ENTRANCE
2	SCREENED MECHANICAL YARD – RANGE EXHAUST
3	SCREENED MECHANICAL YARD – BUILDING SUPPLY
4	DUMPSTER ENCLOSURE
5	HANDICAPPED PARKING SPACE
6	STAFF/VISITOR PARKING SPACE – 31 TOTAL SPACES
7	SPENT AMMUNITION CONTAINMENT
8	**1**\ UNOBSTRUCTED SPACE – CONCEPTUAL /**1**/
9	ACCESS CONTROL GATE
10	SERVICE DRIVE – MECHANICAL EQUIPMENT AND BULLET CONTAINMENT ACCESS
11	SERVICE DRIVE – HVAC AND DELIVERY ACCESS

12	SECONDARY/SERVICE ENTRANCE
13	SECONDARY MEANS OF EGRESS

2-7 COMPOSITE FACILITY ADJACENCY.

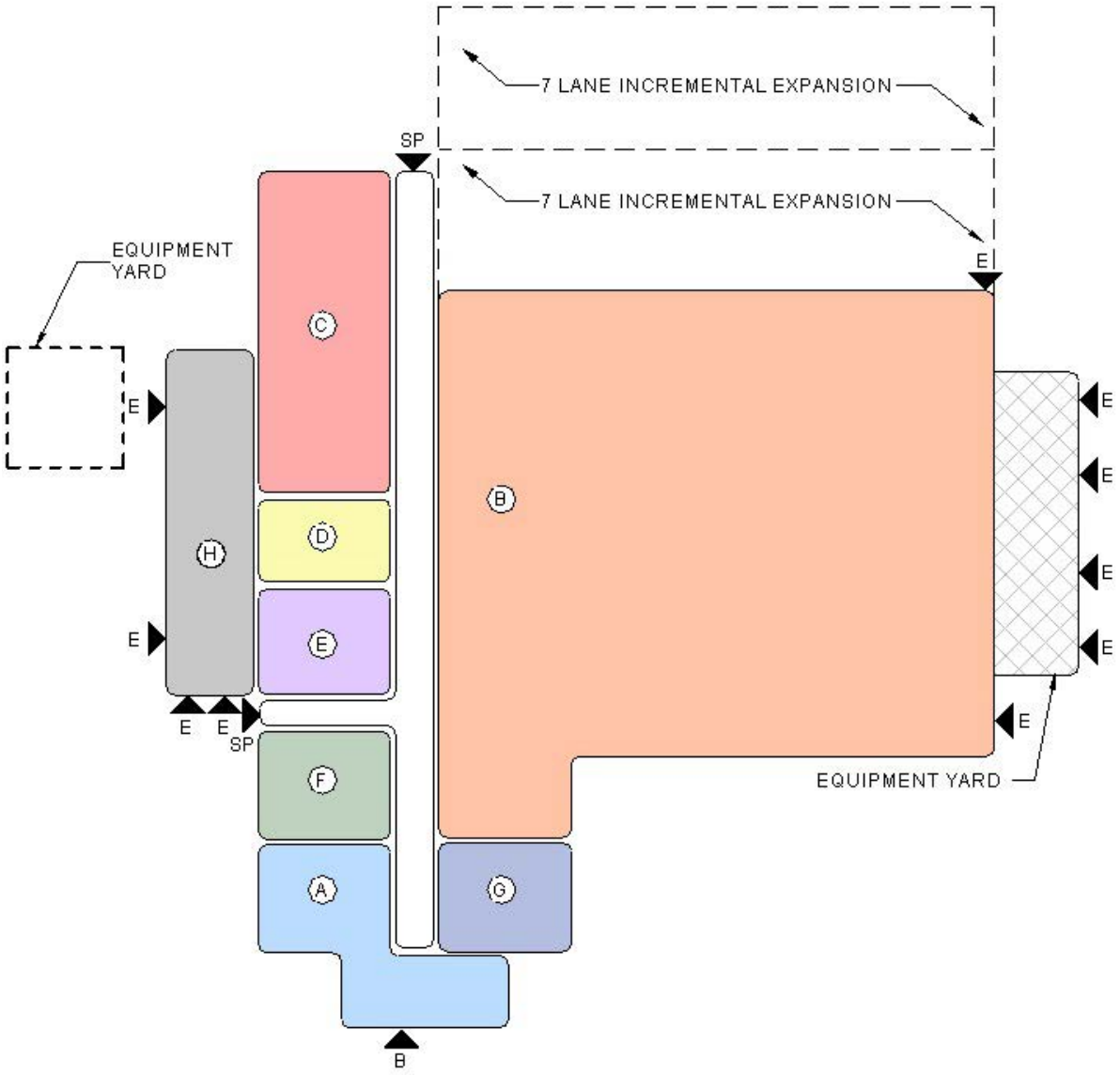
The space program for the indoor small arms firing range facilities is developed based upon the annual small arms qualification training requirements and authorized manning of the base, as well as historical data from the Air Force Security Forces Center (AFSFC).

The space program developed through the base planning team generally represents the maximum space allowed. The final space program for a new indoor small arms firing range will need to be carefully determined by installation representatives and the criteria in this FC. Additional information is found in Appendix B.

The required space adjacencies are illustrated in Figure 2-2. All program spaces are assigned a module designator. Spaces that must be located next to each other or share an important operational flow are grouped into one module with the intent that the module will remain intact during final design (although it may slightly change shape).

Composite plans represent conceptual solutions for indoor small arms range project requirements. These composite facility plans convey an AFSFC-approved solution. The building shape may be adjusted in response to site requirements or unusual or specific installation issues if approved in accordance with the procedures in Chapter I. See Appendix B for conceptual facility floor plans. Three concept plans and the related BIM drawings are included in Appendix B.

Figure 2-2 Functional Adjacency Diagram



MODULES

A	ADMINISTRATION
B	ARMS RANGE
C	TRAINING
D	MAINTENANCE
E	CLEANING
F	STORAGE
G	UTILITY
H	BUILDING SUPPORT

LEGEND ENTRY/EXIT

B	BUILDING ENTRY
E	EQUIPMENT ENTRY
SP	SECONDARY/PERSONNEL ENTRY

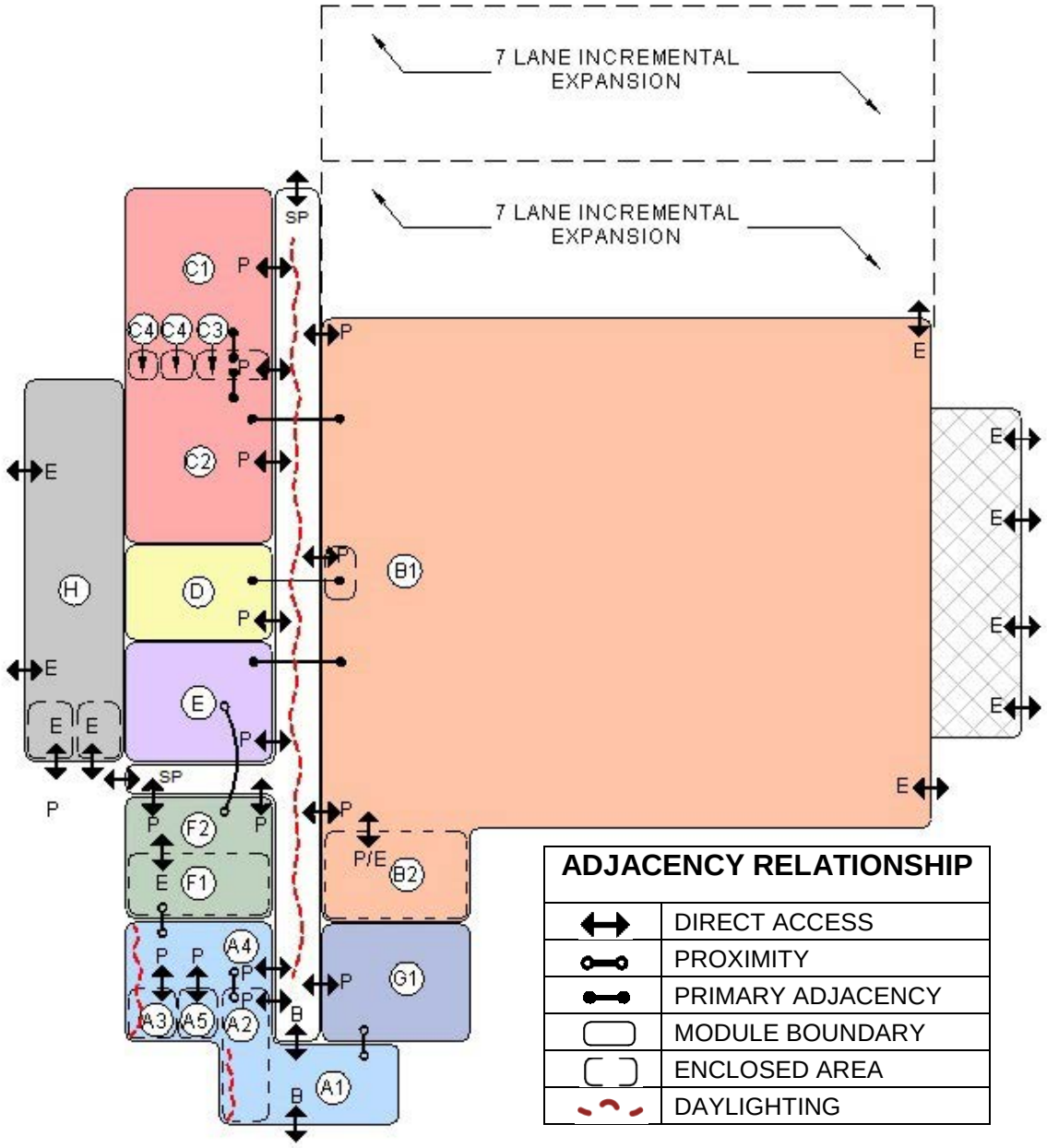
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CHAPTER 3 FACILITY REQUIREMENTS AND CRITERIA MODULES

3-1 ADJACENCY DIAGRAM.

The majority of administration/instructors and trainees will enter the facility through the main building entrance. From that point, access to all other spaces within the facility is from a major circular corridor, etc.

Figure 3-1 Overall Module Adjacency Diagram

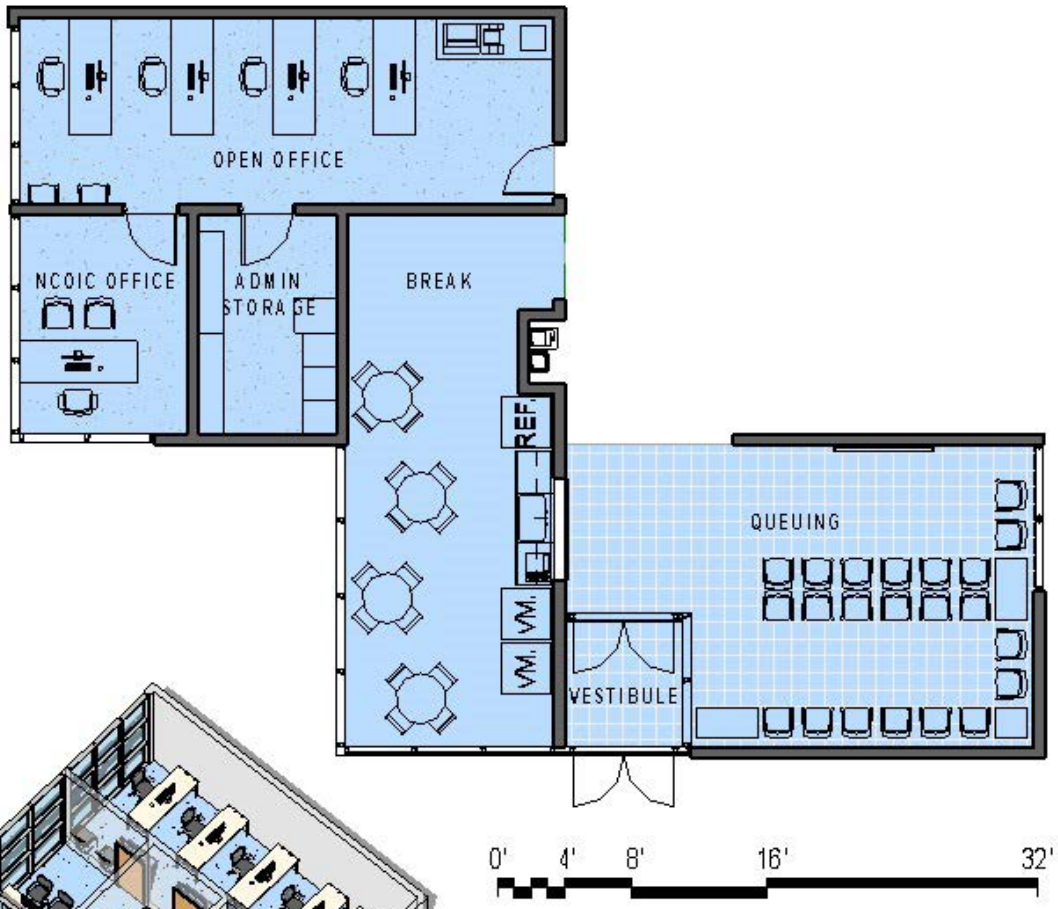


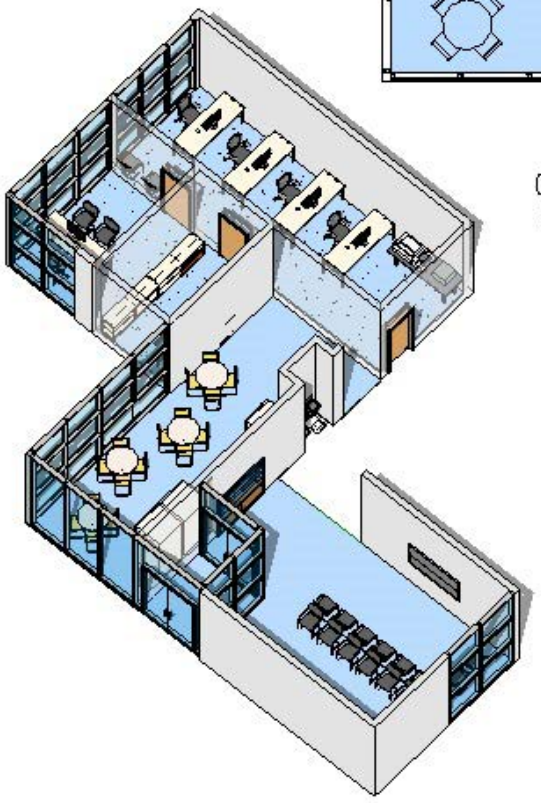
MODULES ROOM SCHEDULE			
A1	QUEUING	C2	WEAPONS SIMULATOR
A2	BREAK ROOM	C3	OBSERVATION ROOM
A3	NCOIC OFFICE	C4	STORAGE
A4	OPEN OFFICE	D	WEAPONS MAINTENANCE SHOP
A5	ADMIN/INSTRUCTOR STORAGE	E	CLEANING
B1	ARMS RANGE	F1	ARMS VAULT
B2	RANGE SUPPLIES	F2	ISSUE ROOM
C1	CLASSROOM	G1	RESTROOMS/LOCKER ROOM
		H	BUILDING SUPPORT

LEGEND ENTRY/EXIT	
B	BUILDING ENTRY
E	EQUIPMENT ENTRY
P	PERSONNEL ENTRY
SP	SECONDARY/PERSONNEL

3-2 MODULE A: ADMINISTRATION.

Figure 3-2 Floor Plan and Axonometric





MODULE A – ADMINISTRATION ROOM SCHEDULE	
ROOM NAME	**AREA**
ADMIN STORAGE	**See Appendix-B Programming Worksheets**
BREAK	
NCOIC OFFICE	
OPEN OFFICE	
QUEUEING	
VESTIBULE	

***NOTE: DAYLIGHTING TO BE DESIGNED PER UFC 1-200-02**

Figure 3-3 Administrative Instructor Storage Data Sheet

Description/Usage		Storage space for office supplies, file storage, and instructor's personal effects.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal
	Security/ Hardwar	Keyed lock set
	View Panels/ Kick-Plates	Kick-plate
Finishes	**Walls**	Gypsum board
	Floor	Concrete
	Base	Vinyl
	Ceiling	Exposed to structure
Plumbing		N/A
HVAC		Air conditioned and heated
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		One 120V convenience outlet
Lighting		Fluorescent or LED (5 fc) lighting
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		**\1** See UFC 4-179-02 for administrative sound levels **/1/**
Furnishings, Equipment, and Casework		Storage shelving for office supplies; filing cabinets; 2'-0" x 2'-0" single-tier equipment storage lockers (one per instructor and NCOIC)
Special Requirements		Expandable, with open office based upon number of instructors

Figure 3-4 Break Room Data Sheet

Description/Usage		Room for students and instructors to get coffee or eat meals.
Ceiling Height		9’-0” minimum
Windows		Daylighting requirements per UFC 1-200-02
Doors	**Type**	N/A
	Security/ Hardware	N/A
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Impact-resistant gypsum board, paint
	Floor	Sealed/stained concrete or tile
	Base	Rubber/vinyl or tile
	Ceiling	Acoustical ceiling tile
Plumbing		Connections for coffee maker, sink with disposer, refrigerator, and floor drain
HVAC		Air conditioned and heated
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V dedicated circuits for coffee maker, microwave and refrigerator; 120V convenience outlets for vending machine(s)
Lighting		Fluorescent or LED lighting (20 fc) with ceiling-mounted occupancy sensors
Communication	**Tele.**	One public-use wall phone
	Data	Base-specific Wi-Fi
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		Minimum STC rating of 42 between occupied spaces and break room
Furnishings, Equipment, and Casework		Coffee maker; microwave; refrigerator; upper and lower cabinets with sink; seating-tables or bar style w/seating
Special Requirements		Break area in close proximity to queuing room; break area based upon 16% of total building occupants multiplied by 18 square feet per occupant.

Figure 3-5 NCOIC Office Data Sheet

Description/Usage		Private office for non-commissioned officer in charge.
Ceiling Height		9’-0” minimum
Windows		Daylighting requirements per UFC 1-200-02
Doors	**Type**	Hollow metal
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Gypsum board, paint
	Floor	Sealed/stained concrete or carpet tile
	Base	Vinyl/rubber or tile
	Ceiling	Acoustical ceiling tile
Plumbing		N/A
HVAC		Air conditioned and heated
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets. One per wall, quad outlet at desk
Lighting		Fluorescent or LED (50 fc) lighting with ceiling-mounted occupancy sensor
Communication	**Tele.**	Outlet at desk
	Data	One data outlet at desk
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		Minimum STC rating of 42. **\1** See UFC 4-179-02 for acoustic sound levels. **/1/**
Furnishings, Equipment, and Casework		Desk with chair; 2 guest chairs; computer
Special Requirements		140 square foot private office

Figure 3-6 Open Office Data Sheet

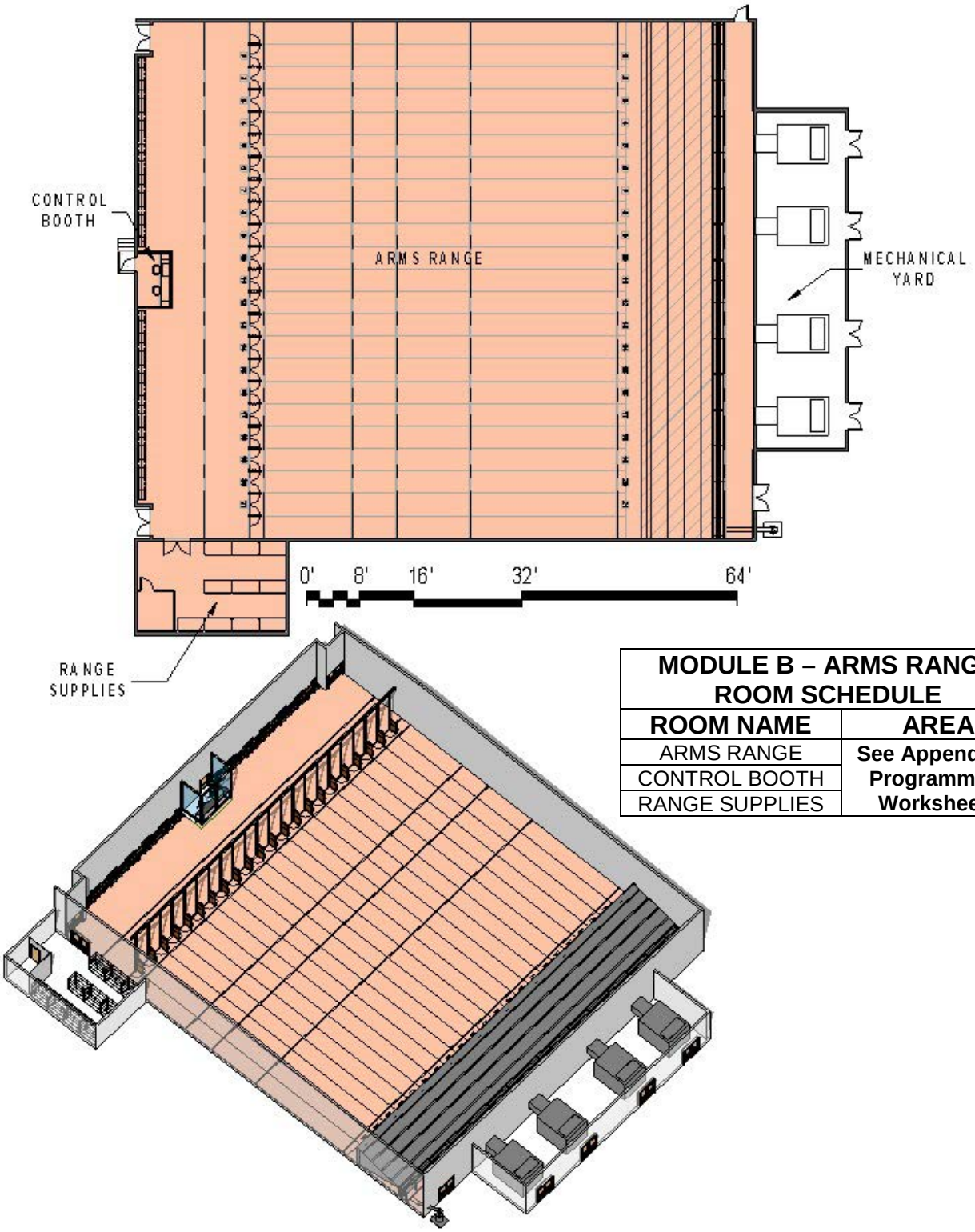
Description/Usage		Open office for range instructors to perform daily administrative duties.
Ceiling Height		9'-0" minimum
Windows		Daylighting requirements per UFC 1-200-02
Doors	**Type**	Hollow metal
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plates
Finishes	**Walls**	Gypsum board with chair rails, paint
	Floor	Sealed/stained concrete or carpet tile
	Base	Vinyl/rubber or tile
	Ceiling	Acoustical ceiling tile
Plumbing		N/A
HVAC		Air conditioned and heated
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience quad outlets at each work station; copier and other office equipment; charging station
Lighting		Fluorescent or LED (50 fc) lighting; ceiling-mounted occupancy sensor and daylighting sensor
Communication	**Tele.**	One outlet at each work station
	Data	One outlet at each work station
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		Minimum STC rating of 42. **\1** See UFC 4-179-02 for acoustic sound levels. **/1/**
Furnishings, Equipment, and Casework		Desks with chairs (one per instructor); 2 guest chairs; computer (one per instructor); copier with table; radio charging station with table
Special Requirements		Open office to expand with range size; one instructor for each seven students; Open office area based upon 80 square feet per instructor with additional 20 square feet for admin support

Figure 3-7 Queuing Room Data Sheet

Description/Usage		Queuing area for range students awaiting instruction; includes seating (size based upon range capacity) and display area.
Ceiling Height		9’-0” minimum
Windows		Daylighting requirements per UFC 1-200-02
Doors	**Type**	Pair 3’-0” x 7’-0” anodized aluminum door and frames with sidelights; optional 3’-0” x 7’-0” aluminum door with removable sidelights
	Security/ Hardware	Keyed lock set (minimum); possible access control
	View Panels/ Kick-Plates	Sidelights
Finishes	**Walls**	Impact-resistant gypsum board, paint
	Floor	Sealed/stained concrete or tile
	Base	Rubber/vinyl or tile
	Ceiling	Open to structure or acoustical ceiling tile
Plumbing		Electric water cooler
HVAC		Air conditioned and heated
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets/wall-mounted TV; display case
Lighting		Fluorescent or LED lighting (15 fc) with ceiling-mounted occupancy sensor
Communication	**Tele.**	One public-use wall phone
	Data	Base-specific Wi-Fi
	CCTV	N/A
	CATV	Base-specific
	Security	N/A
Acoustical		Minimum STC rating of 42
Furnishings, Equipment, and Casework		Display case; chairs (number based upon range capacity, minimum one chair per lane); wall-mounted TV; end tables
Special Requirements		Queuing area changes with range size, based upon total number of firing lanes at 20 square feet per student including area for circulation. Additional square feet for entry vestibule; provide walk-off mat.

3-3 MODULE B: ARMS RANGE – 21 LANES.

Figure 3-8 Floor Plan and Axonometric



MODULE B – ARMS RANGE ROOM SCHEDULE	
ROOM NAME	**AREA**
ARMS RANGE	**See Appendix-B Programming Worksheets**
CONTROL BOOTH	
RANGE SUPPLIES	

Figure 3-9 Arms Range Data Sheet

Description/Usage		Indoor arms range for weapons training with control room. Allows firing from standing, kneeling, prone, and barricade positions. **\1** Fourteen (14) 5-foot-wide lanes minimum, expandable to 56 lanes maximum; automatic target retrieving system adjustable; bullet trap with deceleration chamber and dust and solids collection. **/1/**
Ceiling Height		**\1** Ceiling height varies based on target distance. See UFC 4-179-02, Table 4-1. For ranges that require vehicle access, use a 12-foot ceiling height. **/1/**
Windows		N/A
Doors	**Type**	Acoustical hollow metal doors, two pair 3'-0" x 7'-0"
	Security/ Hardware	Keyed lockset or cipher system
	View Panels/ Kick-Plates	Kick-plates on all doors
Finishes	**Walls**	**\1** Armor plate or cast-in-place concrete (unpainted) with acoustical panels **/1/**
	Floor	**\1** Sealed concrete or armor plate **/1/**
	Base	N/A
	Ceiling	Steel baffles with acoustical panels
Plumbing		N/A
HVAC		Laminar airflow 75 fpm; see para. 4-5.2
Fire Protection		Visual strobes and mass notification. No sprinkler system.
Power		Specific for target retrieval and bullet collection systems
Lighting		Special lighting (controlled by control room); target controls
Communication	**Tele.**	One outlet in control room
	Data	One outlet in control room; one outlet near bullet collection
	CCTV	N/A
	CATV	N/A
	Security	None
Acoustical		**\1** Provide acoustical panels at perimeter walls and baffles in sufficient quantity to meet the noise reduction criteria of UFC 4-179-02 **/1/**
Furnishings, Equipment, and Casework		**\1** Preparation area with wall-mounted benches and tables; control room with range control system; barricades; bullet trap system; acoustical panels; automatic target retrieval system (non-RPIE). **/1/** See BIM drawings for additional information.
Special Requirements		**\1** Refer to UFC 4-179-02 for small arms range requirements **/1/**

Figure 3-10 Control Booth Room Data Sheet

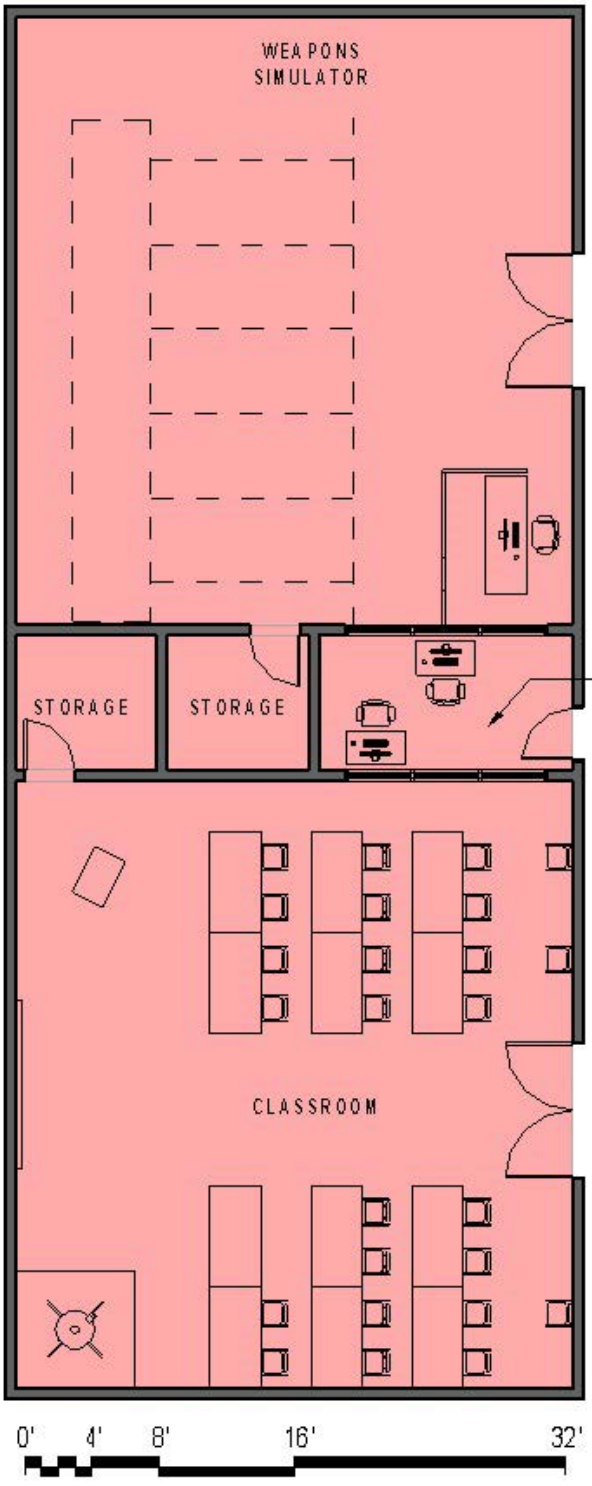
Description/Usage		Area for control of range operations.
Ceiling Height		**\1** N/A **/1/**
Windows		**\1** Full range visibility acoustic **/1/**
Doors	**Type**	**\1** Acoustic metal doors and frames **/1/**
	Security/ Hardware	Keyed lockset
	View Panels/ Kick-Plates	Kick-plates on all doors
Finishes	**Walls**	**\1** Acoustic walls and windows **/1/**
	Floor	**\1** Sealed concrete with 2-foot raised floor **/1/**
	Base	N/A
	Ceiling	Acoustic ceiling tile
Plumbing		N/A
HVAC		Air conditioned and heated w/separate unit; see para. 4-5.2 (maintain positive air pressure)
Fire Protection		**\1** Visual strobes and mass notification. No sprinkler system **/1/**
Power		120V power strip(s) for controls
Lighting		Fluorescent or LED (15 fc) light fixtures with wall-mounted dimming control
Communication	**Tele.**	One outlet
	Data	One outlet connected to base LAN
	Control	Control panel for lights, target retrieval, and bullet collector
	PA	Speakers throughout facility
Acoustical		**\1** See UFC 4-179-02 **/1/**
Furnishings, Equipment, and Casework		Countertop and two workstations
Special Requirements		Locate adjacent to arms range with direct access to corridor

Figure 3-11 Range Supplies Data Sheet

Description/Usage		Area for storage of targets and other range-required supplies; secure tool storage.
Ceiling Height		**1*\ 8’-0” minimum */1**
Windows		N/A
Doors	**Type**	Hollow metal, pair 3’-0” x 7’-0”
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plates on door
Finishes	**Walls**	Concrete; CMU
	Floor	Sealed concrete
	Base	Vinyl
	Ceiling	Open to structure
Plumbing		N/A
HVAC		Exhaust only (provide ducted make-up air or outside air grill)
Fire Protection		**1*\ See UFC 4-179-02 */1**
Power		120V convenience outlet; two per room
Lighting		Fluorescent or LED (15 fc) light fixtures with wall-mounted occupancy sensor
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		N/A
Furnishings, Equipment, and Casework		Shelving racks for supply storage; wire mesh partition for secure tools and materials storage
Special Requirements		Locate adjacent to arms range with direct access

3-4 MODULE C: TRAINING.

Figure 3-12 Floor Plan and Axonometric



MODULE C – TRAINING ROOM SCHEDULE	
ROOM NAME	**AREA**
CLASSROOM	**See Appendix-B Programming Worksheets**
OBSERVATION ROOM	
STORAGE	
STORAGE	
WEAPONS SIMULATOR	

***NOTE: DAYLIGHTING TO BE DESIGNED PER UFC 1-200-02**

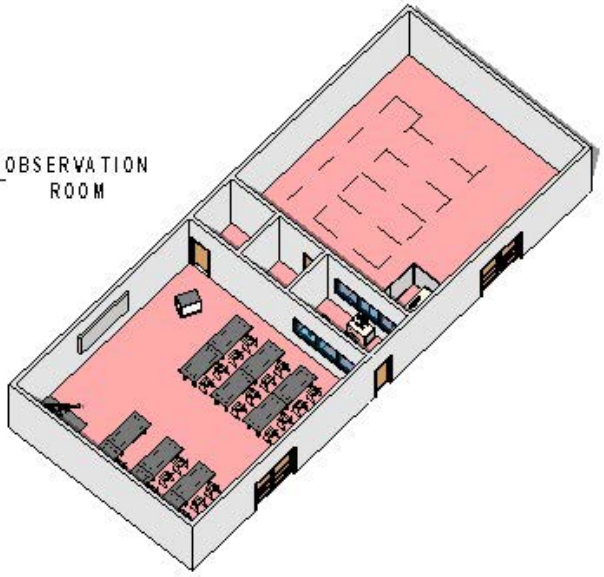


Figure 3-13 Classroom Data Sheet

Description/Usage		Instructor-based arms training in classroom setting, including vehicle weapons mount training.
Ceiling Height		9’-0” minimum
Windows		Daylighting requirements per UFC 1-200-02
Doors	**Type**	Pair 4’-0” x 7’-0” hollow metal doors
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plates
Finishes	**Walls**	Concrete/CMU, painted
	Floor	Sealed/stained concrete or tile
	Base	Vinyl/rubber or tile
	Ceiling	Open to structure or acoustical ceiling tile
Plumbing		N/A
HVAC		Air conditioned and heated
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets; ten lf on center around perimeter; projector outlet(s); dedicated circuit for podium
Lighting		Dimmable fluorescent or LED lighting fixtures (50 fc) with ceiling-mounted occupancy sensors and override switches; daylight sensors
Communication	**Tele.**	One wall outlet near podium
	Data	One wall outlet near podium
	CCTV	N/A
	CATV	One wall outlet near podium; base-specific
	Security	N/A
Acoustical		Minimum STC rating of 50. **1**\ See UFC 4-179-02 for maximum noise levels in classrooms. **/1/**
Furnishings, Equipment, and Casework		7’-0” x 7’-0” vehicle mount mockup; projector set up or wall-mounted TV; 36” x 48” tables with 2 stackable chairs per table; 36” x 48” instructor table; instructor podium; stackable chairs for additional instructors (1 instructor per 7 students); motorized blackout screens for fenestration
Special Requirements		22-person classroom is standard for 21-lane range with one seat per firing lane and additional seating for instructors; expandable with range; verify egress requirements for larger facilities

Figure 3-14 Observation Room Data Sheet

Description/Usage		**\1** Current operations no longer require a separate observation room for classrooms or simulator rooms. Space may be reallocated to simulator equipment storage and simulator support systems. **/1/**
Ceiling Height		9’-0” minimum
Windows		One-way glass window units to classroom and simulator
Doors	**Type**	Hollow metal, 3’-0” x 7’-0”
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plates
Finishes	**Walls**	Concrete/CMU, painted
	Floor	Sealed/stained concrete or tile
	Base	Vinyl/rubber or tile
	Ceiling	Acoustical ceiling tile
Plumbing		N/A
HVAC		Air conditioned and heated
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlet for each work station
Lighting		Fluorescent or LED lighting fixtures (20 fc) with ceiling-mounted occupancy sensors and override switches; dimmable
Communication	**Tele.**	One outlet per workstation
	Data	One outlet per workstation
	CCTV	**\1** Optional observation tools (non-RPIE equipment support) **/1/**
	CATV	N/A
	Security	N/A
Acoustical		Minimum STC rating of 46
Furnishings, Equipment, and Casework		Desk with chair for each viewing area; computer
Special Requirements		Used in conjunction with classroom and simulator; Observation area based upon 64 square feet per occupant

Figure 3-15 Classroom/Simulator Room Storage Data Sheet

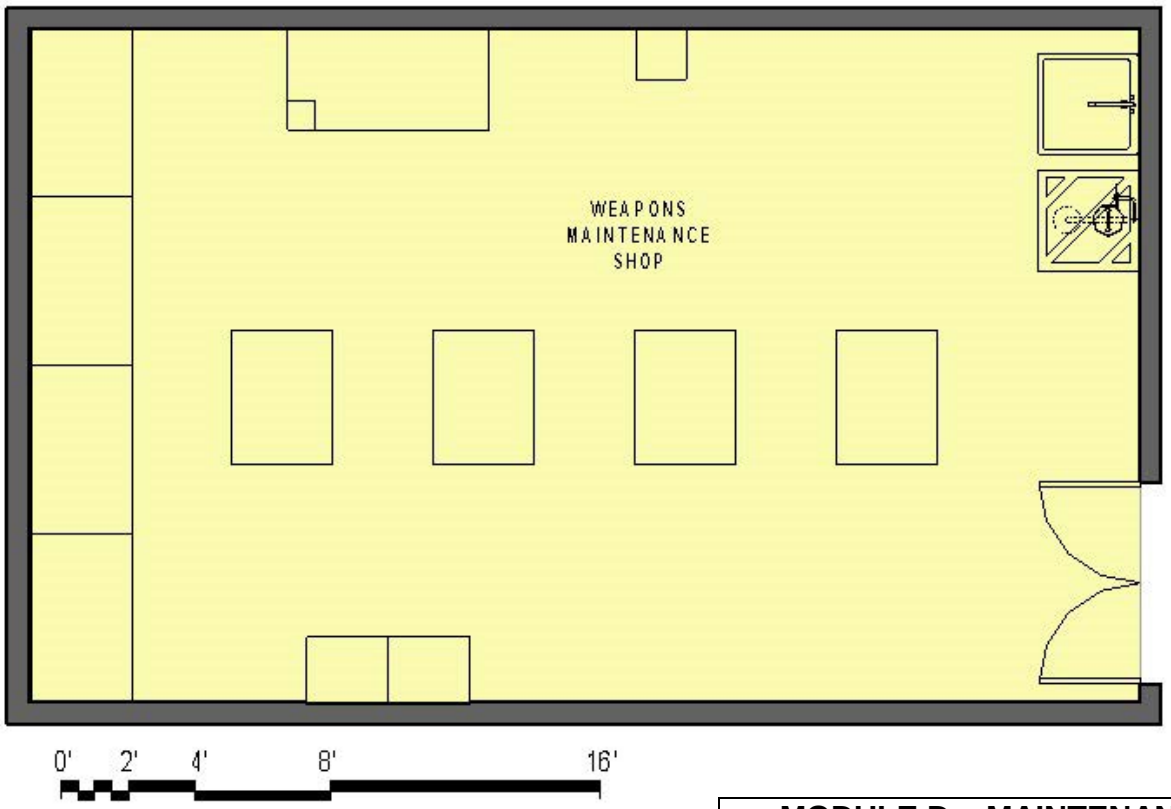
Description/Usage		Storage for classroom and simulator items.
Ceiling Height		9’-0” minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3’-0” x 7’-0”
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plates
Finishes	**Walls**	Concrete/CMU, painted
	Floor	Sealed/stained concrete or tile
	Base	Vinyl/rubber or tile
	Ceiling	Acoustical ceiling tile
Plumbing		N/A
HVAC		Provide conditioned supply air
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		None
Lighting		Fluorescent or LED lighting fixtures (5 fc) with wall-mounted occupancy sensor
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		N/A
Furnishings, Equipment, and Casework		N/A
Special Requirements		Provide storage room for each classroom and/or simulator module; expandable with range size.

Figure 3-16 Weapons Simulator Data Sheet

Description/Usage		Computer-based marksmanship training. **\1** Simulator size and controls configuration determined by manufacturer's requirements. Current simulator of choice is the Meggit's FATS 100MIL. Validate actual simulator requirements with the installation. **/1/**
Ceiling Height		**\1** 10'-0" minimum **/1/**
Windows		N/A
Doors	**Type**	Hollow metal, pair 3'-0" x 7'-0"
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plates
Finishes	**Walls**	Concrete/CMU, paint
	Floor	Sealed/stained concrete or tile. **\1** Two-foot raised firing platform **/1/**
	Base	Vinyl/rubber or tile
	Ceiling	Acoustical ceiling tile
Plumbing		N/A
HVAC		Air conditioned and heated
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets; dedicated circuit for simulator system
Lighting		Dimmable fluorescent or LED lighting fixtures (50 fc) with ceiling-mounted occupancy sensors
Communication	**Tele.**	One outlet at front
	Data	One outlet at front
	CCTV	N/A
	CATV	One outlet at front; base-specific
	Security	N/A
Acoustical		**\1** See UFC 4-179-02 for maximum noise levels. **/1/** Minimum STC rating of 50, walls and doors
Furnishings, Equipment, and Casework		Commercially purchased projection-based simulator system; desk with chair; computer; simulator instructor booth
Special Requirements		Simulator module is preferred module; module can be deleted based upon specific base installation requirements and budgeted facilities

3-5 MODULE D: MAINTENANCE.

Figure 3-17 Floor Plan and Axonometric



MODULE D – MAINTENANCE ROOM SCHEDULE	
ROOM NAME	**AREA**
WEAPONS MAINTENANCE SHOP	**See Appendix-B Programming Worksheets**

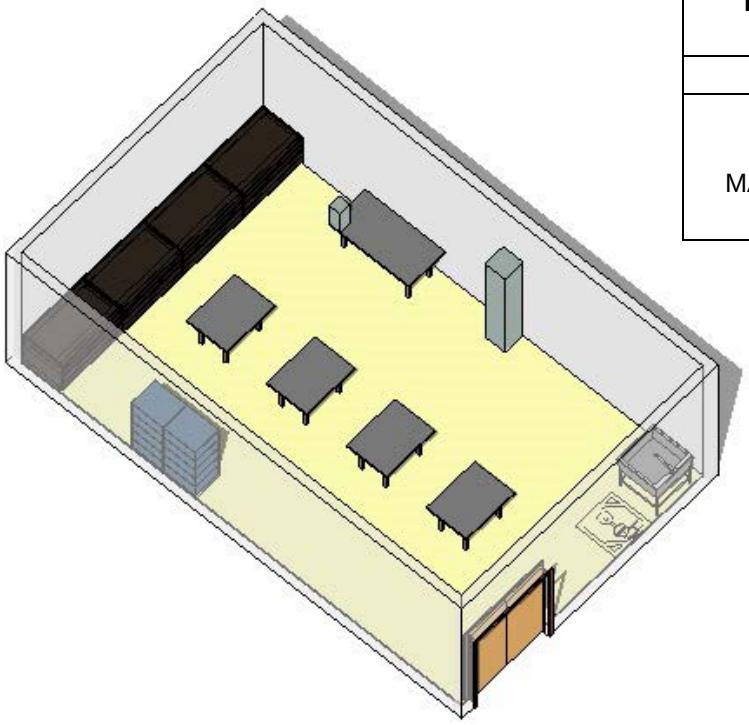
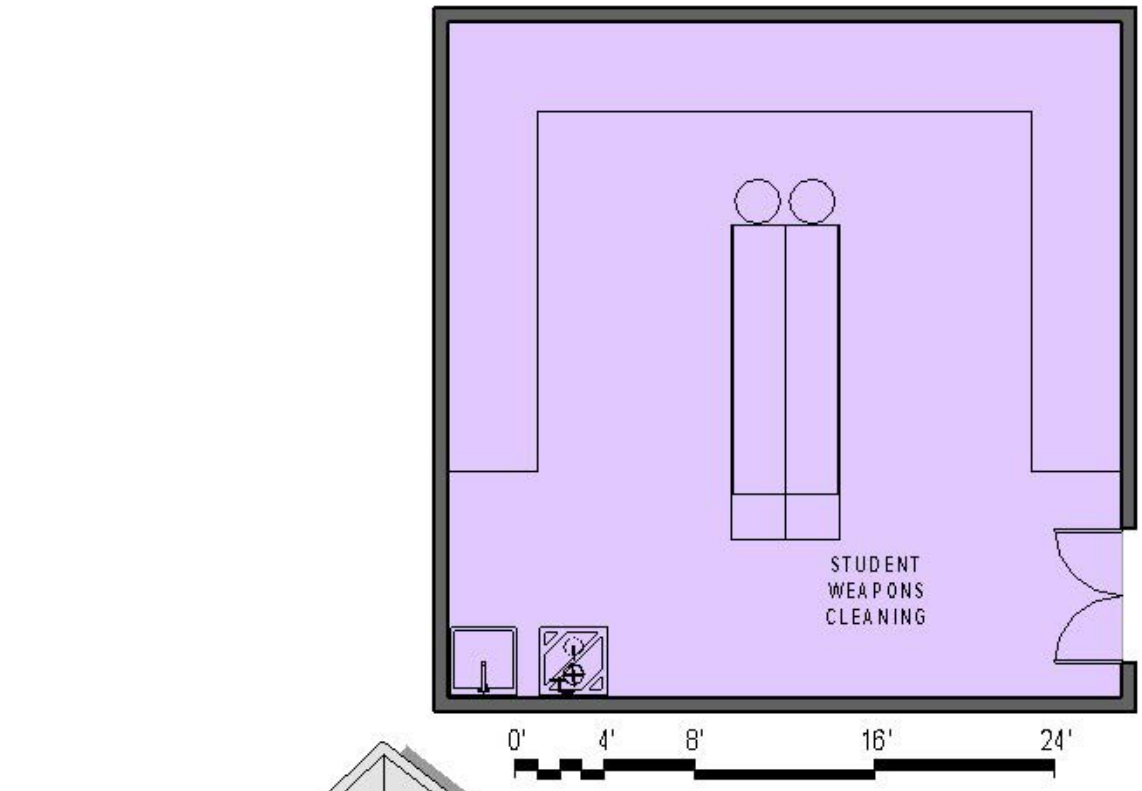


Figure 3-18 Weapons Maintenance Shop Data Sheet

Description/Usage		Space to restore/maintain weapons to serviceable condition. Primarily for instructor use.
Ceiling Height		9’-0” minimum
Windows		N/A
Doors	**Type**	Hollow metal, pair 3’-0” x 7’-0”
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plates
Finishes	**Walls**	CMU, paint
	Floor	Sealed concrete
	Base	Vinyl
	Ceiling	Open to structure
Plumbing		Connections for shop sink and emergency eyewash
HVAC		Air conditioned and heated w/exhaust ventilation for chemicals
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets around room and at work spaces; provide power to workbenches and grinding wheel stand
Lighting		Fluorescent or LED lighting fixtures (50 fc) with wall-mounted occupancy sensor; task lighting at repair stations
Communication	**Tele.**	One outlet
	Data	One outlet
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		Minimum STC rating of 50
Furnishings, Equipment, and Casework		Lockable parts storage cabinets; stainless steel workbenches; grinding wheel with stand; shop sink; table with vise; flammable storage cabinets; emergency eyewash
Special Requirements		Expandable with range; provide one workbench per instructor;

3-6 MODULE E: CLEANING.

Figure 3-19 Floor Plan and Axonometric



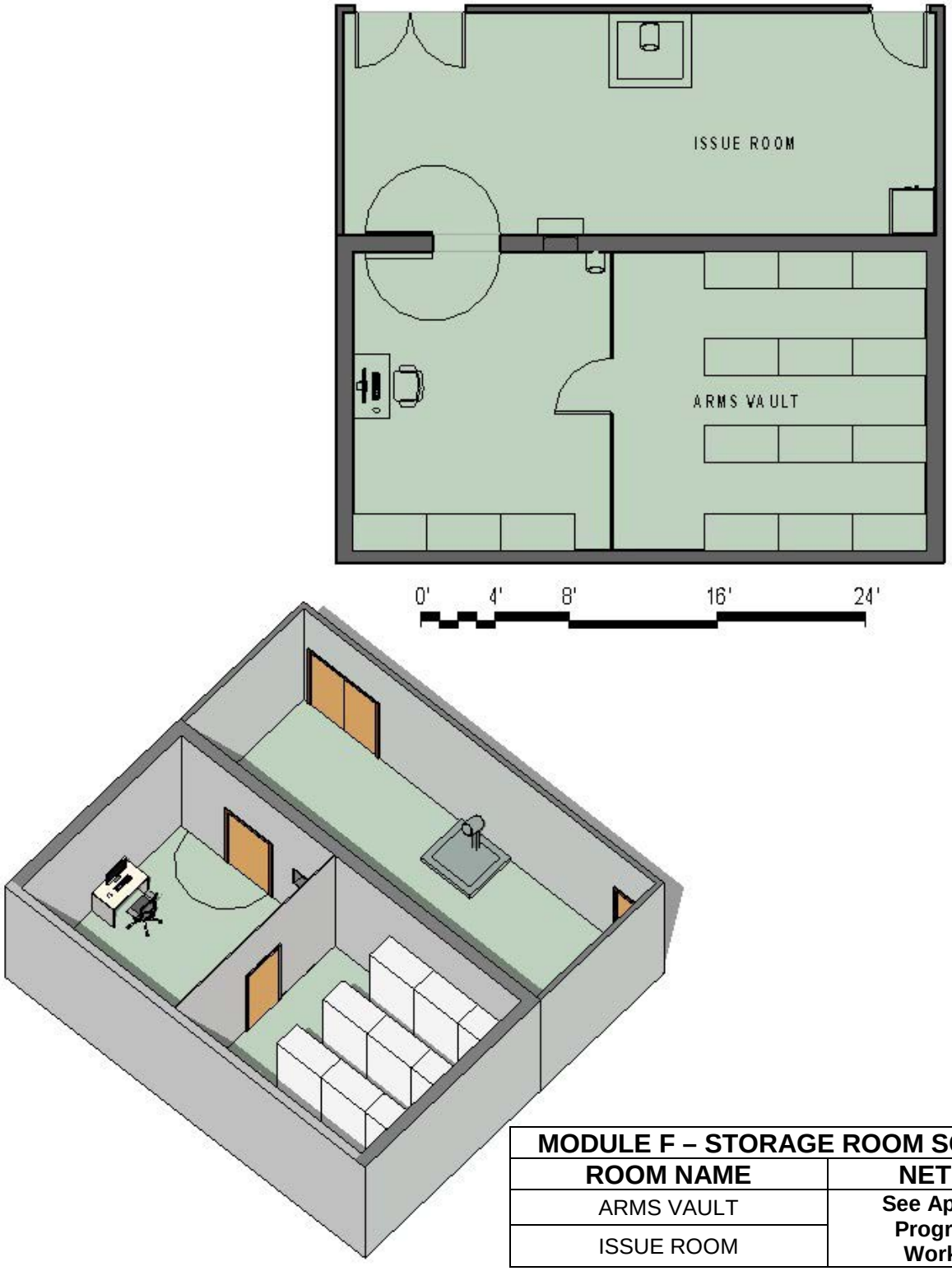
MODULE E – CLEANING ROOM SCHEDULE	
ROOM NAME	**AREA**
STUDENT WEAPONS CLEANING	**See Appendix-B Programming Worksheets**

Figure 3-20 Student Weapons Cleaning Data Sheet

Description/Usage		Space for instructor-supervised weapons cleaning procedures performed by students.
Ceiling Height		9’-0” minimum
Windows		N/A
Doors	**Type**	Hollow metal, pair 3’-0” x 7’-0”
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plates
Finishes	**Walls**	CMU/impact-resistant gypsum board, paint
	Floor	Sealed concrete
	Base	Vinyl
	Ceiling	Acoustical ceiling tile
Plumbing		Connections for shop sink and emergency eyewash
HVAC		Air conditioned and heated w/exhaust ventilation
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets at all tables
Lighting		Fluorescent or LED lighting fixtures (50 fc) with ceiling-mounted occupancy sensors; task lighting at cleaning stations
Communication	**Tele.**	One outlet
	Data	One outlet
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		Minimum STC rating of 50
Furnishings, Equipment, and Casework		Continuous stainless steel U-shaped perimeter table (standing height); lockable storage cabinets; shop sink; emergency eyewash; flammable storage cabinets; hazardous waste receptacles
Special Requirements		Expandable with range; verify egress requirements for larger facilities

3-7 MODULE F: STORAGE.

Figure 3-21 Floor Plan and Axonometric



MODULE F – STORAGE ROOM SCHEDULE	
ROOM NAME	**NET AREA**
ARMS VAULT	**See Appendix-B Programming Worksheets**
ISSUE ROOM	

Figure 3-22 Arms Vault Data Sheet

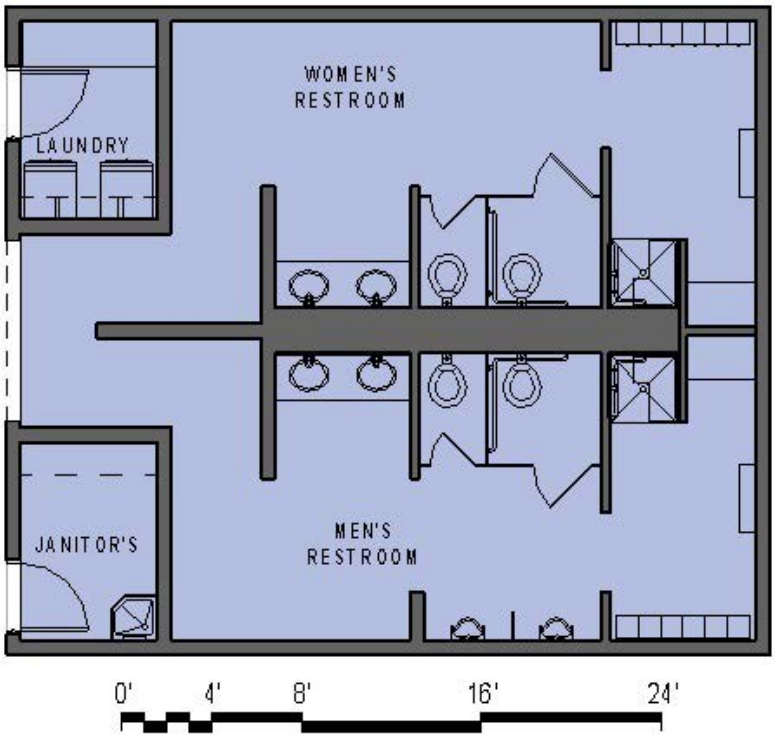
Description/Usage		Weapons and ammunition storage and distribution. Vault constructed area to provide secure storage of arms and ammunition; secure storage of ammunition separate from arms; issue window.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	GSA-approved Class V vault door
	Security/ Hardware	N/A
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Concrete/CMU, paint
	Floor	Sealed concrete
	Base	Vinyl
	Ceiling	Concrete
Plumbing		N/A
HVAC		Air conditioned and heated (maintain RH < 65%)
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V outlets at all workstations
Lighting		Fluorescent or LED (30 fc)
Communication	**Tele.**	One outlet at workstation
	Data	One outlet at workstation
	CCTV	N/A
	CATV	N/A
	Security	Access control and door switch monitoring
Acoustical		N/A
Furnishings, Equipment, and Casework		Clearing barrel; issue window; GSA-approved Class V vault door; wire mesh partition for ammunition storage; desk and chair; computer; arms rack (number determined by location requirements)
Special Requirements		Day gate optional based upon specific base installation; expandable with range

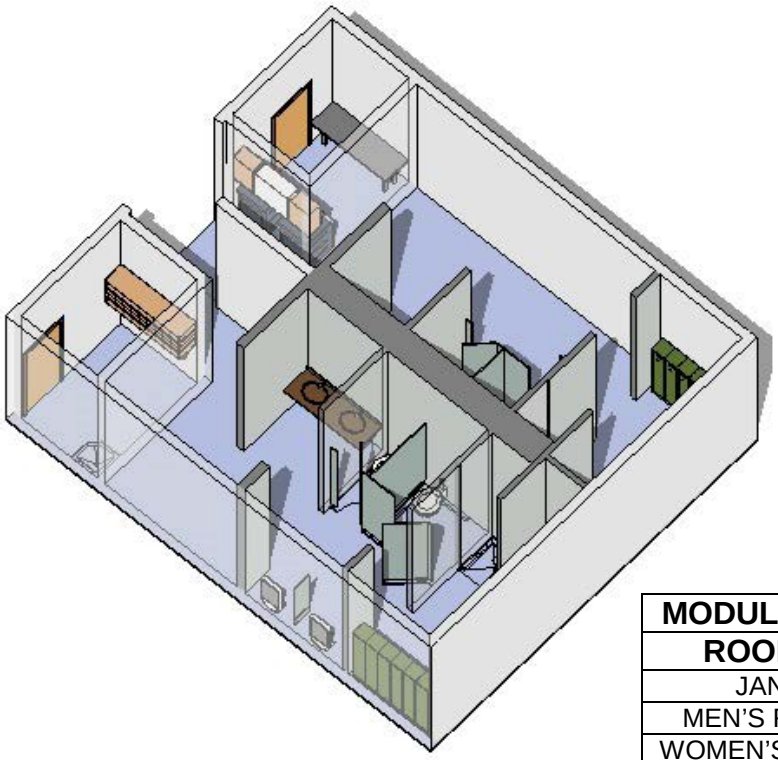
Figure 3-23 Issue Room Data Sheet

Description/Usage		Area for students to obtain and safely clear arms.
Ceiling Height		9’-0” minimum
Windows		N/A
Doors	**Type**	Hollow metal
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plates
Finishes	**Walls**	**\1** Wall behind clearing barrel must be UL-rated for maximum weapon. **/1/** CMU/impact-resistant gypsum board, paint.
	Floor	Sealed concrete
	Base	Vinyl
	Ceiling	Acoustical ceiling tile
Plumbing		N/A
HVAC		Year-round temperature control
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		One outlet near window
Lighting		Fluorescent or LED lighting fixtures (20 fc) with ceiling-mounted occupancy sensor
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	Intrusion detection system (IDS)
Acoustical		N/A
Furnishings, Equipment, and Casework		GSA-approved two-drawer safe; clearing barrel (design per AFMAN 31-229)
Special Requirements		Maintain 12’-0” clear depth of room; expandable with arms vault

3-8 MODULE G: UTILITY.

Figure 3-24 Floor Plan and Axonometric





MODULE G – UTILITY ROOM SCHEDULE	
ROOM NAME	**AREA**
JANITOR'S	**See Appendix-B Programming Worksheets**
MEN'S RESTROOM	
WOMEN'S RESTROOM	
LAUNDRY ROOM	

Figure 3-25 Janitor's Closet Data Sheet

Description/Usage		Storage for cleaning supplies.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3'-0" x 7'-0"
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plate
Finishes	**Walls**	Moisture-resistant gypsum board; cement board at wet walls, paint
	Floor	Sealed concrete
	Base	Vinyl
	Ceiling	Moisture-resistant gypsum board
Plumbing		Connection for utility sink, floor drain
HVAC		Exhausted (provide fresh make-up air)
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		None
Lighting		Fluorescent or LED lighting fixtures (5 fc) with ceiling-mounted occupancy sensors
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		N/A
Furnishings, Equipment, and Casework		Stainless-steel shelving with integrated mop holders; floor-mounted utility sink
Special Requirements		None

Figure 3-26 Restroom/Locker Room Data Sheet

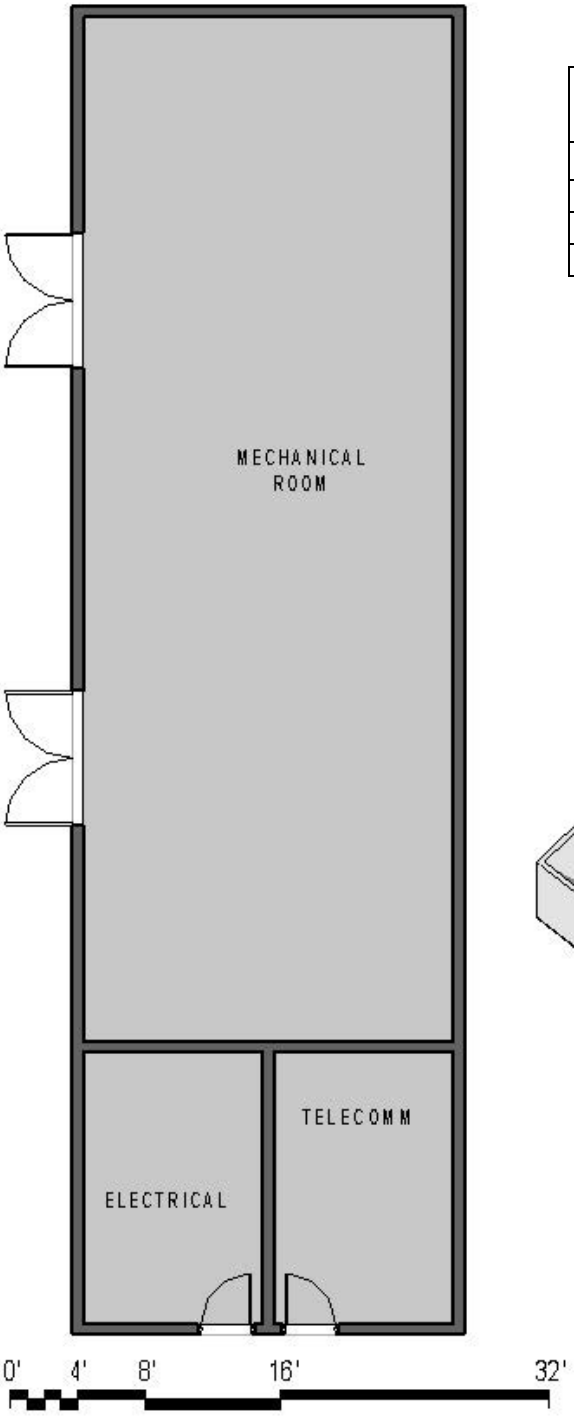
Description/Usage		Restroom facilities for students and instructors; locker/shower room facilities for instructors to remove potential lead contamination.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, if utilized
	Security/ Hardware	N/A
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Moisture-resistant gypsum board; cement board at wet walls; tile at wet areas near fixtures or tile wainscot
	Floor	Tile
	Base	Tile
	Ceiling	Moisture-resistant gypsum board
Plumbing		Connections for lavatories, water closets, urinals, showers; floor drain
HVAC		Year-round temperature control, humidity control, exhaust at showers
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		Outlet for hand dryer and hair dryer in locker area
Lighting		Fluorescent or LED lighting fixtures (10 fc) with ceiling-mounted occupancy sensors; moisture-resistant
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		N/A
Furnishings, Equipment, and Casework		Vanities with lavatories; urinals; toilet partitions with water closets; urinal partitions; toilet and shower accessories; accessible and standard benches; accessible showers; lockers; mirrors at lavatories and shower areas
Special Requirements		70/30 male to female ratio typical (verify with location requirements) plumbing fixture count per UFC 3-420-01; Provide lockers per location requirements

Figure 3-27 Laundry Room Data Sheet

Description/Usage		Laundry facilities for instructors to remove lead contamination.
Ceiling Height		9’-0” minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3’-0” x 7’-0”
	Security/ Hardware	Standard
	View Panels/ Kick-Plates	Kick-plate
Finishes	**Walls**	Moisture-resistant gypsum board, paint
	Floor	Sealed concrete
	Base	Vinyl
	Ceiling	Moisture-resistant gypsum board
Plumbing		Connection for washer
HVAC		Vent dryer and exhaust room air (provide fresh make-up air)
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		Connection for washer and dryer
Lighting		Fluorescent or LED lighting fixtures (10 fc) with ceiling-mounted occupancy sensors
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		Minimum STC rating of 50
Furnishings, Equipment, and Casework		Washer; dryer; 2’-0” x 4’-0” stainless-steel layout table
Special Requirements		None

3-9 MODULE H: BUILDING SUPPORT.

Figure 3-28 Floor Plan and Axonometric



MODULE H – BUILDING SUPPORT ROOM SCHEDULE	
ROOM NAME	**NET AREA**
ELECTRICAL	**See Appendix-B Programming Worksheets**
MECHANICAL ROOM	
TELECOMM	

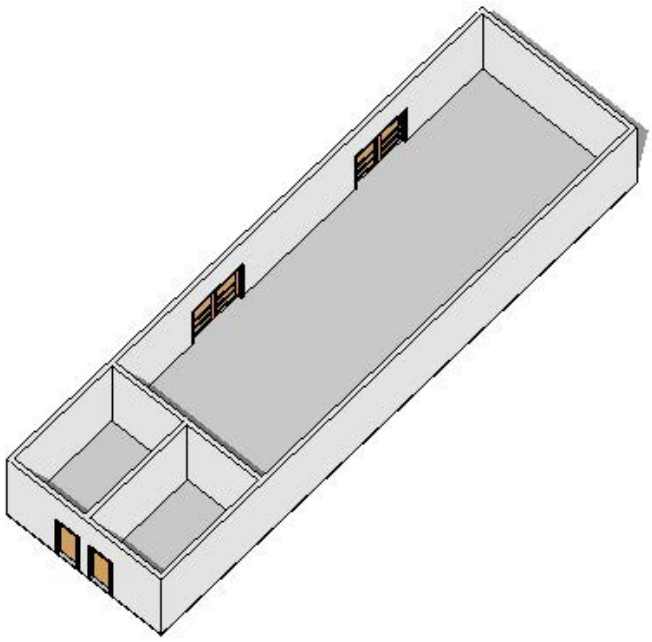


Figure 3-29 Building Support Data Sheet

Description/Usage		Space for mechanical, electrical, and telecommunications systems.
Ceiling Height		9’-0” minimum
Windows		N/A
Doors	**Type**	Hollow metal
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plate
Finishes	**Walls**	Gypsum board/CMU
	Floor	Sealed concrete
	Base	Vinyl
	Ceiling	Open to structure
Plumbing		Floor drains, water connections; compressed air
HVAC		Ventilated w/fresh air (provide conditioned air for telecom rm)
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V outlet on each wall; circuit connections to specific equipment
Lighting		Fluorescent or LED fixtures (10 fc)
Communication	**Tele.**	One outlet; service entrance to main room rack
	Data	One outlet
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		Minimum STC rating of 50 at mechanical room walls
Furnishings, Equipment, and Casework		Mechanical, electrical and telecommunication equipment
Special Requirements		Design each system per appropriate UFC document

CHAPTER 4 TECHNICAL CRITERIA

4-1 GENERAL.

1\ Comply with UFC 1-200-01, which provides the applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, AT, security, high-performance and sustainability requirements, and safety. /**1**/ Use this FC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein. **1**\ Use UFC 4-179-02 for specific indoor small arms firing range requirements. /**1**/

4-2 STRUCTURE.

4-2.1 Foundation.

The foundation design and type is site specific and must be designed based on geotechnical recommendations provided by a licensed geotechnical engineer knowledgeable of the local conditions.

4-2.2 Superstructure.

1\ The range may be constructed using modular or conventional construction methods. /**1**/ Provide clear spans for the firing range and target systems. Use pre-engineered components for superstructure framing, where feasible. The superstructure must support the bullet deflector plates/baffle system and other equipment (e.g., bullet trap). Camber the roof framing for the firing range to remain flat under super-imposed dead loads.

1\ Provide hardened ceilings and walls for the arms/ammunition storage rooms. /**1**/

A perimeter steel structure to support the roof framing and CMU or concrete walls may be used for ease of construction and local parameters. **1**\ CMU is no longer allowed for ballistic containment. /**1**/

The framing for the roof structure of the firing range may be one of the following two options:

- Roof joists spanning the full distance from the front to the back of the range with no intermediate supports. Do not span side to side because it limits expansion.

- Along the firing line (barricade) there may be steel columns (dividing the lanes) supporting steel girders spanning the width of the firing range. This line of girders could support open web bar joists spanning from the girder to the front wall (about 25 feet [7.6 meters]) on one side and to the back wall (about 115 feet [35 meters]) on the other side.

4-3 EXTERIOR DESIGN.

In general, the building's image, theme, and fixtures must be consistent with the programs offered and the architecture established on base. Reflect the local geographical and cultural environment in the design and comply with AFCFS and installation architectural standards. Provide a visually attractive, safe, and welcoming appearance. Consider grouping high bay spaces together. Do not allow the building massing to dominate or overwhelm surrounding structures.

4-3.1 Entrances/Exits.

Entries into the firing range must be limited and secured for safety. Entries to the range are not to be provided downrange of the firing line. Provide warning lights to signal that live rounds are being fired within the range.

4-3.2 Doors and Windows.

Limit windows to the queuing room, classroom, administrative areas, break room, and corridor. Use aluminum or hollow metal frames and doors. Mitigate glare and direct sunlight in activity spaces.

4-4 INTERIOR DESIGN.

4-4.1 Interior Construction.

Personnel will be handling weapons that bump against walls and trim. Provide durable, low-maintenance construction materials and do not use hollow-core wood doors. All interior glass must be tempered safety glass and mirrors must be made of break-resistant materials.

Provide counters, casework, and cabinets of high-quality and durable construction. Provide countertops of solid surface/solid composite plastics only or stainless steel.

4-4.2 Finishes.

Provide finishes that are compatible with the intended uses and are highly durable and low maintenance. They must meet the requirements listed in NFPA 101. **1*\ Also coordinate the interior design with the Air Force Interior Design Standards, major command and installation design standards, and UFGS 09 68 00. /**1**/ Personnel with weapons and ammunition often bump and scrape walls, so provide heavy-duty, durable finishes.

Provide acoustical treatment to minimize sound reverberations and intensity within the indoor small arms firing range.

4-4.3 Window Treatments.

Include window treatments (shading systems) as an integral part of the construction contract in administrative areas. Dual fabric solar roller shade systems with manual roll chain operation are recommended. Analyze solar conditions when selecting a window treatment. Window treatments must provide full coverage to reduce light leakage. Any window treatment must be flame-resistant and commercial quality.

4-5 SERVICES.

4-5.1 Plumbing.

Design domestic hot and cold water, sanitary and storm drainage, compressed air, propane, fuel oil, or natural gas systems to meet the requirements of UFC 3-420-01 and local installation standards.

The weapons maintenance and student weapons cleaning rooms shall each require emergency eyewash. Compressed air shall be provided in the student weapons cleaning room.

4-5.2 Heating, Ventilating, and Air Conditioning (HVAC).

1*\ Design the HVAC system to meet the requirements of UFC 3-410-01 and UFC 4-179-02. /1**/

The air supply system for the firing range must ensure a safe environment for participants by delivering air at the firing line and exhausting air at the target end. **1*\ Air must travel in a laminar fashion at 71 to 79 fpm across the firing line to prevent powder residue from settling. Provide uniform, unidirectional laminar airflow across the firing line by installing a perforated air distribution radial plenum along the rear wall. See UFC 4-179-02 for heating and cooling criteria. Exhaust air must be provided at the end of the indoor small arms firing range at the bullet trap and must maintain 0.05 inch of water negative pressure on the range. /**1**/ Exhaust fan controls must be interlocked with the supply fan to ensure simultaneous operation. Re-circulation of range air is not permitted and exhaust air discharge from the range and bullet trap shall meet local, state, and federal requirements. The range control booth shall maintain positive pressure relative to the indoor small arms firing range.

The HVAC system for the weapons cleaning area, ammunition storage area, and weapons maintenance area must be designed for safe operations with chemicals and munitions. Provide exhaust ventilation for the weapons maintenance shop, range supplies, student weapons cleaning room, laundry, janitor closet, and restrooms. Exhaust makeup air may be transferred from adjacent spaces (not from firing range), provided adequate ventilation is supplied to prevent negative air pressure in relation to the outside. Provide occupancy sensors to control all exhaust fans. Weapons and ammunition storage areas must maintain relative humidity below 65 percent.

4-5.3 Fire Protection and Life Safety.

Refer to UFC 1-200-01 to determine the applicable design codes and standards for all building and life safety features for the facility. UFC 1-200-01 references UFC 3-600-01 and will be utilized to determine the passive fire protection features of the facility, such as building height and area, construction type, egress limitations, etc., as well as the active fire protection features of the facility, including fire detection, fire alarm, fire suppression, etc.

1\ UFC 4-179-02 provides specific DoD design and construction criteria for small arms ranges and shall take precedence over all other design standards where conflicts exist for fire protection requirements. /**1**/

4-5.4 Electrical.

1\ Provide electric service and distribution equipment, wiring receptacles and grounding, interior and exterior lighting and control, emergency lighting, telephone, communication systems, fire alarm, other health and safety alarms, and intrusion systems in accordance with NFPA 70, UFC 3-520-01, UFC 4-179-02, and installation design requirements. /**1**/

See the latest edition of *Electric Current Abroad* to determine voltages and cycles in overseas locations. Service grounding system and all wiring methods must meet current NFPA 70 requirements. All service equipment must be Underwriters Laboratories (UL) listed. Alternately, published proof from an approved independent testing laboratory may be provided.

4-5.4.1 Lighting.

1\ Provide lighting and control systems throughout the facility in accordance with UFC 3-530-01 and UFC 4-179-02. /**1**/ Pay particular attention to issues such as glare, heat generation, and impact protection for the fixtures in the indoor small arms firing range. Provide a control system to highlight target lines at the 3, 7, 10, 15, and 25 meter lines and to simulate night or daylight.

Provide a flashing light system to simulate a police car light bar. Provide “range in use” warning lights.

4-5.4.2 Communications and Data.

Telephone and data outlets may be independent of each other or combined into a single junction box. Also consider wireless audio, video, and data installations to add flexibility. If the hard-wired connections can be combined into a single junction box then the cover plate to that junction box must allow for multiple connections. In some unique situations, the CATV/internal video connection can also be combined into a single junction box with the appropriate cover plate.

Identify the technical design requirements for the CCTV system with the base user and AFSFC.

4-5.4.3 Alarm Systems.

Provisions for alarm systems must be identified during the planning/programming process. Provide an alarm system to warn personnel that live fire is in progress and/or if any downrange doors are open. Provide an intrusion detection alarm system to protect vault arms and ammunition.

4-6 SITE DESIGN AND ORGANIZATION.

4-6.1 Parking and Access Drives.

Provide parking for both staff and patrons with the appropriate access drives. Consider bicycle racks near the facility entrance in a secure location. **1**\ For landscaping and site pavements refer to UFC 4-010-01, paragraph 3-3, for the unobstructed space requirement around the facility. /**1**/

4-6.2 Service Drive.

The size of required service vehicles should be verified by the designer prior to planning the service access areas. Provide a back-up spur for dead-end and service drives that exceed 100 feet (30 meters) in length for receiving area, garbage dumpster/storage (indoor or outdoor), mechanical room, and service entry, if one is designated. Provide a service vehicle apron and consolidate service access when possible.

4-6.3 General Site Lighting.

1\ Provide exterior “range in use” flashing red indicator lighting as required by UFC 4-179-02. /**1**/

4-7 BARRIER-FREE DESIGN REQUIREMENTS.

Refer to UFC 1-200-01 for barrier-free design requirements.

Indoor small arms firing range activities will be for able-bodied personnel only. Visitors with physical disabilities will be allowed as observers but not participants.

4-8 ANTITERRORISM.

Refer to UFC 4-020-01 for AT requirements. The firing range portion of the building may be classified as low occupancy due to the personnel density of more than 430 SF/PN, which would exempt the firing range from all UFC 4-010-01 provisions.

4-9 SUSTAINABLE DESIGN.

Comply with the requirements of UFC 1-200-02, *High Performance and Sustainable Building Requirements* and achieve green building certification in accordance with the current AF Sustainable Design and Development memo.

APPENDIX A REFERENCES

Use the latest available issuance of the reference

AIR FORCE

AFI 31-101, *Integrated Defense*, http://www.e-publishing.af.mil/

AFMAN 31-229, *USAF Weapons Handling Manual*, http://www.e-publishing.af.mil/index.asp

AFMAN 32-1084, *Facility Requirements*, http://www.e-publishing.af.mil/

Air Force Corporate Facility Standards (AFCFS), http://afcfs.wbdg.org/index.html

US Air Force Interior Design Standards, http://wbdg.org/ccb/AF/AFDG/interiordesign.pdf

ARCHITECTURAL BARRIERS ACT

ABA Accessibility Standard for Department of Defense Facilities, http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/aba-standards

DEPARTMENT OF COMMERCE

Electric Current Abroad, http://trade.gov/publications/abstracts/electric-current-abroad-2002.asp

DEPARTMENT OF DEFENSE

UFC 1-200-01, *General Building Requirements*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 1-200-02, *High Performance and Sustainability Building Requirements*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-420-01, *Plumbing Systems*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-520-01, *Interior Electrical Systems*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-600-01, *Fire Protection Engineering for Facilities*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

1\ UFC 4-179-02, *Small Arms Ranges*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4 /**1**/

1\ UFGS 09 68 00, *Carpeting*, https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs /**1**/

NATIONAL FIRE PROTECTION ASSOCIATION

NFPA 101, *Life Safety Code*, http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=101

APPENDIX B BEST PRACTICES

\1\

B-1 U.S. AIR FORCE RANGE SIZE REQUIREMENTS CALCULATOR.

The Range Size Requirements Calculator is used to determine the number of lanes required based on the historic training load and as adjusted for future growth or draw-down expectations. The spreadsheet can be found on the Whole Building Design Guide website: http://www.wbdg.org/references/pa_dod_sps.php

Figure B-1 Range Size Requirements Calculator

STEP 1--Annual Training Requirement						
Historical AF Training requirement		Rifle Qual	Pistol Qual	Shotgun Qual	Other Qual (i.e. MP5	Yr Total
	Current FY -1	1233	455	28	14	1730
	Current FY -2	1337	335	32	32	1736
	Current FY -3	1298	438	14	28	1778
	3 Yr Average					1748
Mission Changes: list, and add/subtract the number of personnel projected to require annual training (+ or -)						0
Total Design Training Requirement (DTR)						**1748**

STEP 2--Total Training Days Requirement		
Available Training Days	365	Days
Weekends (104), Holidays (10)	-114	Days
SF Core Trng	-27	Days
CA Core Trng	-12	Days
MAJCOM, Wing Down days	-4	Days
Non-Main Range Weapons Trng (i.e. M203, M249, M240, MK19, etc.)	-9	Days
Range Maintenance (1 day dedicated per month, does not include range rehab/project)	-12	Days
Weapons Maintenance (1 day dedicated per month)	-12	Days
Annual Weapons Inspections	-10	Days
List additional requirement/ # of days (do not include pro-fire or sustainment) (AFSFC must validat	0	Days
Total Training Days Available (TDA)	**165**	Days

STEP 3--Lane Requirement		
Range Lane Requirement DTR/TDA	10.59	Lanes
Greatest multiple of 7 lanes to satisfy the range lane requirement	**14**	Lanes

STEP 4--Manpower Consideration	
Manpower Authorization--as reflected on the UMD	
Officer-in-charge (if applicable)	0
Non-commisioned Officer-in-Charge (SEI 312 or 3P051B)	1
CA Instructors (3P051B or 3P031B)	3
Total Manpower Authorized	**4**

STEP 5--AFCEC and AFSFC Consideration (i.e. number of ranges, range type, and mission set)

B-2 U.S. AIR FORCE INDOOR RANGE INTERACTIVE PROGRAMMING SPREADSHEET.

The Interactive Programming Spreadsheet assists programmers to determine the size of the direct and indirect support component of the range based on the training load requirement, as described in paragraph B-1. The Interactive Programming Worksheet can be found on the Whole Building Design Guide website: http://www.wbdg.org/references/pa_dod_sps.php

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Figure B-2 Indoor Small Arms Range Facility (14 Lane – Standard)

Indoor Small Arms Range Facility (14 Lane - Standard)

MODULE NO.	AREA	NO. OCCUP	SF PER USER	NO. OF ROOMS REQD	INDIVIDUAL ROOM RQRMNTS SF	NET USER REQUIREMENTS SF	NET USER REQUIREMENTS SM	COMMENTS
A	Administration							
A.1	Queuing	14	20	1	340	340	31.59	1
A.2	Break	17	20	1	340	340	31.59	2
A.3	NCOIC Office	1	140	1	140	140	13.01	3
A.4	Open Office	3	80	1	260	260	24.15	4
A.5	Admin / Instructor Storage	0	0	1	100	100	9.29	
	SUBTOTAL ADMINISTRATION AREA					1180	109.82	
B	Arms Range							
B.1	Arms Range	17		1	10,930	10,930	1,015.40	
B.2	Range Supplies	0		1	700	700	65.03	
	SUBTOTAL ARMS RANGE AREA					11630	1,080.43	
C	Training							
C.1	Classroom	17		1	900	900	83.61	5
C.2	Weapons Simulator	7		1	5 point sim	1125	104.51	5
C.3	Observation Room	0		0	130	0	0.00	6
C.4	Storage	0		2	50	100	9.29	
	SUBTOTAL TRAINING AREA					2125	197.41	
D	Maintenance							
D.1	Weapons Maintenance Shop	2		1	550	550	51.10	7
	SUBTOTAL MAINTENANCE AREA					550	51.10	
E	Cleaning							
E.1	Student Weapons Cleaning	17		1	700	700	65.03	8
	SUBTOTAL CLEANING AREA					700	65.03	
F	Storage							
F.1	Arms Vault	1		1	400	400	37.16	9
F.2	Issue Room	17		1	300	300	27.87	10
	SUBTOTAL STORAGE AREA					700	65.03	
G	Utility							
F.1	Restrooms / Locker Rooms	0		1	530	530	49.24	
F.2	Janitor's Closet	0		1	45	45	4.18	
F.3	Laundry Room	0		1	65	65	6.04	
	SUBTOTAL UTILITY AREA					640	59.46	
H	Building Support							
F.1	Mechanical	0		1	1800	1800	167.22	11
F.2	Electrical	0		1	150	150	13.94	11
F.3	Telecommunications	0		1	150	150	13.94	
	SUBTOTAL BUILDING SUPPORT AREA					2100	195.09	
	Exterior Elements							
	Mechanical Yard	0		0.5	1100	550	51.10	14
	Exterior Canopy	0		0.5	120	60	5.57	14
	SUBTOTAL STORAGE AREA					610	56.67	
	TOTAL FACILITY NET FLOOR AREA					20,236.00	1,879.83	12,13
	NET TO GROSS	14%						
	TOTAL FACILITY GROSS AREA					23,068	2,143	

COMMENTS:

1. Queuing area based upon 20 sq ft per occupant with additional 60 sq ft for Vestibule; Refer AFI 32-1084 Table 6.3 - Waiting and Vestibule
2. Break area based upon 20 sq ft per occupant; Arms Range to conduct simultaneous training
3. NCOIC Office area based upon Private office with up to two visitors; Refer AFI 32-1084 Table 6.2
4. Open Office area based upon 80 sq ft per occupant with additional 20 sq ft for administrative support; Refer AFI 32-1084 6.1.2.1, 6.1.2.3, and Table 6
5. Classroom / Weapons Simulator areas based upon specific requirements per AFSF. 5 point MEGGITT FATS 100 MIL
6. Observation Room area based upon 64 sq ft per occupant, Refer AFI 32-1084 Table 6.2.1 - No longer required
7. Weapons Maintenance Shop area based upon specific requirements per AFSF
8. Student Weapons Cleaning area based upon specific requirements per AFSF
9. Arms Range area based upon requirements set forth in UFC 4-215-01
10. Issue Room area based upon 12'-0" minimum depth for proper distribution and clearing of arms
11. Building Support areas may differ per climatic and systematic requirements
12. This facility has a low net to gross factor due to the square footage of the indoor small arms range
13. Net to Gross Area includes circulation, walls, and corridors
14. Arms Range Mechanical Yard and Exterior Canopy are covered exterior spaces and are calculated at 1/2 square footage

Figure B-3 Indoor Small Arms Range Facility (21 Lane – Standard)

Indoor Small Arms Range Facility (21 Lane - Standard)

MODULE NO.	AREA	NO. OCCUP	SF PER USER	NO. OF ROOMS REQD	INDIVIDUAL ROOM RQRMNTS	NET USER REQUIREMENTS		COMMENTS
					SF	SF	SM	
A	Administration							
A.1	Queuing	24	20	1	540	540	50.17	1
A.2	Break	24	20	1	480	480	44.59	2
A.3	NCOIC Office	1	140	1	140	140	13.01	3
A.4	Open Office	4	80	1	340	340	31.59	4
A.5	Admin / Instructor Storage	0	0	1	100	100	9.29	
	SUBTOTAL ADMINISTRATION AREA					1600	148.64	
B	Arms Range							
B.1	Arms Range	25		1	15,800	15,800	1,467.82	
B.2	Range Supplies	0		1	700	700	65.03	
	SUBTOTAL ARMS RANGE AREA					16500	1,532.86	
C	Training							
C.1	Classroom	25		1	1200	1200	111.48	5
C.2	Weapons Simulator	12		1	10 point sim	2025	188.12	5
C.3	Observation Room	0		0	130	0	0.00	6
C.4	Storage	0		2	50	100	9.29	
	SUBTOTAL TRAINING AREA					3325	308.89	
D	Maintenance							
D.1	Weapons Maintenance Shop	4		1	700	700	65.03	7
	SUBTOTAL MAINTENANCE AREA					700	65.03	
E	Cleaning							
E.1	Student Weapons Cleaning	24		1	900	900	83.61	8
	SUBTOTAL CLEANING AREA					900	83.61	
F	Storage							
F.1	Arms Vault	1		1	576	576	53.51	9
F.2	Issue Room	22		1	400	400	37.16	10
	SUBTOTAL STORAGE AREA					976	90.67	
G	Utility							
F.1	Restrooms / Locker Rooms	0		1	680	680	63.17	
F.2	Janitor's Closet	0		1	45	45	4.18	
F.3	Laundry Room	0		1	65	65	6.04	
	SUBTOTAL UTILITY AREA					790	73.39	
H	Building Support							
F.1	Mechanical	0		1	1800	1800	167.22	11
F.2	Electrical	0		1	150	150	13.94	11
F.3	Telecommunications	0		1	150	150	13.94	
	SUBTOTAL BUILDING SUPPORT AREA					2100	195.09	
	Exterior Elements							
	Mechanical Yard	0		0.5	1575	787.5	73.16	14
	Exterior Canopy	0		0.5	120	60	5.57	14
	SUBTOTAL STORAGE AREA					847.5	78.73	
	TOTAL FACILITY NET FLOOR AREA					27,738.50	2,578.91	12,13
	NET TO GROSS	13%						
	TOTAL FACILITY GROSS AREA					31,345	2,912	

COMMENTS:

1. Queuing area based upon 20 sq ft per occupant with additional 60 sq ft for Vestibule; Refer AFI 32-1084 Table 6.3 - Waiting and Vestibule
2. Break area based upon 20 sq ft per occupant; Arms Range to conduct simultaneous training
3. NCOIC Office area based upon Private office with up to two visitors; Refer AFI 32-1084 Table 6.2
4. Open Office area based upon 80 sq ft per occupant with additional 20 sq ft for administrative support; Refer AFI 32-1084 6.1.2.1, 6.1.2.3, and Table 6
5. Classroom / Weapons Simulator areas based upon specific requirements per AFSF. 10 point MEGGITT FATS 100 MIL
6. Observation Room area based upon 64 sq ft per occupant, Refer AFI 32-1084 Table 6.2.1 - No longer required
7. Weapons Maintenance Shop area based upon specific requirements per AFSF
8. Student Weapons Cleaning area based upon specific requirements per AFSF
9. Arms Range area based upon requirements set forth in UFC 4-215-01
10. Issue Room area based upon 12'-0" minimum depth for proper distribution and clearing of arms
11. Building Support areas may differ per climatic and systematic requirements
12. This facility has a low net to gross factor due to the square footage of the indoor small arms range
13. Net to Gross Area includes circulation, walls, and corridors
14. Arms Range Mechanical Yard and Exterior Canopy are covered exterior spaces and are calculated at 1/2 square footage

Figure B-4 Indoor Small Arms Range Facility (56 Lane)

Indoor Small Arms Range Facility (56 Lane - Standard)

MODULE NO.	AREA	NO. OCCUP	SF PER USER	NO. OF ROOMS REQD	INDIVIDUAL ROOM RQRMNTS	NET USER REQUIREMENTS		COMMENTS
					SF	SF	SM	
A	Administration							
A.1	Queuing	56	20	1	1180	1180	109.62	1
A.2	Break	56	20	1	1120	1120	104.05	2
A.3	NCOIC Office	1	140	1	140	140	13.01	3
A.4	Open Office	16	80	1	1300	1300	120.77	4
A.5	Admin / Instructor Storage	0	0	1	400	400	37.16	
	SUBTOTAL ADMINISTRATION AREA					4140	384.61	
B	Arms Range							
B.1	Arms Range	64		1	39,700	39,700	3,688.13	
B.2	Range Supplies	0		1	1,600	1,600	148.64	
	SUBTOTAL ARMS RANGE AREA					41300	3,836.77	
C	Training							
C.1	Classroom	63		1	2700	2700	250.83	5
C.2	Weapons Simulator	24		1	20 point sim	4050	376.25	5
C.3	Observation Room	0		0	200	0	0.00	6
C.4	Storage	0		4	200	800	74.32	
	SUBTOTAL TRAINING AREA					7550	701.40	
D	Maintenance							
D.1	Weapons Maintenance Shop	8		1	1200	1200	111.48	7
	SUBTOTAL MAINTENANCE AREA					1200	111.48	
E	Cleaning							
E.1	Student Weapons Cleaning	63		1	2500	2500	232.25	8
	SUBTOTAL CLEANING AREA					2500	232.25	
F	Storage							
F.1	Arms Vault	1		1	900	900	83.61	9
F.2	Issue Room	22		1	700	700	65.03	10
	SUBTOTAL STORAGE AREA					1600	148.64	
G	Utility							
F.1	Restrooms / Locker Rooms	0		1	680	680	63.17	
F.2	Janitor's Closet	0		1	45	45	4.18	
F.3	Laundry Room	0		1	65	65	6.04	
	SUBTOTAL UTILITY AREA					790	73.39	
H	Building Support							
F.1	Mechanical	0		1	4600	4600	427.34	11
F.2	Electrical	0		1	300	300	27.87	11
F.3	Telecommunications	0		1	300	300	27.87	
	SUBTOTAL BUILDING SUPPORT AREA					5200	483.08	
	Exterior Elements							
	Mechanical Yard	0		0.5	4705	2352.5	218.55	14
	Exterior Canopy	0		0.5	210	105	9.75	14
	SUBTOTAL STORAGE AREA					2457.5	228.30	
	TOTAL FACILITY NET FLOOR AREA					66,737.50	6,199.91	
	NET TO GROSS	13%						12,13
	TOTAL FACILITY GROSS AREA					76,413	7,098	

COMMENTS:

1. Queuing area based upon 20 sq ft per occupant with additional 60 sq ft for Vestibule; Refer AFI 32-1084 Table 6.3 - Waiting and Vestibule
2. Break area based upon 20 sq ft per occupant; Arms Range to conduct simultaneous training
3. NCOIC Office area based upon Private office with up to two visitors; Refer AFI 32-1084 Table 6.2
4. Open Office area based upon 80 sq ft per occupant with additonal 20 sq ft for administrative support; Refer AFI 32-1084 6.1.2.1, 6.1.2.3, and Table 6
5. Classroom / Weapons Simulator areas based upon specific requirements per AFSF HQ. 20 point MEGGITT simulator
6. Observation Room area based upon 64 sq ft per occupant, Refer AFI 32-1084 Table 6.2.1 - No longer required
7. Weapons Maintenance Shop area based upon specific requirements per AFSF HQ
8. Student Weapons Cleaning area based upon specific requirements per AFSF HQ
9. Arms Range area based upon requirements set forth in UFC 4-215-01
10. Issue Room area based upon 12'-0" minimum depth for proper distribution and clearing of arms
11. Building Support areas may differ per climatic and systematic requirements
12. This facility has a low net to gross factor due to the square footage of the indoor small arms range
13. Net to Gross Area includes circulation, walls, and corridors
14. Arms Range Mechanical Yard and Exterior Canopy are covered exterior spaces and are calculated at 1/2 square footage

/2/

B-3 PDF FLOOR PLANS AND BIM DRAWING LINK.

The .pdf and BIM drawings can be found on the Whole Building Design Guide at https://www.wbdg.org/ffc/af-afcec/prototypes-standard-designs /**1**/

APPENDIX C GLOSSARY

°F	degrees Fahrenheit
ABA	Architectural Barriers Act
ADP	Area Development Plan
A-E	architect-engineer
AFCFS	Air Force Corporate Facilities Standards
AFH	Air Force Handbook
AFI	Air Force Instruction
AFMAN	Air Force Manual
AFSFC	Air Force Security Force Center
ASTM	American Society of Testing and Materials
AT	antiterrorism
BIM	Building Information Modeling
CATV	cable television
CCTV	closed-circuit television
CMU	concrete masonry unit
DOD	Department of Defense
fpm	feet per minute
GSA	General Services Administration
HVAC	heating, ventilating, air conditioning
IDP	Installation Development Plan
LED	light-emitting diode
NCOIC	non-commissioned officer in charge
NFPA	National Fire Protection Association

PDF	Portable Document Format
SF	square feet
STC	Sound Transmission Class
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specification
V	volt

UFC 4-211-01
13 April 2017
Change 3, April 20, 2021

UNIFIED FACILITIES CRITERIA (UFC)

AIRCRAFT MAINTENANCE HANGARS



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UNIFIED FACILITIES CRITERIA (UFC)

AIRCRAFT MAINTENANCE HANGARS

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by \1\ ... /1/)

Change No.	Date	Location
1	November 2017	See UFC Summary Sheet
2	May 11, 2020	See UFC Summary Sheet
3	April 20, 2021	See UFC Summary Sheet

This UFC supersedes UFC 4-211-01N dated 25 October 2004 with Change 3, dated 16 December 2009.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

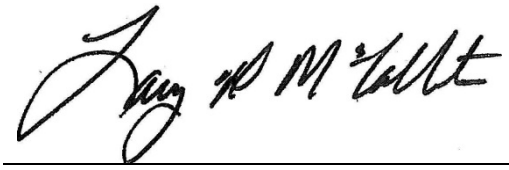
UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Refer to UFC 1-200-01, *DoD Building Code (General Building Requirements)*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Document: UFC 4-211-01, *Aircraft Maintenance Hangars*

Superseding: UFC 4-211-01N, *Aircraft Maintenance Hangars*: Type I, Type II and Type III dated 25 October 2004 with Change 3 dated 16 December 2009, NAVFAC Interim Technical Guidance (ITG 2010-01) - *Maintenance Hangar Design and Planning Guidance for F35B or C*, and Engineering Technical Letter (ETL) 02-15: *Fire Protection Engineering Criteria New Aircraft Facilities*, 3 December 2002.

Description: This UFC provides criteria for planning and design of Aircraft Maintenance Hangars for the aircraft of the combined DoD United States Armed Forces.

Reasons for Document: This is a new Joint Service document. This new document represents another step in the Joint Services effort to bring uniformity to the planning, design and construction of military facilities. The UFC was developed to provide design requirements to accomplish the following:

- Assist planners in understanding the facility requirements to ensure accurate space programs budgets.
- Provide architects, engineers, and construction surveillance personnel with essential, minimum (min) requirements for the design and construction of Aircraft Maintenance Hangars.
- Clarify the operational intent of the facility design.

Impact: The following will result from the publication of this UFC:

- This UFC creates a single source for common DoD Aircraft Maintenance Hangar criteria and an accurate reference to individual Service-specific documents.
- This UFC facilitates updates and revisions and promotes agreement and uniformity of design and construction between the Services.

Unification Issues: Non-unified content is mainly a result of operational differences among the Services and is addressed in the Service-specific chapters including:

- The Navy included Functional Data Sheets (FDS) in this UFC. The Army keeps their Room Data Sheets with the Army Standard and the Air Force keeps these specific requirements with their Dynamic Prototypes.
- The Army and Navy perform fuel cell operations in the Aircraft Maintenance Bay per operational guidelines. The Air Force has specific construction criteria for the design of fuel cell maintenance hangars.

- Service differences in various subjects are noted in this UFC:
  - Aircraft Clearance Tables
  - Design of the Aircraft Maintenance Bay slab on ground
  - Ordnance grounding
  - Fire suppression and detection
  - High intensity overhead radiant heaters in the Aircraft Maintenance Bay
  - Aircraft power distribution servicing aircraft
  - Aircraft Maintenance Bay floor finish options

\1\ Reasons for Document Change 1:

Revised paragraphs 3-4.2 Ground Floors, 3-4.2.3.1Aircraft Maintenance Bay - Slab on Ground Design, and 7-4.1Aircraft Maintenance Bay - Slab on Ground Loading.

Previously, the UFC did not allow for slab on ground variable thickness in the hangar bay for areas not subject to aircraft loading. Generally, the reasoning was that the hangar bay may experience different aircraft during its lifespan due to change in mission or during special circumstances such as airshows or storms where aircraft may be "dense packed" into every available slab space or just to maintain future flexibility of use. However, it was recognized that this could result in substantial savings in a very large hangar bay. The governing rationale to revise was to continue to prohibit variable thickness in multiple aircraft hangar bays since these hangars generally house smaller aircraft and are less likely to maintain dedicated aircraft parking locations in perpetuity, but to allow slab thickness variation for single aircraft hangar bays where a very large aircraft dedicated to one single parking spot was envisioned. In any case, the designer should validate the requirements with the user. For standard hangars, such as Navy Type I, II, III, and IV, this is prohibited since the intention for these is to maintain hangar bay flexibility in accommodating multiple aircraft platforms or repurposing the hangar.

Revised paragraph 5-6.7.4 Existing Water Only Delue Systems.

Paragraph revised due to error in intent.

Deleted old bullet under paragraph 3-5.8.2.1 Preconditioned Air Systems relating to portable units being used for backup since later paragraph describes two units tied together with manifold for redundancy. /1/

\2\ Reasons for Document Change 2:

Revised paragraphs:

- General
  - Incorporated Navy FY 19-01 ITG and other F-35 cooling air system lessons learned in 3-5.8 Process Systems and 4-2.2 Mechanical Systems.
  - Upgraded compressed air hangar bay and shop requirements to reflect new equipment needs of cabin pressure testing and fuel cell evacuators.
  - Removed AFFF specific fire protection requirements
  - Other general fire protection system changes
  - Additional references added for battery maintenance shops
- Chapter 1
  - 1-4 Scope of Facility revised to clarify applicability to all aircraft hangars.
- Chapter 2
  - 2-1.6 Solar Glare Hazard Analysis revised.
  - Paragraph 2-2.1.3 Heavy Maintenance Shops revised.
- Chapter 3
  - Figures 3-1, 3-1-1, 3-1-2, 3-1-3 revised.
  - Revised typographical errors in column labels.
  - 3-3.4.1.1 Aircraft Maintenance Bay and 3-3.4.1.3 Heavy Maintenance Shops revised to generalize light-colored floor coatings
  - Paragraph 3-5.3.1.7 Specialized or Localized Exhaust revised.
  - 3-5.8.1Compressed Air, Table 7-4: Hangar Bay (OH), and Table 7-19: Hangar Bay (OH) (F-35 Only) revised to include minimum requirements
  - Paragraph 3-7.1 Hazardous (Classified) Locations revised.
  - 3-7.4 Renewable Energy Sources
  - 3-7.13 \2\ Aerospace Ground Equipment (AGE) Electrical Power Provisions added for safety.
  - Revised paragraph 3-10 Hangar Doors for reference to structural prohibition on vertical lift fabric doors in high wind areas.
  - 3-10.1.3 Catwalk revised to emphasize importance and need.

- 3-11.3.1Trench Design revised to emphasize ductile iron trench covers
- Fire Protection
    - ◊ Removed AFFF specific requirements
    - ◊ Clarified fire protection requirements variation between services.
    - ◊ Updated separation drawing and section details.
    - ◊ Unified pump redundancy requirements between services.
    - ◊ Updated positioning of high-expansion generators in relation to helicopters.
    - ◊ Clarified allowable location for fire protection system controls.
    - ◊ Added additional guidance on zoned systems
    - ◊ Revised guidance on testing of optical detectors.
    - ◊ Added clarifying note on electrical classified locations.
    - ◊ 3-6.4 Fire Water Supply AFFF deleted and replaced with Low Level Water only
    - ◊ 3-6.8.1 Fire Suppression Pipe Labeling AFFF bullet for label deleted.
    - ◊ 3-6.8.2 Fire Suppression Drainage AFFF deleted.
    - ◊ 3-6.9 \2\ Foam/Water or Water Only Flow Control Valves Paragraph title change to include Water Only flow control valves and deleted last sentence regarding AFFF.
    - ◊ 3-6.10 Foam/Water Proportioning System 3rd bullet modified to replace “AFFF” with “concentrate”.
    - ◊ 3-6.11.2 \2\ Deleted **Paragraph retained to avoid numbering issues for references. /2/** paragraph deleted regarding AFFF.
    - ◊ 3-6.12 \2\ Foam/Water Solution and Low Level Water Only Piping /2/ Edited to include Low Level Water systems.
    - ◊ 3-6.12.1 \2\ Low Level Water Only Piping AFFF replaced with Low Level Water
    - ◊ 3-6.16 \2\ Low Level Water Trench Nozzle System and 3-6.16.1 Low Level Water System Performance AFFF/foam replaced with Low Level Water.

- ◊ 3-6.18 Hydraulic Calculations AFFF/foam replaced with Low Level Water.
- ◊ 3-6.19.1 \2\ Fire Alarm Control Unit/Autonomous Control Unit (FACU/ACU) through 3-6.19.2.3 Foam/Water, Low Level Water Only, and Preaction Supervised Solenoid Disconnect AFFF/foam replaced with Low Level Water.
- ◊ 3-6.19.5.1 \2\ Conduit and Enclosure Installation within the Hangar Bay through Figure 3-10: Start Foam System Signage AFFF/foam replaced with Low Level Water.
- ◊ Revised and added: Figure 3-10: Start Foam System Signage, Figure 3-11: Stop Low Level System Signage, Figure 3-12: Stop Foam System Signage, Figure 3-13: Stop Low Level System Signage

- Chapter 4
  - o 4-2.2 Mechanical Systems \2\ revised.
- Chapter 5
  - o 5-3.2 Aircraft Maintenance Bay Striping Requirements and Figure 5-1 Notes revised allowing matching of center line from outside.
  - o 5-1.2\2\ US Air Force Standard Designs for Aircraft Maintenance Hangars
  - o 5-12.3.4 Fuel Foam/Cell Repair Room
  - o 5-12.5.3 Washing Facilities
  - 0 5-12.7.1Hazardous (Classified) Locations
  - o 5-14 Facilities for Unfueled Aircraft to 5-15 Hangars for Fuel Servicing added.
  - o General Fire Protection
    - ◊ Clarified requirements for fire protection releasing controls.
    - ◊ Clarified requirements for fire protection optical detectors.
    - ◊ Clarified requirements for auxiliary notification devices.
    - ◊ Clarified requirements for HAS/PAS electrical classified locations.
    - ◊ Deleted requirements of HAS/PAS AFFF systems.
    - ◊ Added modernization requirements for existing high-expansion foam protected hangars.

- ◊ Added modernization requirements for existing unprotected hangars.
- ◊ Revised drain requirements to unify with NAVY and support F-35 cooling requirements.
- ◊ Added requirements for unfueled aircraft hangars at Air Logistics Centers and at government owned contractor operated plants.
- ◊ Added guidance for aircraft fuel servicing in hangars.

- Chapter 6
  - 6-1 INTRODUCTION Clarified Army UAS hangar applicability.
  - 6-1.1 US Army Aircraft Maintenance Strategy revised.
  - 6-3.1.2 UAS Aircraft revised.
  - Figure 6-1: Typical Maintenance Bay Configuration andFigure 6-2 Maintenance Bay Pavement Markings revised.
  - 6-4.1.1\2\ UAS Hangars – Group 3 and Group 4 /2/clarified for Group 3 and Group 4
  - 6-5.1 Heating revised
  - 6-5.3 Plumbing revised
  - 6-6.2 Fire Pumps Revised
  - 6-11.1.2 Location and Spacing
- Chapter 7
  - Table 7-1: \3\ Standard Hangar Bay Module Dimensions and Crane Capacities* Type I F-35B (USMC) width revised for Iintermediate Maintenance Program (IMP) maintenance and renamed to Navy and USMC Type I vs. F-35B and F-35C.
  - 7-2.4 \2\ Low Level System Containment to 7-11.1.6 \2\ Low Level Discharge Devices AFFF term removed generally
  - 7-7.3 Power Service Points bullet added for Triton hangar GSE
  - 7-3.2 Aircraft Maintenance Bay Striping Requirements and Figure 7-1 Notes revised allowing matching of center line from outside.
  - 7-14.5 Functional Data Sheets “cfm” changed to “scfm” throughout.
- Appendix
  - APPENDIX B: GLOSSARY SCFM added
  - C-6.5 \2\ Trench Drain Location to C-6.6 Alternate Foam/Water Discharge Notification AFFF term deleted.

/2/

\3\ Reasons for Document Change 3:

- Chapter 1
  - 1-5 Commentary added to this document per UFC 1-300-01.
- Chapter 3
  - 2-1.7 and 2-1.7.1 added for lighting impacts.
  - 3-3.2.3 revised.
  - Figure 3-4 revised.
  - 3-5.1 and 3-5.2 revised.
  - 3-5.8.2.6 and 3-5.8.2.7 revised.
  - 3-6.3.2 revised.
  - 3-6.17.2 revised.
  - 3-6.19.2.4 Optical Flame Detection Inhibit Switch clarified.
  - 3-6.19.4 revised.
  - 3-7.6.1 Typo corrected.
  - 3-6.10 bullet added.
  - 3-6.17.3 revised.
  - 3-7.1 revised.
  - 3-7.5.2 revised.
  - 3-7.14 added.
  - 3-9.3 revised.
  - 3-10.1.1 revised.
  - 3-10.2 revised.
  - Table 3-3 title and notes revised.
- Chapter 4
  - Title Change and 4-1 Title revised.

- 4-2.2 Mechanical requirements modified.

- Chapter 5
  - Table 5-1 title and table revised.
  - 5-2.2 reviesed.
  - 5-6.1 revised.
  - 5-6.5 revised.
  - 5-6.6 through 5-6.7.9 relocated to 5-15, 5-16, 5-17 and revised.
  - 5-11.1 revised.
  - 5-12.7.1 revised.
  - 5-12.6.2 revised.
  - 5-15, 5-16, 5-17 relocated and revised from 5-6.6 through 5-6.7.9.
- Chapter 6
  - 6-1.3 Applicability added.
  - 6-6.3.1 revised.
  - 6-6.6 revised.
  - 6-6.7 revised.
  - Table 6-1 Title and notes revised.
- Chapter 7
  - 7-3.1.3 corrected
  - 7-3.1.5 revised.
  - 7-9 and 7-9.3 revised to clarify Navy crane hazardous environment.
  - Table 7-1 revised. Table 7-2 Title and notes revised.
  - 7-7.5 revised.
- Appendix
  - C-7.4 Hazardous (Classified) Locations added. /3/

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE

This UFC provides requirements for Aircraft Maintenance Hangars. This UFC is not intended as a substitution for thorough review during design by individual Program Managers and Operations Staff in the appropriate Service.

This UFC is organized with general requirements and Service-specific requirements. Apply Chapters 1, 2, 3, 4 and Appendices to all Services. Additionally, apply Chapters 5, 6, and 7 to Air Force, Army, and Navy respectively for Service-specific requirements.

1-1.1 Applicability

The information in this UFC applies to the design of all new construction projects, to include additions, alterations, and renovation projects within the United States and its territories and possessions and outside of the United States and its territories and possessions.

1-1.2 References

APPENDIX A: REFERENCES contains a list of references used in this UFC.

1-2 USERS OF THIS UFC

This UFC is intended as a source of basic architectural and engineering information for all individuals involved in the planning, design and construction of Aircraft Maintenance Hangars.

Specific users of the UFC include the following:

1-2.1 Architects and Engineers

Architects and Engineers (A/E) who will provide design services under the direction of the individual Service design agencies.

1-2.2 Planning Personnel

Planning personnel will use this UFC for programming new or replacement facilities, pre-design planning, or assessing the extent of improvements required in an existing Aircraft Maintenance Hangar in order to achieve the standard established herein.

1-2.3 Additional Users

Additional users may include entities for operational or other purposes. The respective users should refer to this UFC from their own policy documents as appropriate and may include:

- Headquarters Staff and Field Operating Agencies,

- Major Command (MAJCOM) Staff/Regions,
- Base, Installation and Garrison Commanders,
- Installation Facilities Management,
- Installation Technical Proponents.

1-3 GENERAL BUILDING REQUIREMENTS

Comply with UFC 1-200-01. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and government criteria referenced therein.

1-3.1 Facility Requirements Document (FRD)

The airframe manufacturer's FRD or equivalent document is an integral requirement of hangar design that contains additional airframe specific facilities requirements that must be considered and satisfied in addition to this UFC.

FRDs are typically authored by the airframe manufacturer and contain many specific details, are often quite voluminous and difficult to obtain. The FRD may have additional technical facility requirements, special spaces, special clearances, special maintenance procedures, systems, data or other items that may impact the hangar design. This UFC is not a substitute for the FRD of the design airframe(s) being hangared.

1-4 SCOPE OF FACILITY

This UFC specifies requirements for aircraft hangars that support all types of fixed wing, rotary wing, and hybrid aircraft of the Army, Air Force, Navy, Marine Corps, and Reserves. The UFC additionally applies to hangars for select Unmanned Aircraft Systems (UAS)/Remotely Piloted Aircraft (RPA).

\2\ This UFC applies to all aircraft hangars including maintenance hangars and also to other specialized hangar types. Additional study is required to identify unique requirements, functional areas or systems based on mission or aircraft. /2/ Some specialized hangars include but are not limited to depot, transient, special operations, research, fuel-cell maintenance, and prototype hangars. For aircraft corrosion control and paint facility hangar design requirements, refer to UFC 4-211-02 and this UFC where incorporated by specific reference. Maintenance hangars support ongoing day to day functions of the aviation squadron, wing or brigade and facilitate routine, preventative, basic aircraft upkeep to sustain aircraft operations. Maintenance activities are generally short-term and minor in nature compared to those that might be performed in more intensive intermediate maintenance level or depot-level hangars that facilitate extensive breakdown and rebuilding of components. Maintenance hangars are typically characterized by large obstruction-free hangar bays surrounded by various configurations of supporting trade shop and administrative spaces. Extra value has been placed on facility safety, continuity of mission operations, flexibility, maximizing

hangar bay utilization, and minimizing life-cycle costs of materials and systems. For these reasons, the UFC limits options on certain requirements, ranging from structural systems and hangar doors, to proven systems for the expected large-scale aircraft and operations common in military maintenance hangars. Exemptions to certain requirements may be submitted for consideration where supported and warranted by the mission requirements. \2\ See Mil-STD 3007G. /2/

1-4.1 Service Specific Information

Refer to Chapters 5, 6, and 7 for Air Force, Army, and Navy, respectively, for Service-specific information.

\3\

1-5 COMMENTARY

Limited commentary has been added to the chapters. Section designations for such **commentary are preceded by a "[C]" and the commentary narrative is highlighted with** light gray. Below is an example:

[C] 1-2.3 EXAMPLE TEXT

This is an example of how commentary appears in this document.

/3/

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CHAPTER 2 PLANNING AND LAYOUT

2-1 SITE ISSUES

Coordinate the design and construction of Aircraft Maintenance Hangars adjacent to an airfield with airfield operations, civil engineering master planning, existing Air Traffic control Tower site lines, and the Federal Aviation Administration (FAA) (when applicable) to confirm the new facility will not conflict with airspace, ground operations or required unobstructed clearances. Review safety and security prior to commencement of design or construction. Refer to UFC 3-260-01 for further requirements.

2-1.1 Airport Operations Area (AOA) Safety

The planning and design of an Aircraft Maintenance Hangar will emphasize AOA safety. AOA safety includes unobstructed airspace and safe and efficient ground movements per UFC 3-260-01.

The Airport Operations Area is any area of an airport, installation, or station used or intended to be used for the landing, takeoff or surface maneuvering of aircraft. The AOA includes such paved areas or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiway or aprons.

2-1.2 Construction Phasing Plan

Prior to Construction, provide notification of construction by issuing notices as required by Federal Aviation Administration Advisory Circular (FAAAC) 150/5200-28, latest edition. Include a construction phasing plan in the contract documents. The purpose of a phasing plan is to establish guidelines and constraints for the contractor to follow during construction. Submit the construction phasing plan for coordination and review at the concept stage and all design stages. Coordinate the plan with airfield management, airfield operations, communications, ground and flight safety, environmental, emergency services, security forces, and logistics. Include the extent of fencing required to keep personnel out of the construction area and to keep Foreign Object Damage (FOD) off the airfield. Include crane restrictions, required FAA permits, flight line access requirements for personnel and equipment, hours of operations within the AOA, haul routes for materials (especially concrete trucks), stockpile locations, details for closing portions of the airfield, and airfield barricades. Refer to UFC 3-260-01 ABBREVIATIONS Section 14 for further guidance on phasing and operational safety plans.

2-1.3 Safety Clearances

Apply all horizontal and vertical operational safety clearances to Aircraft Maintenance Hangars that dictate the general arrangement and sizing of hangars and their relationship to airfield and airside facilities. There are, however, general considerations that apply in most cases, such as:

- Adherence to required unobstructed clear zones

- Adherence to standards in support of safety in aircraft operations
- Non-interference with line of sight or other operational restrictions
- Use of existing facilities
- Flexibility in being able to accommodate changes in aircraft types or missions
- Efficiency in ground access
- Priority accorded aeronautical activities where available land is limited
- Security
- DoD and Military Service-level explosive safety quantity distances when applicable

2-1.4 Airport Operations Area Security

Regulatory requirements for security of assets can have a significant impact on the planning and layout associated with aircraft, as well as the aircraft themselves, requiring varying types and levels of protection. Operational security of the airfield is also a consideration. Collocate maintenance buildings to inhibit or prevent unauthorized access and enhance facility and airfield security.

2-1.5 Integration of Security Measures

Integrate protective features such as barriers, fences, lighting, access control, intrusion detection, and assessment into the site and facility planning and design process to minimize problems with aircraft operations and safety requirements. Include the protective measures in the design, based on risk and threat analyses, with an appropriate level of protection, and comply with security-related requirements.

2-1.6 Solar Glare Hazard Analysis

If any new photovoltaic and glass-enclosed solar-hot water systems are proposed, provide solar glare hazard analysis as required by FAA policy. Refer to Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports. FAA policy on Glint/Glare Impacts on DoD Aviation Operations requires Glint/Glare analysis of photovoltaic and glass-enclosed solar-hot water systems that are on military airfields and within 2 miles of military airfield control towers, active runways thresholds, and helicopter landing zones. FAA policy requires the use of FAA's Solar Glare Hazard Analysis Tool (SGHAT) for Glint/Glare analysis found on website: https://share.sandia.gov/phlux. This analysis is required for eliminating the potential for ocular impact to pilots and/or air traffic control facilities due to glare from solar photovoltaic (PV) and solar hot water (SHW) systems on airports.

To prevent mirror-like reflections from building surfaces to aircraft in flight, provide roofs and other external surfaces with a specular reflectance compatible with the location of the building on the airfield. If the building is located so that glare is an operational hazard, provide surfaces of the building with a light reflectance of not more than 10,

measured at an angle of 85 degrees in accordance with American Society of Testing and Materials (ASTM) D523, *Specular Gloss* at critical surfaces of the building.

\2\ Solar PC or SHW systems should not block, reflect, or disrupt NAVAIDS, and other equipment required for safe aviation operations. Designer must coordinate with appropriate authorities to insure no impact to NAVAIDS system operations./2/

2-1.6.1 Airfield Manager Approval for Solar Energy System Projects

Provide the results of the SGHAT to the Airfield Manager for evaluation of any possible adverse effects to the airfield daily operations prior to approving new photovoltaic and glass-enclosed solar-hot water systems on the military airport.

\3\

2-1.7 Nightime Light Hazard Analysis

Nighttime light pollution impacts both airfield operations and flight operations when Night Vision Goggles are in use. Minimize operational hazards due to nighttime light pollution emanating from both interior and exterior of facility by minimizing and orienting glazed openings and exterior lighting fixtures. Provide cutoff shielding on exterior lighting fixtures. Consider impacts from any major interior light sources such as hangar bay lights with open hangar door or through translucent panels of fabric hangar doors. During conceptual design, perform computer rendering lighting studies from point of view of Control Tower and Ground Control stations to ensure no hazards exist.

2-1.7.1 Airfield Manager Approval

During review of the concept phase submission, provide the results of the nighttime light hazard analysis to the Airfield Manager for evaluation of any possible adverse effects to airfield operations. Obtain approval of Airfield Manager prior to executing projects on the military airport or heliport. Resubmit and obtain approval of Airfield Manager of any proposed design modifications that deviate from previous approved solution.

/3/

2-2 FACILITY FUNCTIONS AND ADJACENCIES

Maintenance hangars are required to provide weather-protected shelter for the servicing and repair of aircraft at the organizational level.

2-2.1 Ground Level

The following spaces are typically provided on the ground level of a two story hangar. Locate these rooms with consideration of the access requirements described in each Paragraph, regardless of the number of levels in the hangar.

2-2.1.1 Aircraft Maintenance Bay

Aircraft Maintenance Bays are sized to accommodate aircraft as well as the maintenance activities around the aircraft. The Aircraft Maintenance Bays require direct access to a component of the flight line, preferably a peripheral taxi or tow-way.

2-2.1.2 Maintenance Administration

Maintenance administration spaces include maintenance control, quality control, rooms to access maintenance records and manuals on computers, as well as office space for manufacturers' representative personnel. Most of these spaces need direct or nearly direct access to the Aircraft Maintenance Bay.

2-2.1.3 Heavy Maintenance Shops

These industrial spaces house shops for maintaining large heavy parts and equipment such as engines, sheet metal and composites. All of these spaces require direct or nearly direct access to the Aircraft Maintenance Bay. Provide an overhead door or a pair of personnel doors to the Aircraft Maintenance Bay for movement of large equipment. \2\ If a battery maintenance shop is required, see UFC 3-520-05 for additional requirements. Lithium-Ion battery maintenance requires significant space and mechanical systems. /2/

2-2.1.4 Light Maintenance Shops

These spaces house shops for maintaining parts from the aircraft such as electronics, avionics, or weapons systems. Direct access to the Aircraft Maintenance Bay is preferred but not required because these parts are more portable than those in the heavy maintenance shops.

2-2.1.5 Storage

Ground level storage includes spaces for storing and issuing parts and tools for the maintenance of the aircraft. Direct access to both the Aircraft Maintenance Bay and to the exterior are preferred, but direct access to the exterior is more important to allow for deliveries.

2-2.1.6 Personnel Support

Break rooms, restrooms, showers and locker rooms should be located to support ground level personnel.

2-2.1.7 Building Support

Building support spaces includes areas used for maintaining the building and areas that house building utilities. Facility maintenance rooms have a low priority for adjacency, but they are typically located near the utility rooms. Utility spaces include mechanical rooms, compressor rooms, electrical rooms, communication rooms, fire protection rooms, and janitor closets. Provide major utility rooms with direct exterior access and locate them close to exterior equipment related to the space. Communication rooms

typically require interior access. Provide separate general, secure and unit-managed communications rooms. Confirm access with the installation. Account for equipment and access space for maintaining equipment in Utility space sizing. Consider user access for user-owned and operated equipment such as a compressor that may be in a shared utility room. Mechanical rooms in hangars are typically larger than in other types of buildings because they often contain equipment supporting maintenance operations, such as air compressors. Fire Protection Rooms in hangars are typically larger than in other types of buildings due to foam systems required to protect Aircraft Maintenance Bays. Provide a janitor closet near the restrooms.

2-2.2 Upper Level

The following spaces are typically provided on the upper level of a two story hangar. Locate these rooms with consideration of the access requirements described in each Paragraph, regardless of the number of levels in the hangar.

2-2.2.1 Operational Administration

Unit administration offices, conference rooms and training rooms may be remote from the Aircraft Maintenance Bay and are typically located on the upper level. Spaces in this category are often grouped based on the level of security required for the use.

2-2.2.2 Personnel Support

Break rooms, restrooms, locker rooms should be located to support upper level personnel.

2-2.2.3 Building Support

These spaces are often satellite rooms associated with ground level mechanical, electrical and communication rooms. Provide a janitor closet near the restrooms.

2-2.3 Secure Spaces

Many hangars require some level of physical security for the protection of assets such as classified materials, Sensitive Compartmented Information (SCI) or Special Access Program (SAP) information. The requirements for the protection of assets is defined in DoD and Service regulatory guidance or policy. The security requirements must be coordinated with the supported command and their security representatives to ensure the configuration will meet their operational (compartmented) and the regulatory and policy based security requirements. When a hangar has more than one secure space, serious consideration should be given to consolidate multiple secure spaces. Any consolidation will reduce the initial and sustainment cost for infrastructure, electronic security systems and the associated accrediting requirements. When required, integrate the physical security protective measures into the site, building, room(s), or area(s) as applicable.

2-3 MINIMUM AIRCRAFT MAINTENANCE BAY CLEARANCES

Provide the minimum required clearances between the aircraft and adjacent horizontal obstructions, vertical obstructions, and other aircraft in designing the Aircraft Maintenance Bay as indicated in Table 2-1: Minimum Aircraft Maintenance Bay Clearances and Figure 2-1: Minimum Aircraft Maintenance Bay Clearances, Figure 2-2: Alternate Corner Configuration, Figure 2-3: Vertical Hangar Clearances, Figure 2-4: Vertical Hangar Clearances with Sloped Roofs. These clearances are essential to ensure aircraft are protected from structural damage as they are moving in and out of the hangar and to allow personnel and equipment to safely and efficiently maneuver around the aircraft during aircraft maintenance activities.

2-3.1 Horizontal Obstructions

The nearest horizontal fixed obstructions include but are not limited to the inside face of the wall, faces and jambs of hangar doors, structural columns or bracing, bollards, liner panels, mechanical equipment or ductwork, plumbing equipment, valves and pipes, electrical equipment such as power transformers or other permanent physical items. Fixed obstructions do not include furniture, tables, desks, benches, cabinets, tools, parts, carts or other movable objects. Clearances from rotary blade aircraft are from rotor blade arcs, except where specifically noted otherwise in Table 2-1: Minimum Aircraft Maintenance Bay Clearances.

2-3.2 Vertical Obstructions

The nearest fixed or mobile overhead obstructions include but are not limited to structure, draft curtains, mechanical, electrical, and plumbing equipment such as lighting, fans, heaters, ductwork, and fire protection systems, crane rails and crane bridges. Crane hoists and hooks are excluded if they can be maneuvered around tall parts of the aircraft and can be stored out of the way during aircraft movement.

2-3.3 Additional Clearances

Specific airframe or Service requirements may increase the minimum clearances required by Table 2-1: Minimum Aircraft Maintenance Bay Clearances to allow performance of certain maintenance operations. Coordinate with the maintenance unit staff to determine if additional space is required to maintain the aircraft. Provide additional clearances where required by an approved document such as the design aircraft's Facility Requirements Document (FRD) or a Service-specific standard design, defined Service hangar type, or other approved criteria. For example, the FRD may require additional space aft of the aircraft to remove the engine, or additional space above an aircraft to provide the crane hook height to perform maintenance operations such as pulling the rotor shaft out of a helicopter or maintaining the radar dome on an Airborne Warning and Control System (AWACS) aircraft. Jacking the design aircraft will reduce the overhead clearance below requirements in this UFC. Confirm jacking the design aircraft in the parking position does not require additional height to avoid conflict with an overhead obstruction. Minimum hook height is to the saddle of the hook.

Maximize the unobstructed space in Aircraft Maintenance Bays where designs allow for exceeding the minimum clearances determined from this section. Exceeding minimum requirements for bay widths and depths, door heights, clear heights or crane hook heights may provide the flexibility to accommodate a future aircraft type or a revised aircraft parking layout without violating required clearances. For example, if for some good reason the structure of an Aircraft Maintenance Bay roof is higher than necessary to meet the minimum vertical clearance requirements, locate MEP systems and cranes as high as possible rather than dropping them to the minimum clear height allowed.

2-3.4 Alternate Corner Configuration

The concept indicated in Figure 2-2: Alternate Corner Configuration is acceptable for Aircraft Maintenance Hangars of any size where it may be desirable to re-distribute large corner areas. The clearances indicated by Table 2-1: Minimum Aircraft Maintenance Bay Clearances apply to all hangars, even if using the alternate corner configuration. Where used in hangars with multiple aircraft parking positions the alternate corner configuration is only acceptable at the end bays. Do not reduce the square footage of the Aircraft Maintenance Bay. Distribute the area gained by the corner configuration within the Aircraft Maintenance Bay.

This UFC allows encroaching on the space in front of the wings of aircraft with walls and other fixed obstructions. However, it is the designer's responsibility to confirm operational clearance requirements around the aircraft if introducing obstructions in front of the wings of aircraft. Consult the users for any specific airframe or Service requirements that limit the location of an alternative sidewall configuration. Provide additional clearances where required by an approved document such as the design aircraft's Facility Requirements Document (FRD) or a Service-specific standard design, defined Service hangar type, or other approved criteria. For example, the FRD may require additional space in front of the wing of the aircraft to remove a wing-mounted engine. Allow for alternate aircraft layouts that could be used in the future such as tail-in parking. If future flexibility is a guiding concern, do not locate core spaces such as elevators, utility rooms, restrooms or showers in the high bay space. Refer to Appendix C-3.2: Considerations for Large Aircraft Maintenance Bays.

Table 2-1: Minimum Aircraft Maintenance Bay Clearances

SEE CLEARANCES A THROUGH H ON FIGURES 2-1 THROUGH 2-4			AIR FORCE AND ARMY		NAVY - NOTE 10				NOTES:
			WINGSPAN < 100' 30.48M	WINGSPAN > 100' 30.48M	HANGAR TYPE I	HANGAR TYPE II	HANGAR TYPE III	HANGAR TYPE IV	
FIGURE 2-1 AND 2-2	A	AIRCRACT TO NEAREST FIXED OBSTRUCTION ALONG BACK WALL	10'-0" 3.05M	15'-0" 4.57M	10'-0" 3.05M	10'-0" 3.05M	20'-0" 6.01M	15'-0" 4.57M	1, 2, 3
	B	AIRCRAFT TO INSIDE FACE OF HANGAR DOOR	10'-0" 3.05M	10'-0" 3.05M	7'-6" 2.29M	10'-0" 3.05M	15'-0" 4.57M	15'-0" 4.57M	1, 2, 4
	C	AIRCRAFT TO NEAREST FIXED OBSTRUCTION ALONG SIDE WALL	10'-0" 3.05M	15'-0" 4.57M	7'-6" 2.29M	10'-0" 3.05M	20'-0" 6.01M	15'-0" 4.57M	1, 2, 3
	D	AIRCRAFT TO ADJACENT AIRCRAFT	10'-0" 3.05M	15'-0" 4.57M	7'-6" 2.29M	10'-0" 3.05M	20'-0" 6.01M	15'-0" 4.57M	1, 2, 5
	E	AIRCRAFT TO HANGAR DOOR JAMB	10'-0" 3.05M	10'-0" 3.05M	6'-0" 1.83M	8'-6" 2.59M	18'-6" 5.64M	13'-6" 4.12M	1, 2, 6
FIGURES 2-3 AND 2-4	F	AIRCRAFT TO NEAREST FIXED OR MOBILE OVERHEAD OBSTRUCTION	10'-0" 3.05M	10'-0" 3.05M	5'-0" 1.52M	5'-0" 1.52M	5'-0" 1.52M	5'-0" 1.52M	1, 7, 8
	G	AIRCRAFT TO UNDERSIDE OF DOOR HEAD	7'-0" 2.13M	7'-0" 2.13M	5'-0" 1.52M	5'-0" 1.52M	5'-0" 1.52M	5'-0" 1.52M	1, 7, 8
	H	HOOK HEIGHT (SADDLE OF HOOK)	Army: Per Std Design Air Force: Per FRD		Refer to Table 7-1				1, 7, 9

Notes:

1. Refer to 2-3: Minimum Aircraft Maintenance Bay Clearances.

2. Refer to Figure 2-1: Minimum Aircraft Maintenance Bay Clearances.

3. Minimum clearances A and C are to a vertical plane at the face of the fixed obstruction that extends furthest toward the aircraft.

4. The minimum clearance from the aircraft to the hangar door is to a vertical plane at the interior face of the innermost panel of a sliding door, or to the interior face of a vertical lift door panel or mullion. Fixed columns along the hangar door separating bays are considered hangar door jambs for the purpose of determining clearances.

5. Minimum clearance between aircraft is from any part of the aircraft. Depending on the hangar configuration, the minimum clearance between aircraft is wingtip to wingtip, nose to nose, tail to tail, nose to tail, or rotor blade arc to rotor blade arc. Do not assume wingtips or rotor blades are folded. Do not determine minimum clearances between aircraft based on specific stationary rotor blade positions.

6. Minimum horizontal clearances at hangar door jambs are from wingtip or rotor blade to the edge of the clear width of the hangar door opening as the aircraft passes through the door opening. Rotor blades are assumed to be fixed in the narrowest configuration possible when entering and leaving the hangar. Do not assume wingtips or rotor blades are folded. Fixed columns along the hangar door separating bays are considered hangar door jambs for the purpose of determining clearances.

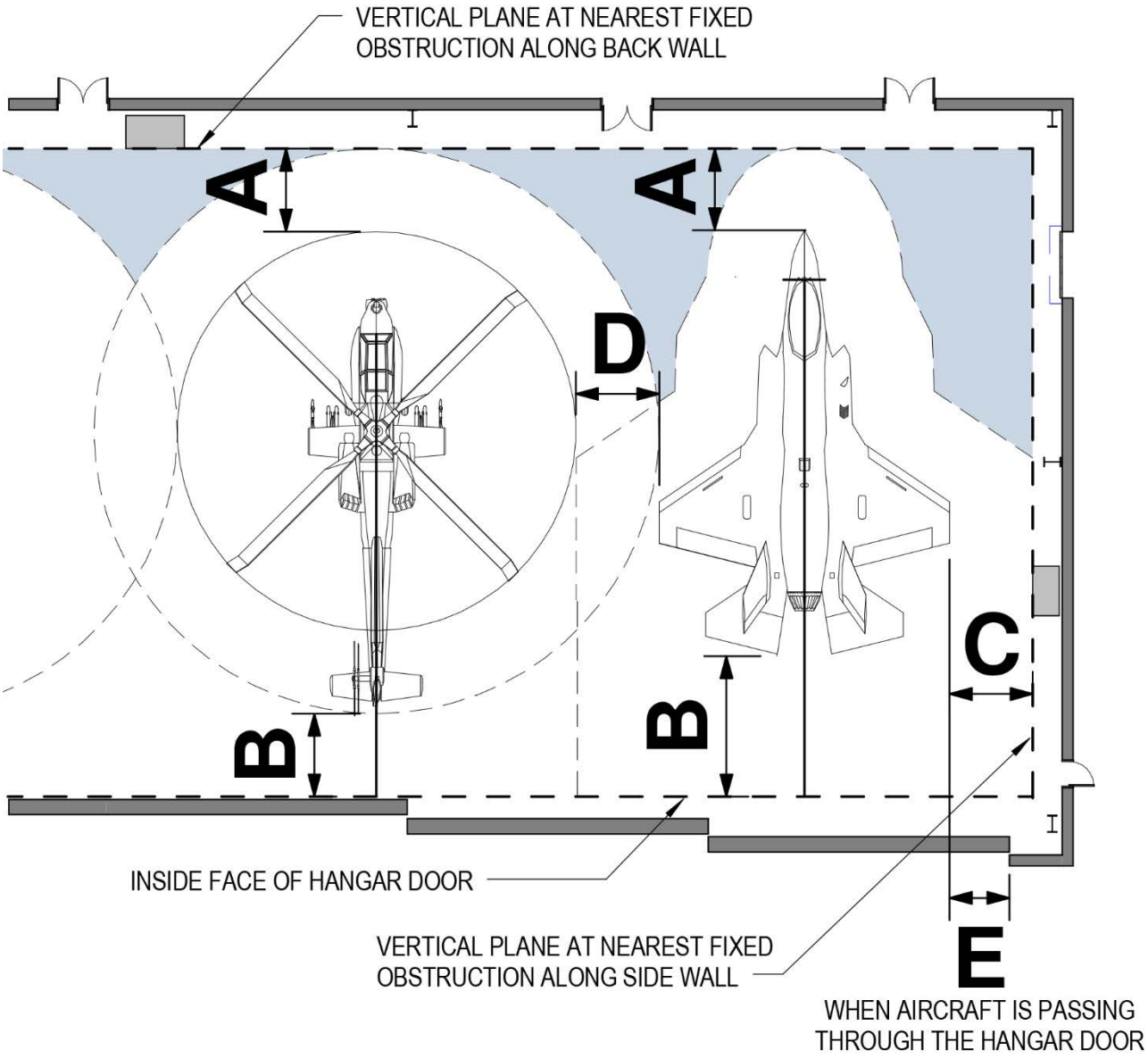
7. Refer to Figure 2-3: Vertical Hangar Clearances and Figure 2-4: Vertical Hangar Clearances with Sloped Roofs.

8. Minimum vertical clearances are from the top of the aircraft to the bottom of the nearest fixed or mobile overhead obstruction.

9. Minimum Hook height is to the saddle of the hook.

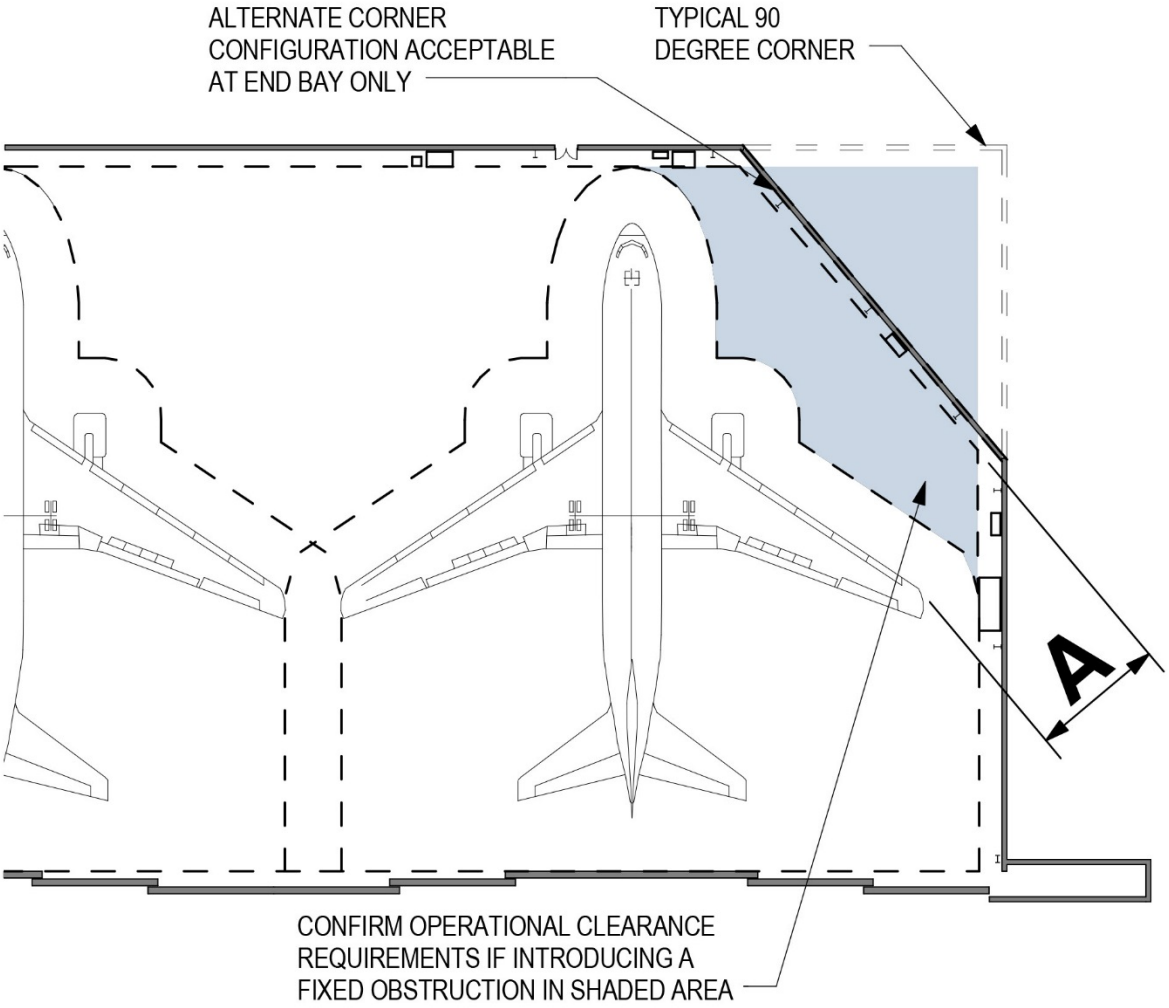
10. Refer to 7-3.1: Types of Hangars.

Figure 2-1: Minimum Aircraft Maintenance Bay Clearances



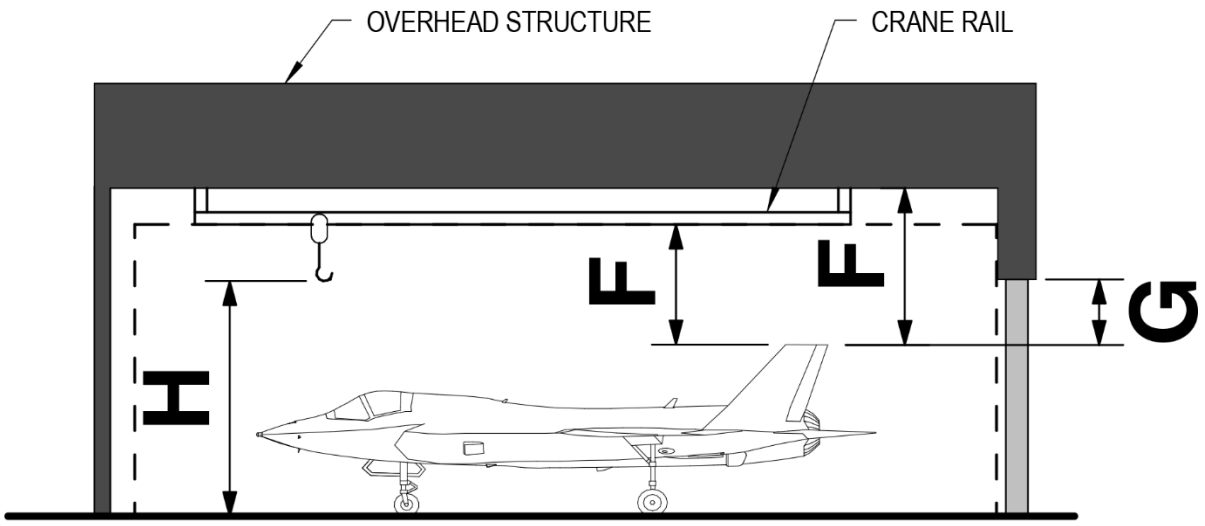
Note: Refer to Table 2-1: Minimum Aircraft Maintenance Bay Clearances for dimensions A, B, C, D and E.

Figure 2-2: Alternate Corner Configuration



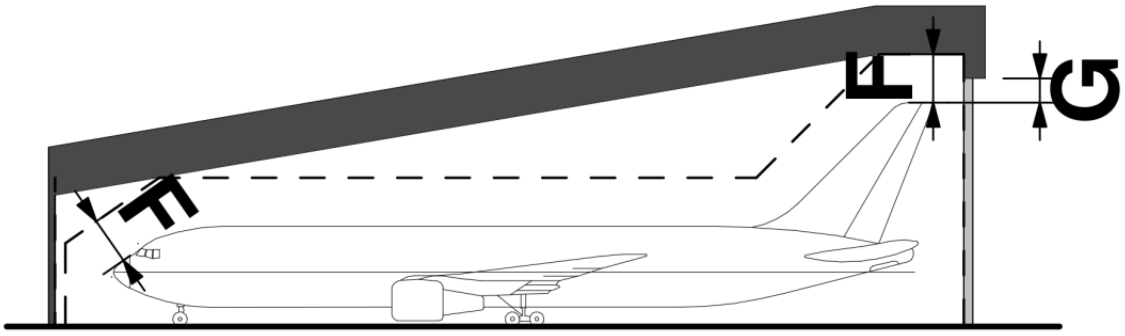
Note: Refer to 2-3.4: Alternate Corner Configuration and Table 2-1: Minimum Aircraft Maintenance Bay Clearances for dimension A.

Figure 2-3: Vertical Hangar Clearances



Note: Refer to Table 2-1: Minimum Aircraft Maintenance Bay Clearances for dimensions F, G, and H.

Figure 2-4: Vertical Hangar Clearances with Sloped Roofs



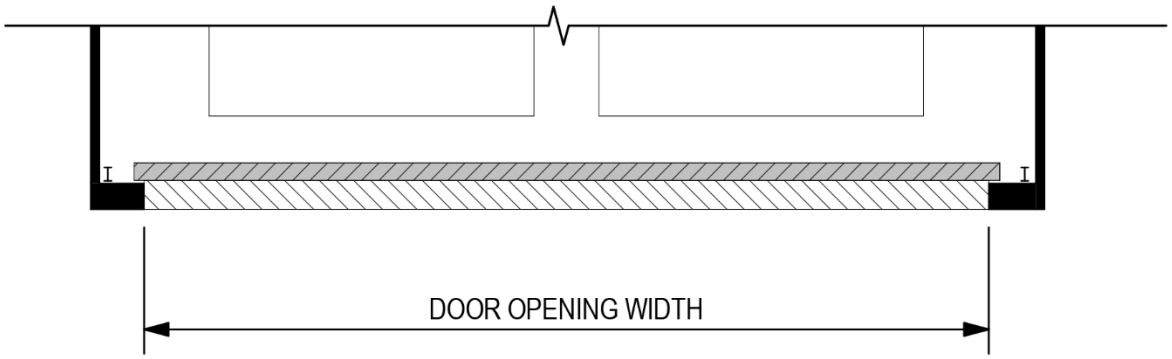
Note: Refer to Table 2-1: Minimum Aircraft Maintenance Bay Clearances for dimensions F and G.

2-4 NET TO GROSS AREA IN AIRCRAFT MAINTENANCE HANGARS

Planning personnel are encouraged to allow sufficient net-to-gross area for specific spaces in Aircraft Maintenance Hangars. Aircraft Maintenance Bays require additional square footage outside of the safety lane where structure and other utilities create obstructions which cannot be specifically accounted for in paragraph 2-3: Minimum Aircraft Maintenance Bay Clearances. Hangars require large mechanical rooms to accommodate equipment such as air compressors. Hangar fire protection rooms are larger than in typical buildings due to the foam suppression system required for the Aircraft Maintenance Bay. Select Hangar doors based on the pros and cons of the different types of doors and by the users/installation preferences.

The area required for different types of hangar doors varies, but is not intended to govern the decision of the type of hangar door to use. Calculate the area inside the exterior face of hangar doors in the closed position at 100% square footage. Calculate the area inside the exterior face of door pockets at 100% square footage. Enclose all door pockets. Do not include the area under the roof, outside of the hangar doors. Refer to Figure 2-5: Space Requirements for Vertical Lift Fabric Doors and Figure 2-6: Space Requirements for Sliding Steel Hangar Doors for clarification on calculating gross square footage of different hangar doors.

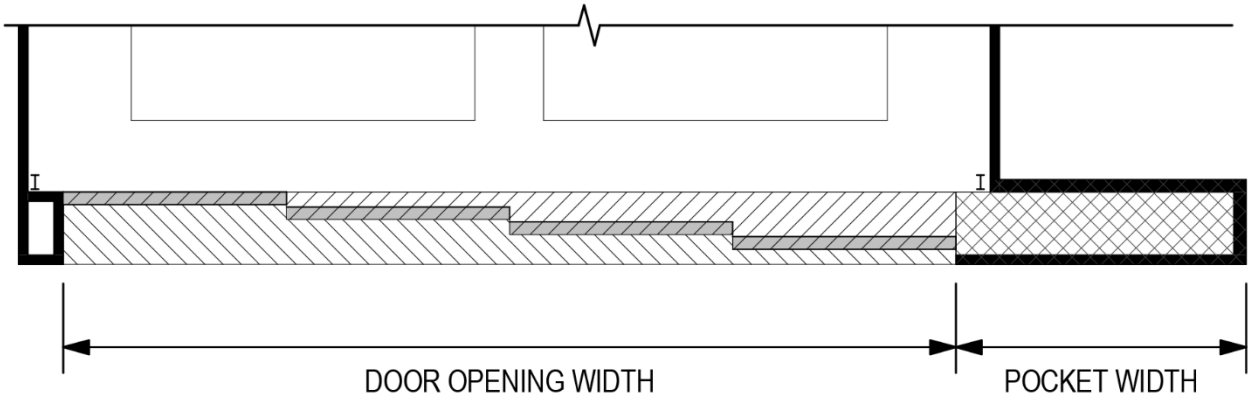
Figure 2-5: Space Requirements for Vertical Lift Fabric Doors



Count the area inside the exterior face of the door as 100% square feet

Do not count the area under roof and outside the exterior face of the door

Figure 2-6: Space Requirements for Sliding Steel Hangar Doors



Count the area inside the exterior face of the door as 100% Square Footage (SF)

Do not count the area under roof and outside the exterior face of the door

Count the area inside the exterior face of a door pocket as 100% SF

2-5 ACCESSIBILITY

It is the goal of the DoD to make its facilities accessible to persons with disabilities. In accordance with UFC 1-200-01, follow the Architectural Barriers Act (ABA) Accessibility Standard for Department of Defense Facilities.

2-6 SUSTAINABLE DESIGN

Design Aircraft Maintenance Hangars per the requirements of UFC 1-200-02. Refer to Appendix C - Best Practices for discussion on sustainability strategies applicable to Aircraft Maintenance Hangars.

2-7 HAZARDOUS MATERIALS

2-7.1 Background Information

The DoD, including the Department of the Navy, operates facilities which routinely utilize, or have utilized in the past, hazardous materials and chemicals that contain lead, cadmium and chromium, and other heavy metals. Operations and activities which can create an unsafe condition with regards to worker protection, include (but are not limited to): manual demolition, scraping, grinding, heat-gun applications, power tooling with dust collection, application of corrosion control materials, spray paint with lead/chromium (VI)/Cadmium-based paints, burning, power tooling without dust

collection, rivet busting, cleanup activities with dry abrasives, movement/removal of enclosures, abrasive blasting, welding, cutting and burning on steel structures. When these operations occur, there are hazards associated with the generation of dust, debris and fumes. The hazards and the controls required are dependent on the materials used. Additionally, these operations, and utilization of these hazardous materials and chemicals, are found in aviation facilities.

2-7.2 Facility Design Requirements

Comply with the Occupational Safety and Health Act (OSHA), American Conference of Governmental Industrial Hygienist (ACGIH), and DoD regulations and guidelines for facilities that will operate, or will continue to operate, utilizing hazardous materials and/or chemicals. The requirements found in the OSHA regulations and the DoD Instructions and Directives may affect facility design requirements, which may include (but are not limited to): separate toilets and washing/bathing areas for workers who are exposed to the hazard, change rooms, decontamination areas, break rooms, clothes washing facilities, areas for controlled disposal of contaminated waste and work clothes, both local and general high-efficiency particulate air (HEPA) ventilation systems and filters, eyewash stations and deluge showers. Areas of facilities utilizing these hazardous materials and/or chemicals must be designated as regulated areas whenever exposure can be expected to be in excess of the permissible exposure limit(s), and must be demarcated from the rest of the workplace in a manner that adequately establishes and alerts building occupants of the boundaries of the regulated area. Design facilities in a manner to allow the OSHA required air sampling and monitoring that are required for the specific hazardous material in use. Design facilities to control these hazards below the standards set in the stated regulations. Refer to Appendix D, Questionnaire, for a list of questions the planner and designer should ask the operators regarding their aircraft maintenance operations and activities.

Additionally, the DoD Instruction 6055.01, Appendix 4 lists additional requirements for facilities which involve operations generating airborne dust, mist, debris, or aerosols containing lead, chromium (VI), or cadmium. These requirements include (but are not limited to): containment processes and methods to monitor effectiveness of housekeeping procedures, decontamination procedures, and engineering controls tailored to each facility.

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CHAPTER 3 GENERAL HANGAR REQUIREMENTS

3-1 INTRODUCTION

Typical systems utilized in Aircraft Maintenance Hangars are described below. Refer to Chapters 5, 6, and 7 for Air Force, Army, and Navy specific applicability and exceptions to Chapter 3. Specific rooms where these systems are used are indicated later in this UFC.

3-2 CIVIL

3-2.1 Siting

3-2.1.1 General

When siting the hangar, place emphasis on operation, function, energy efficiency, safety, and Fire Department and Emergency vehicle access. Provide efficient access to the flight line. Other factors to consider include topography, vegetative cover, existing construction, weather elements, wind direction, soil conditions, flood hazards, natural and man-made obstructions, adjacent land use, availability of usable airspace, accessibility of utilities, taxiway and runway clearances, existing Control Tower sight lines, and future expansion capability. When siting the Hangar, give careful consideration to vehicular parking, pedestrian access, and traffic flow. Follow UFC 3-260-01 and UFC 1-200-01.

3-2.1.2 Airfield Clearance Criteria

Site hangars in accordance with the airfield clearance requirements in UFC 3-260-01.

3-2.1.2.1 Restrictions

Land use restrictions dealing with runway clearances, helipad planning, aircraft noise, and use of airspace are to be applied to the site location with UFC 3-260-01 and UFC 2-100-01.

3-2.1.2.2 Construction in Floodplains or on Wetlands

Avoid siting and construction of facilities in wetlands and floodplains. If this cannot be avoided, design and site the facility in accordance with UFC 1-200-01 and UFC 3-201-01.

3-2.1.2.3 Soil and Groundwater Conditions

Complete the geotechnical design in accordance with UFC 3-220-01.

3-2.2 Vehicular and Pedestrian Circulation

3-2.2.1 Street System

Coordinate design of the parking lot and street system with the overall traffic circulation plans for the installation as well as the adjacent road system. Provide convenient and safe vehicular access and circulation for essential services, such as deliveries, trash and garbage collection, fire protection, and maintenance and repair. Minimize through traffic routes adjacent or near the Hangar and Pedestrian routes. Design items such as site access and drives, tactical vehicle access, parking lots, fire truck access, and accessible parking in accordance with applicable criteria set forth in the Unified Facilities Criteria (UFC). Design pavement in accordance with UFC 3-250-01FA.

3-2.2.2 Pedestrian Sidewalks/Circulation

Design sidewalks to provide convenient and safe pedestrian access and necessary circulation. Provide an accessible route in accordance with the ABA Accessibility Standards. Coordinate pedestrian access routes into vehicular traffic to minimize crossing to provide safe ingress/egress for personnel. Design pavement in accordance with UFC 3-250-01FA.

3-2.3 Airfield Pavements

3-2.3.1 Airfield Pavements Design

Design geometry of airfield pavements, including hangar access aprons, in accordance with UFC 3-260-01 and UFC 3-260-02. Refer to 3-11.2: Existing Apron Slope for additional requirements. All exterior pavements required to support aircraft loadings are to be considered airfield pavements. Design all interior hangar slabs that support aircraft loadings per Structural Section - Aircraft Maintenance Bay Slab on Ground in this UFC.

Consider flexibility of the pavement sections to accommodate a wide variety of aircrafts, if possible, to accommodate potential aircraft and mission changes.

3-2.3.2 Airfield Pavement Markings

Refer to Chapters 5, 6, and 7 for Service-specific airfield pavement marking requirements. DoD tenant organizations use Service-specific criteria on the military portions of the airfield to the maximum extent practicable, including UFC 3-260-01 and UFC 3-535-01.

3-2.4 Exterior Utility Services

Design utilities in accordance with the appropriate UFC. Avoid installing utilities under airfield pavements to the maximum extent possible. Obtain written approval for the need of any utilities under the airfield pavement other than those directly supporting the apron or parked aircraft, from NAVFAC Headquarters (HQ) Chief Engineer for Navy projects, United States Army Corp of Engineers (USACE) Transportation Systems Center (TSC) for Army projects, and AFCEC pavements engineer for Air Force projects.

3-2.4.1 Storm Drainage

Design storm drainage around hangars and aircraft movement areas in accordance with UFC 1-200-01, and FAA AC 150/5320-5D. Design the storm drainage system, including gutters, drains, inlets and culverts, to carry the anticipated runoff for the appropriate level design storm event, including runoff from melting snow. Design of aboveground storage of runoff tends to attract birds that are not recommended in the AOA.

3-2.4.2 Sanitary Sewer

Capture oily wastewater contaminants from the hangar bay trench system and hangar sinks and drains, if provided, with oil/water separators, or as directed by the department overseeing environmental policy for the installation.

3-2.4.3 Containment of Fire Suppression Effluent

Consider all local environmental regulations to determine the control, treatment and/or remediation measures for the discharge of fire suppression effluent. Refer to Chapters 5, 6, and 7 for Service-specific containment requirements.

3-3 ARCHITECTURAL

3-3.1 Construction, Life Safety, and Fire Fighter Access

Provide hangar construction, life safety, and fire department access in accordance with UFC 3-600-01 except where additional requirements are added by this UFC. Use National Fire Protection Agency (NFPA) 409 only where explicitly noted. If there is a conflict, this UFC supersedes UFC 3-600-01 and NFPA standards.

3-3.1.1 Construction Type

Where Group I, II, and III hangars as defined by National Fire Protection Agency (NFPA) 409 are provided, they are limited to non-combustible Type I or Type II construction as defined by the International Building Code (IBC). Construct Group IV hangars in accordance with the membrane construction requirements in NFPA 409.

3-3.1.2 Protection of Structural Members

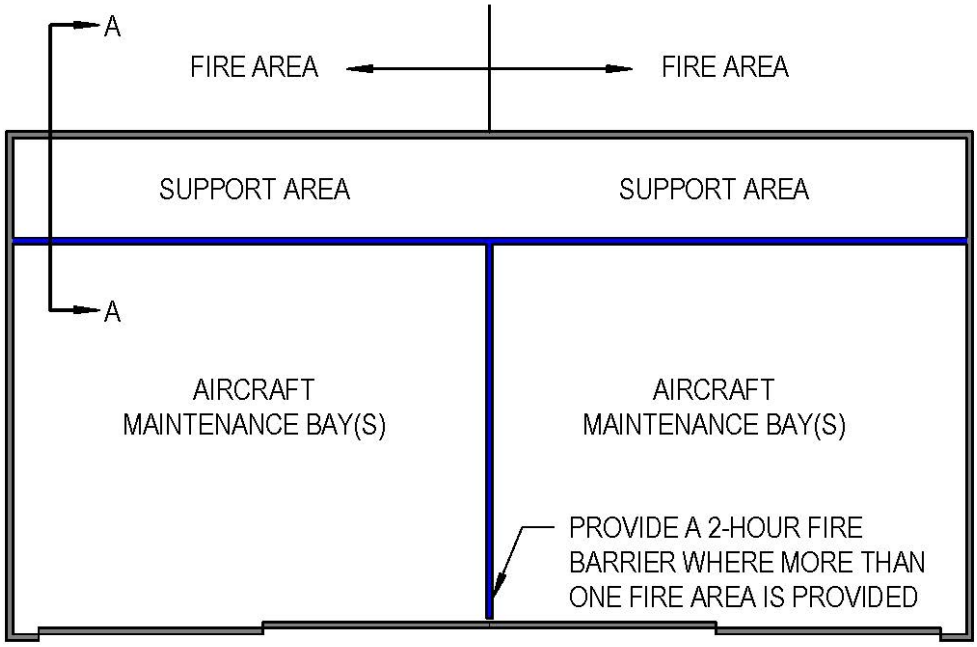
Protection of structural members (columns, beams, trusses, joists) above that established in the type of construction is not required in the hangar bay when protected by an approved fire suppression system in compliance with this UFC.

3-3.1.3 Internal Fire Rated Separations

Provide fire rated separations that are Underwriters Laboratory (UL) listed, Factory Mutual (FM) approved, a calculated assembly by a Nationally Recognized Testing Laboratory (NRTL), or an assembly calculated in accordance with IBC. At a minimum, provide the fire rated separations listed below and shown in Figure 3-1: Internal Fire Rated Separations.

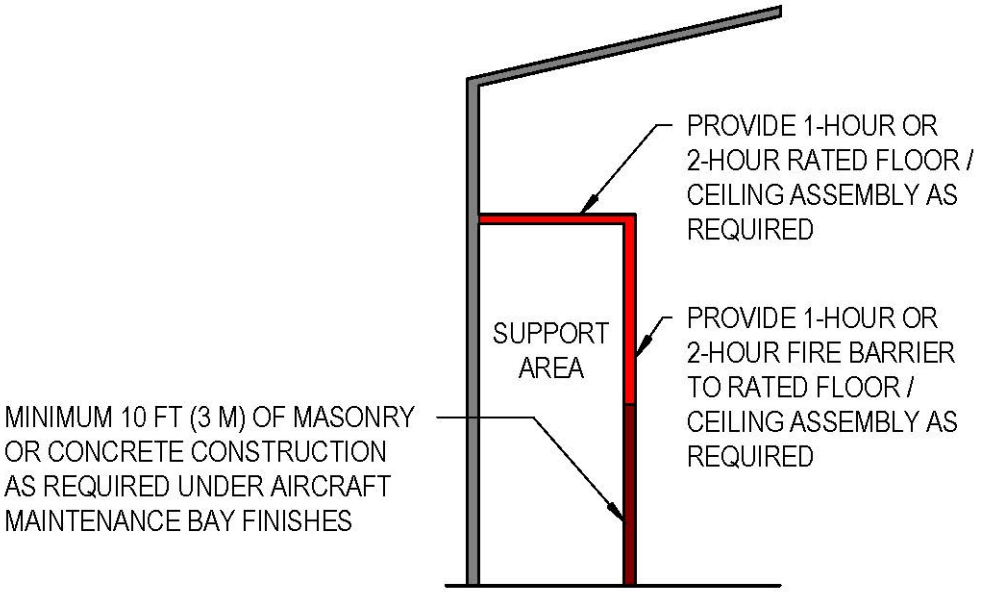
- Provide a 1-hour fire barrier between hangar bay and support areas such as offices, maintenance shops, and storage areas including tools, parts, and tires.
- Provide a 2-hour fire barrier between separate fire areas within the hangar bay.
- Internal fire barriers are not required between adjacent aircraft servicing areas unless required elsewhere in this UFC.
- Protect openings in fire barriers in accordance with NFPA 101, such as doors and windows.
- Protect duct penetrations through fire barriers in accordance with UFC 3-600-01. \2\

Figure 3-1: Internal Fire Rated Separations



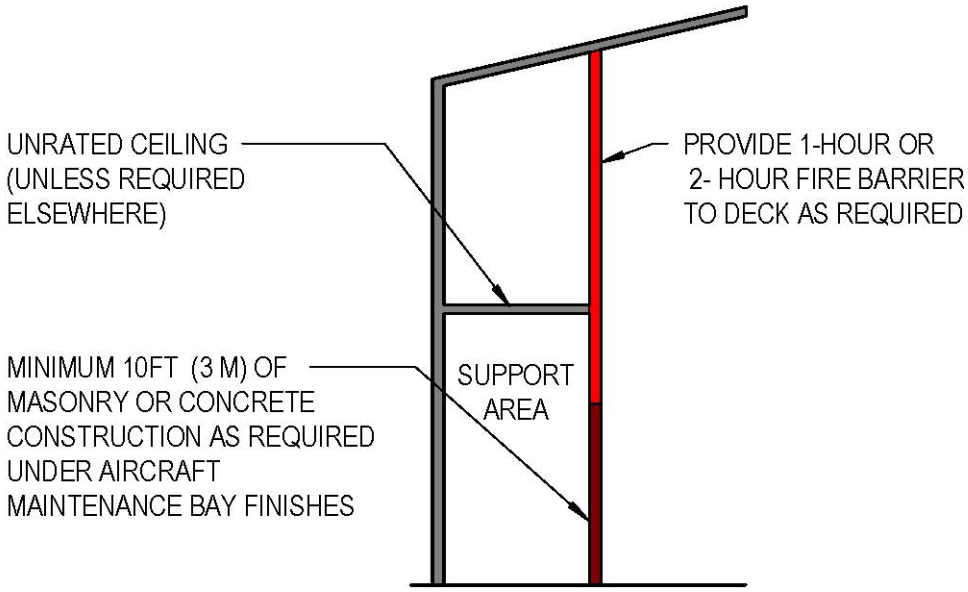
HANGAR BUILDING PLAN VIEW

Figure 3-1-1: Internal Fire Rated Separations



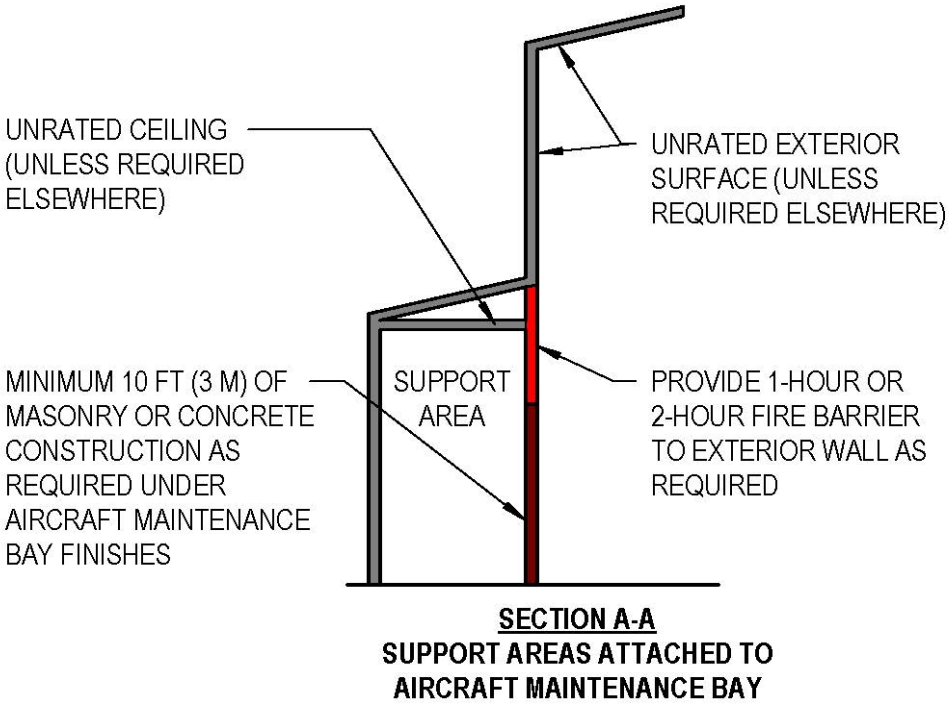
SECTION A-A
SUPPORT AREAS WITHIN AIRCRAFT MAINTENANCE BAY

Figure 3-1-2: Internal Fire Rated Separations



SECTION A-A
SUPPORT AREAS SEPARATED FROM AIRCRAFT MAINTENANCE BAY

Figure 3-1-3: Internal Fire Rated Separations



/2/

3-3.1.4 Internal Fire Wall Separations

Where operational aircraft assets are isolated from non-DoD areas, provide 4-hour rated fire walls where these assets are co-located in a building with non-DoD operations that are beyond the control of the DoD users. Minimize penetrations through such firewalls. Protect any necessary door, window, and other penetration in accordance with Factory Mutual Global Property Loss Prevention Data Sheets 1-22, Criteria for Maximum Foreseeable Loss Fire Walls and Space Separation and 1-23, Protection of Openings.

3-3.1.5 Allowable Fire Area

The allowable fire area in the hangar bay is unlimited where a building is constructed in accordance with this UFC. In some instances, more than one fire area may be provided to limit the size of the foam/water system discharge area.

3-3.1.6 Allowable Building Area

The allowable building area is limited to the restrictions of the IBC. Where a building is constructed in accordance with this UFC, modify the restrictions of unlimited area buildings to allow for three stories and Group A-3 occupancies.

3-3.1.7 Allowable Building Height and Stories

Where the building is constructed in accordance with this UFC, the allowable building height is unlimited. The allowable number of stories is limited to the restrictions of the IBC based on the construction type.

3-3.1.8 Building Clear Space and Fire Separation Distance

Provide clear space around the facility in accordance with NFPA 409. The clear space is permitted to be around a group of buildings, where those buildings are considered a portion of one building on the same lot as defined by IBC.

Provide fire separation distance in accordance with IBC.

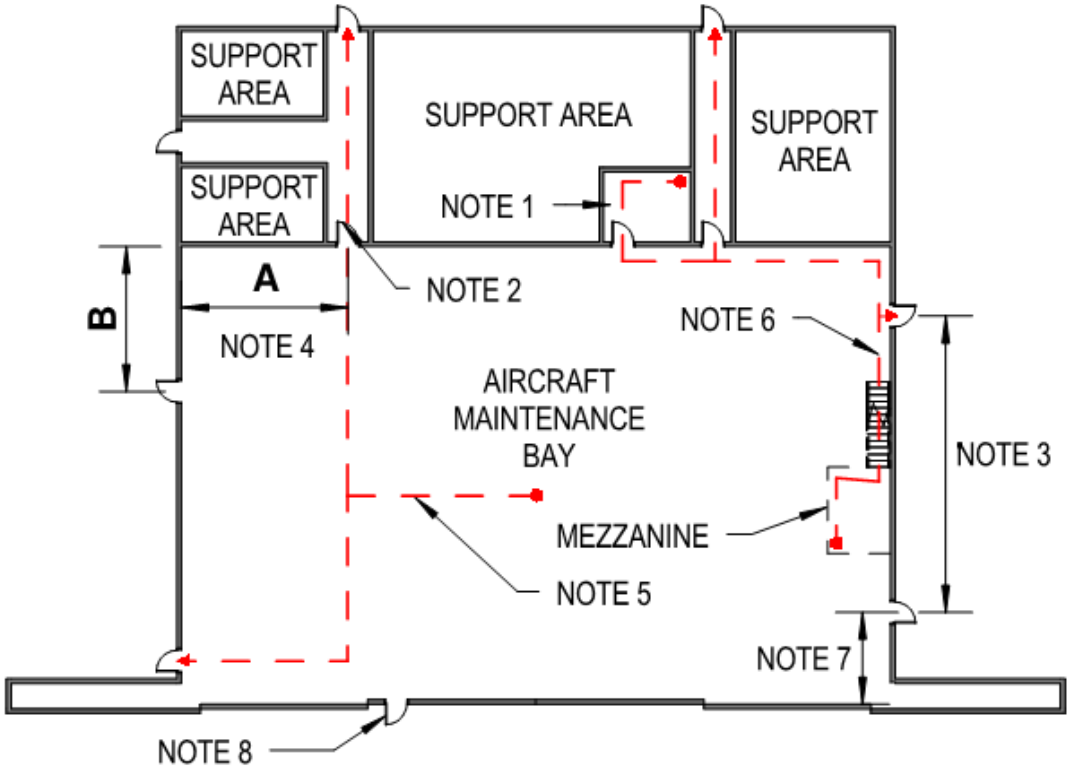
3-3.1.9 Hangar Bay Egress

The requirements of NFPA 101 apply to hangar bay egress, except as modified.

- **For Air Force and Navy**: Provide exits or exit access doors around the entire perimeter of the hangar bay at a maximum spacing of 150 feet (ft.) (45.7 meters (m.)). Unless otherwise noted in this UFC, travel distance limitations do not apply in the hangar bay. Provide each exit access door from the hangar bay, which passes through adjacent building areas, with a continuous unobstructed path to an exit. Travel distance begins at the hangar bay exit access, and is measured along the path of egress travel to the exit. Refer to Figure 3-2: Air Force and Navy Hangar Bay Egress for additional information.
- **For Army:** Provide exits on the exterior walls around the hangar bay egressing directly to the exterior at a maximum spacing of 150 ft. (45.7 m). Locate the first exit on the exterior wall no further than 75 ft. (22.9 m) from the start of the hangar bay exterior wall. Apply the maximum travel distance for General Industrial occupancy as defined by NFPA 101. Refer to Figure 3-3: Army Hangar Bay Egress for additional information.
- Where hangar bay doors exceed 110 ft. (33.5 m), do not provide exits in the hangar bay door to meet the maximum distance limitation between exits. Provide exits within 20 ft. (6.1 m) of each end of the hangar bay door opening.
- Personnel access doors may be provided through the hangar bay door; however these doors are not considered exits for egress.
- Install an egress door in the structure between hangar bay doors, when the structure is greater than 7 ft. (2.1 m) in width. Provide this door regardless of whether the 110 ft. (33.5 m) limitation is exceeded.
- Provide each required exit or exit access door from the hangar bay with panic hardware, and swing the door in the direction of egress travel.

- Support areas are not permitted to have their required egress through the hangar bay with the exception of normally unoccupied rooms less than 100 sq. ft. (9.3 sq. m). This limitation is not inclusive of equipment platforms as defined by IBC.
- Do not exceed a travel distance of 75 ft. (22.9 m) from the most remote location on the mezzanine to an exit or exit access. Equipment platforms as defined per IBC are not considered mezzanines.

Figure 3-2: Air Force and Navy Hangar Bay Egress



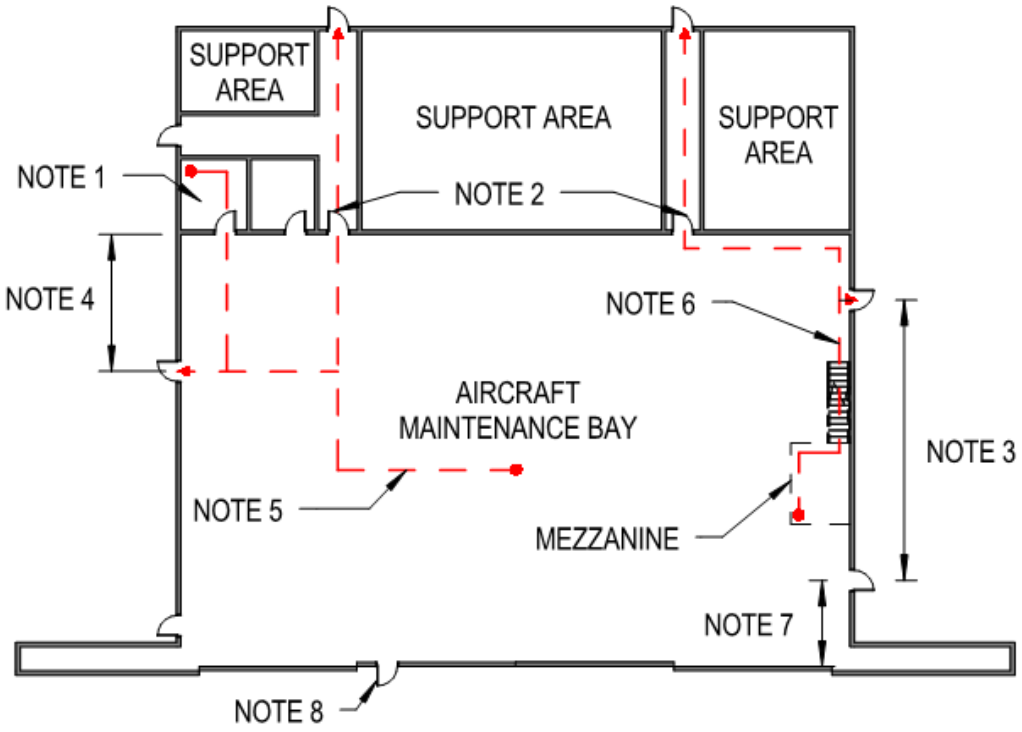
Air Force and Navy Egress Notes:

1. Normally unoccupied rooms less than 100 sq. ft. (9.3 sq. m) may have their sole means of egress through the hangar bay.
2. Travel distance limitations begin at the door from the hangar bay.
3. Except where noted, do not exceed 150 ft. (45.7 m) between exits and exit access doors along the hangar bay perimeter.
4. Do not exceed a cumulative total of 150 ft. (45.7 m) for the distance of A + B.
5. Except where noted, travel distance limitations do not apply within the hangar bay.
6. Do not exceed a travel distance of 75 ft. (22.9 m) from the most remote location on the mezzanine to an exit or exit access.

7. Where the hangar bay door opening exceeds 110 ft. (33.5 m), provide the first exit or exit access within 20 ft. (6.1 m) of the hangar bay door opening.

8. Personnel doors are permitted in the hangar bay door, however they are not considered exits for egress.

Figure 3-3: Army Hangar Bay Egress



Army Egress Notes:

1. Normally unoccupied rooms less than 100 sq. ft. (9.3 sq. m) may have their sole means of egress through the hangar bay.

2. Unless the wall separating the hangar bay from the support area is a horizontal exit as defined by NFPA 101, the distance between exit access doors along this wall is only limited by the travel distance.

3. Except where noted, do not exceed 150 ft. (45.7 m) between exits in the hangar bay exterior wall.

4. Do not exceed 75 ft. (22.9 m) between the start of the hangar bay exterior wall and the first exterior exit along the wall.

5. Travel distance limitations from the hangar bay are applicable until an exit is reached.

6. Do not exceed a travel distance of 75 ft. (22.9 m) from the most remote location on the mezzanine to an exit or exit access.

7. Where hangar bay door exceeds 110 ft. (33.5 m), provide the first exit or exit access within 20 ft. (6.1 m.) of the hangar bay door opening.

8. Personnel doors are permitted in the Aircraft Maintenance Bay door, however they are not considered exits for egress.

3-3.1.10 Draft Curtains

Provide draft curtains in accordance with NFPA 409 and the following requirements. Steel sheeting thinner than 26 gauge (0.455 mm), aluminum, fiberglass reinforced plastic or other plastic materials are not permitted. Fit the curtain tightly against the underside of the roof. Use mineral wool, ceramic fiber or another approved fire stop material to fill steel deck flutes or other gaps through the curtain. Install draft curtains to form rectangular roof pockets. Where structural roof supports extend below the roof or ceiling, install draft curtains on structural roof supports to the extent practical. Construct the bottom edge of the draft curtain at a constant height above and parallel with the finished floor. Draft curtains are not required to extend below the tail height of the aircraft plus the clearance dimension in Table 2-1: Minimum Aircraft Maintenance Bay Clearances.

Provide draft curtains such that d_{min} is the greater of:

- $d_{min} = H_{max}/8$, or
- d_{min} = 4 ft. (1220 mm), and the draft curtain extends at least 1 ft. (305 mm) below H_{min}.

Where:

- d_{min} = Minimum depth of the draft curtain measured down from H_{max} (ft., m).
- H_{max} = Maximum roof height AFF where the draft curtain is installed (ft., m).
- H_{min} = Minimum roof height AFF where the draft curtain is installed (ft., m).

3-3.1.11 Exterior Firefighting Accessibility

Provide suitable exterior fire apparatus access on at least two complete sides of the building. Fire apparatus access is permitted to be around a group of buildings, where those buildings are considered a portion of one building on the same lot as defined by IBC.

Suitable access surfaces include ramps, aircraft parking aprons, automotive parking areas, fire apparatus access roads, and stabilized landscaped areas. Where automotive parking areas are used for fire department access, provide at least one aisle 20 ft. (6.1 m) wide with an adequate turning radius for fire department apparatus.

3-3.1.12 Interior Firefighting Accessibility

Exit and exit access doors from the hangar bay provide building access into the hangar bay for normal structural firefighting operations.

Provide the ability to operate the hangar bay door under emergency conditions. Refer to 3-7.2: Hangar Bay Door Power for requirements.

3-3.2 Exterior Systems

3-3.2.1 Exterior Materials

UFC 3-101-01 recommends that facilities be designed in harmony with the surrounding architecture, judiciously employing the style and character of architecturally significant facilities in the area. Utilize exterior materials and develop a character befitting the size and nature of Aircraft Maintenance Hangars and their location within a typically industrial area near an airfield. Select a color pallet to harmonize with the surrounding architecture. Consider adjacent historical precedent but not to the extent of unwarranted additional cost to the Government.

Provide exterior materials appropriate for the environment at the project location.

3-3.2.2 Exterior Envelope

Provide an exterior envelope per UFC 3-101-01 Chapter 3 Building Envelope Requirements. Construct walls between semi-heated Aircraft Maintenance Bays and adjacent conditioned spaces per requirements for semi-heated spaces in American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) 90.1 Building Envelope Requirements Tables. Consult UFC 3-101-01 to confirm envelope air barrier testing requirements for Aircraft Maintenance Bays.

3-3.2.3 Exterior Walls

\3\ Provide masonry or concrete impact resistant construction for a minimum height of 10 ft. (3.0 m) above the finished floor for the interior and exterior face of the entire perimeter of the Aircraft Maintenance Bay, except at hangar doors. /3/ This includes the side/end walls, as well as the back wall which typically separates the Aircraft Maintenance Bay from shops and parts repair rooms. Refer also to 3-3.1: Construction, Life Safety, and Fire Fighter Access for fire rating requirements for walls between the Aircraft Maintenance Bays and other spaces.

3-3.2.4 Roof

Provide a roof system in accordance with UFC 3-110-03, except as modified in this paragraph. Aggregate surfaces and vegetative roofs are not acceptable due to FOD prevention concerns at airfields. Do not slope roof toward airfield unless rainwater will be collected at the roof eave and taken below grade to storm water drain system. Do not direct rainwater above grade to the flight line side of the hangar. Slope roof away from hangar doors and aircraft movement areas. Provide fall prevention and/or fall protection in accordance with UFC 3-110-03. Most hangars do not have mechanical

equipment on the Aircraft Maintenance Bay roofs but there may be other equipment such as antenna platforms. Provide path and fall protection for access to all roof mounted lighting and antenna platforms from interior roof access point. Refer to 2-1.6 Solar Glare Hazard Analysis.

3-3.2.5 Windows

Provide exterior windows, skylights, and doors on inhabited portions of the building per UFC 4-010-01. In addition, provide all interior windows and glazed doors exposed to the Aircraft Maintenance Bay with laminated glass designed in accordance with UFC 4-010-01 for the same blast effects as the most severely loaded exterior glazing system. Provide materials appropriate for the environment at project location and warrant material for expected lifespan of the building without any requirements for special maintenance. Provide insect screens with any operable windows.

3-3.2.6 Exterior Doors and Hardware

Security issues may govern over these minimum requirements.

3-3.2.6.1 Exterior Hangar Doors

Refer to 3-10: Hangar Doors for hangar door requirements. Refer to C-10: HANGAR DOOR for guidance on best practices for hangar door selection and design.

3-3.2.6.2 Exterior Personnel Door and Frames

Exterior aluminum doors are to be wide stile type with minimum 5 inches (127 millimeters (mm)) stiles, top rails, and mid rails, minimum 10 inches (254 mm) bottom rails, 3/16 inch (5 mm) wall thickness, welded corner construction.

Exterior hollow metal doors to be galvanized or galvannealed steel, Level 4 and Physical Performance Level A. Exterior hollow metal frames to be galvanized or galvannealed steel, welded, Level 4. Refer to American National Standards Institute/Steel Door Institute (ANSI/SDI) A250.8.

3-3.2.6.3 Exterior Door Hardware

Provide hardware meeting ANSI/BHMA Grade 1 listed in the certified products directory. Coordinate hardware scheduling requirements with Base Staff. The hardware requirements include:

- Hinges - ANSI/BHMA A156.26.
- Locksets - ANSI/BHMA A156.13 Operational and security Grade 1 Series 1000 mortise locks tested to exceed at least 3 times the number of cycles required for Grade 1.
- Exit Devices - ANSI/BHMA A156.3 tested to exceed at least 3 times the number of cycles required for Grade 1.

- Closers - ANSI/BHMA A156.4 tested to exceed at least 3 times the number of cycles required for Grade 1.
- Overhead Stops - ANSI/BHMA A156.8.
- Protection Plates - ANSI/BHMA A156.6 - Kick Plates J102, Armor Plates J101.
- Thresholds - ANSI/BHMA A156.21.
- Weather-strip, Sweeps, Drip Caps - ANSI/BHMA A156.22.

Provide closers with heavy-duty arms at all exterior doors. Provide closers with integral spring stop arms or provide separate heavy-duty overhead stops. Provide thresholds, head and jamb weather-strip (with astragals at pairs of doors without mullions), sweeps with integral rain drips, and overhead rain drips at exterior doors. Provide kickplates at hollow metal doors with closers, and at storage room doors with or without closers. Armor plates are required at doors anticipated to encounter cart traffic.

3-3.3 Interior Systems

Durability is extremely important when specifying materials for interior construction and finishes. Aircraft Maintenance Hangars are often occupied 24 hours per day, seven days a week and heavy equipment is regularly handled throughout the facility. Provide durable low maintenance finishes in a limited palette with good appearance retention. Incorporate colors, patterns, and textures which successfully mask minor abrasions and day-to-day soiling between cleaning. Provide finishes that are easily repairable if and when necessary. Provide corner guards if using gypsum board in corridors and other high traffic areas. Provide finishes to incorporate LEED criteria, with low and no VOC adhesive and paint finishes, walk off mats for increased indoor air quality, with highest recycled content as is feasible for the project, and other environmentally sensitive features and benefits.

3-3.3.1 Resilient Flooring

At a minimum, provide durable Class I monolithic vinyl tile resilient flooring resistant to stains and scuffing, able to stand up to high foot traffic and requiring minimum maintenance.

3-3.3.2 Interior Partitions

Extend partitions up to the bottom of the floor/roof construction above for the following areas:

- Commanding Officers Office
- Executive Officers Office
- Conference or Briefing Rooms
- Classrooms or Training Rooms
- Rooms or offices with secure communication systems

- Corridors
- Perimeter of toilet and locker room areas
- Offices and operational spaces where privacy issues are of significant concern
- Flight planning
- Maintenance Shops

Refer to 3-3.3.3: Acoustics for additional requirements. Provide a wall base on all walls in spaces with an applied floor finish.

3-3.3.3 Acoustics

Provide acoustics per UFC 3-101-01 unless superseded by other criteria or the STC ratings listed in individual Functional Room Data Sheets as the basis for the sound attenuation design of the partition, door and window assemblies for the facility.

Hangar maintenance bays and maintenance shops can be high noise areas. Prevent sound from the exterior and sound from these and other noisy spaces such as corridors, toilets, elevator, machine rooms, and mechanical rooms from having negative impact on the adjacent spaces.

3-3.3.4 Floors

Provide floors per 3-4.2: Ground Floors.

3-3.3.5 Ceilings

The following spaces may have exposed ceiling structure:

- Hangar Bay
- Maintenance Shops
- Corridors (Ground Level) and Stairs
- Building Support Spaces

Provide finished ceilings in all other spaces. Refer to Finishes. Typical minimum finished ceiling height to be 9 ft. (2.74 m) unless otherwise indicated. Coordinate minimum hook heights for overhead cranes and hoists with MEP and Structural building systems when setting floor to floor and floor to roof heights to ensure a safe working environment for occupants in those spaces.

3-3.3.6 Interior Doors and Hardware

Security issues may govern over these minimum requirements.

3-3.3.6.1 Interior Hollow Metal Doors and Frames

Interior hollow metal doors are to be Level 3 and Physical Performance Level A. Interior hollow metal frames are to be welded Level 3. Interior hollow metal doors between Aircraft Maintenance Bays and shop spaces and other areas subject to high abuse are to be Level 4 and Physical Performance Level A, with Level 4 welded frames. Interior hollow metal doors at administrative areas may be Level 2 and Physical Performance Level B, with Level 3 frames. Refer to ANSI/SDI A250.8. Provide fire resistant assemblies where required to meet fire ratings. Provide fire-rated glazing door vision panels where required in this UFC. Meet ASTM E90 where acoustical door assemblies are specified.

3-3.3.6.2 Interior Wood Doors

Provide Heavy Duty, Type II, Particle Core, PC-5 or PC-7 interior wood doors. Provide fire resistant composite cores where required to meet fire ratings. Provide wood blocking as required to eliminate the use of through bolts for hardware mounting at fire-resistant composite core doors. Provide Premium "A" Grade veneers using Plain Sliced Red Oak as a minimum standard at wood doors. Provide edge veneers to match face veneers. Provide wood doors prefit, beveled, and factory machined for mortise hardware including pilot holes for hinges screws. Refer to WDMA I.S.1-A and AWS Section 9. Provide factory finished wood doors utilizing WDMA finish system TR-6 as a minimum standard. Meet ASTM E90 where acoustical door assemblies are specified.

3-3.3.6.3 Interior Door Hardware

Provide hardware meeting ANSI/BHMA Grade 1 listed in the certified products directory. Coordinate hardware scheduling requirements with Base Staff.

The hardware requirements include:

- Hinges - ANSI/BHMA A156.26 Full mortise continuous aluminum at Level 4 doors.
- Hinges - ANSI/BHMA A156.1 Heavy weight ball bearing type at Level 2 and 3 metal doors and wood doors with closers, overhead stops, or sized larger than 3'0" x 7'0".
- Hinges - ANSI/BHMA A156.1 standard weight ball bearing type at wood doors without closers or overhead stops, sized 3'0" x 7'0" or smaller.
- Locksets - ANSI/BHMA A156.13 operational and security Grade 1 Series 1000 mortise locks tested to exceed at least 3 times the number of cycles required for Grade 1.
- Locksets - ANSI/BHMA A156.2 Grade 1 series 4000 per are allowable at administrative spaces. Locks tested to exceed at least 3 times the number of cycles required for Grade 1.
- Exit Devices - ANSI/BHMA A156.3 tested to exceed at least 3 times the number of cycles required for Grade 1.

- Closers - ANSI/BHMA A156.4 tested to exceed at least 3 times the number of cycles required for Grade 1.
- Protection Plates - ANSI/BHMA A156.6 Kick Plates J102, Armor Plates J101.

Provide exit devices on door at rooms containing explosives (Paraloft, Flight Gear, and Ordnance). Provide kickplates at all doors with closers and at all storage rooms with or without closers. Armor plates are required at doors that are anticipated to encounter cart traffic.

3-3.3.7 Casework

Specify Architectural Woodwork Institute (AWI) Premium or Custom for construction and finishes per AWI Quality Standards Illustrated, Current Edition. Provide veneer panel core casework, cabinet doors and drawer faces. Provide plastic laminate or better finish on all exposed surfaces of the casework must. Provide solid composite plastics countertops, unless otherwise indicated or requested.

3-3.3.8 Signage

Provide signage per UFC 3-120-01, in Aircraft Maintenance Bay to explain operation of significant building features and limiting factors for hangar door operation. For example, locate a sign near the controls of hangar doors explaining proper operation. Similarly, provide signage near the maintenance control office to explain items such as maximum slab loads, jacking loads, use of ventilation system, operation of the fire protection system, and lighting controls. Develop a comprehensive signage package (both interior and exterior) that addresses way-finding and definition of all spaces within the facility. Provide signage to reflect and complement the environment through colors, images and materials used.

3-3.4 Finishes

3-3.4.1 Ground Level

3-3.4.1.1 Aircraft Maintenance Bay

\2\ Slope Aircraft Maintenance Bay floors to prevent liquid spills from flowing into adjacent areas in compliance with NFPA, IBC, and ABA. Provide a reflective light-colored 5-coat fuel resistive resinous flooring with striping of safety lanes, lead-in lines, nose gear stop lines, grounding points, and other safety markings. Floor color coating is typically light gray to reflect and contrast sharply with foreign objects and small parts and enhance visibility of such items. Although light gray is recommended, other colors may be used as local needs dictate as approved by the user. Coordinate colors, striping and grit level with the users. Provide a grit level meeting OSHA slip resistance requirements. /2/

Provide painted masonry, or concrete construction to a minimum of 10 ft. (3.0 m) Above Finished Floor (AFF) around perimeter of Aircraft Maintenance Bays except at hangar door. Refer to 3-3.1: Construction, Life Safety, and Fire Fighter Access for fire rated

separations between the Aircraft Maintenance Bay and other spaces. A wall base is not required in the hangar bay.

3-3.4.1.2 Maintenance Administration

Provide resilient flooring, painted walls, resilient base, and suspended acoustical ceiling systems. Partitions separating administrative spaces may be gypsum board on metal stud construction. Partitions may extend to above the ceiling for similar office types and spaces where noise between offices is not an acoustical issue.

3-3.4.1.3 Heavy Maintenance Shops

\2\ Provide a reflective light-colored, 5-coat fuel resistive resinous flooring system with striping for safety markings. Floor color coating is typically light gray to reflect and contrast sharply with foreign objects and small parts and enhance visibility of such items. Although light gray is recommended, other colors may be used as local needs dictate as approved by the user. Coordinate colors, striping and grit level with the users. Provide painted concrete or masonry walls up to 10 ft. (3.0 m) minimum around perimeter of each shop. Provide painted exposed ceilings. /2/

3-3.4.1.4 Light Maintenance Shops

Provide resilient flooring or 3-coat fuel resistant resinous flooring. Provide painted gypsum board on metal stud walls and suspended acoustical ceiling systems. Provide static dissipative flooring in electronics, avionics, paraloft, flight gear, ordnance shops and other spaces as required by the user.

3-3.4.1.5 Storage

Provide sealed concrete floors, painted masonry or concrete walls, painted exposed ceilings.

3-3.4.1.6 Personnel Support

Provide porcelain tile floors in shower, toilet and locker rooms. Provide painted concrete or masonry partitions around shower, toilet, and locker rooms. Provide full-height or wainscot-height ceramic or porcelain tile at "wet" walls, at a minimum. Provide moisture-resistant gypsum board or moisture-resistant suspended acoustical ceiling system.

In support spaces such as break rooms provide resilient flooring or seamless resinous flooring, painted gypsum board walls and suspended acoustical ceiling system.

3-3.4.1.7 Building Support

Provide sealed concrete floors and painted masonry or concrete walls and unpainted exposed bottom of floor/roof construction above.

3-3.4.1.8 Corridors

Provide flooring equal to the most durable finish provided in the spaces served by the corridor. Provide 5-coat fuel resistive resinous flooring in corridors providing indirect access to heavy maintenance shops. Provide resilient flooring or 3-Coat fuel resistive resinous flooring in corridors serving light maintenance shops. Provide sealed concrete or resilient flooring in corridors serving only personnel and building support spaces. Provide painted concrete, masonry or impact resistant gypsum board walls, resilient base, and suspended acoustical ceiling systems. Provide full-height corner guards at all exterior corners, including columns.

3-3.4.1.9 Stairs

In stairs, provide resilient flooring and stair accessories, painted concrete, masonry or impact resistant gypsum wall board up to a minimum of 8 ft. (2.44 m) above stair level.

3-3.4.2 Upper Level

Finish upper level spaces similar to commercial office spaces.

3-3.4.2.1 Operational Administration

Provide carpet tile, resilient base, painted gypsum board walls and suspended acoustical ceiling systems.

3-3.4.2.2 Personnel Support

Provide porcelain tile floors and painted gypsum board walls. Provide ceramic tile wainscots at toilet, shower, and locker rooms. Provide full-height ceramic tile wall finishes on all walls in showers or similar 'wet' spaces. Provide moisture-resistant gypsum board or moisture-resistant suspended acoustical ceiling system in toilet, shower and locker rooms.

In support spaces such as break rooms provide resilient flooring or seamless resinous flooring, resilient base, painted gypsum board walls and suspended acoustical ceiling system.

3-3.4.2.3 Building Support

Provide sealed concrete floors and painted gypsum board walls and unpainted exposed bottom of floor/roof construction above.

3-3.4.2.4 Corridors

Provide resilient flooring or carpet tile, painted impact resistant gypsum board walls, resilient base and suspended acoustical ceiling systems.

3-3.4.3 Protective Coatings

Paint all non-prefinished items per requirements below.

- Shop coat exposed exterior ferrous metal primary and secondary steel framing per UFGS 09 97 13.27. Coat all other exposed exterior ferrous metal per 09 90 00, Division 5: Exterior Metal, Ferrous and Non-Ferrous Paint Table.
- Shop coat all exposed and non-exposed ferrous metal of hangar doors per UFGS 09 97 13.27.
- Shop coat exposed interior ferrous metal primary and secondary steel framing inside Aircraft Maintenance Bays per UFGS 09 97 13.27. Coat all other exposed interior ferrous metal inside Aircraft Maintenance Bays per UFGS 09 90 00, Division 5: Interior Metal, Ferrous and Non-ferrous Paint Table.
- Coat exposed interior ferrous metal in spaces other than Aircraft Maintenance Bays and Building Support spaces as defined in 3-3.4: Finishes per UFGS 09 90 00, Division 5: Interior Metal, Ferrous and Non-ferrous Paint Table.
- Coat exposed interior ferrous metal in Building Support spaces as defined in 3-3.4: Finishes at a minimum with primer coat only per UFGS 09 90 00, Division 5: Interior Metal, Ferrous and Non-ferrous Paint Table.
- Coat non-exposed interior ferrous metal at a minimum with a primer coat only per UFGS 09 90 00, Division 5: Interior Metal, Ferrous and Non-ferrous Paint Table.
- Coat other interior substrates such as gypsum board, concrete, masonry and wood per UFGS 09 90 00.
- Provide 5-coat fuel resistive resinous flooring at the Aircraft Maintenance Bay and heavy maintenance shops and associated corridors per UFGS 09 67 23.16. Provide striping of safety lanes, lead-in lines, nose gear stop lines, grounding points, emergency eye wash fixtures, fire extinguishers and other safety markings. Coordinate colors, striping and grit level with the users. Provide grit to meet OSHA Requirements for wet floors. Refer to Chapters 5, 6, and 7 for figures showing Service-specific striping requirements. Follow recommendations in UFGS 09 67 23.16 to coordinate with the structural engineer doing the slab design to provide a below slab vapor barrier, and to design the slab to be as low vapor emitting as possible. Do not use spray-on curing compounds. Specify the manufacturer's Moisture Vapor Reducer coating and just don't use it if the concrete test come in at acceptable vapor emissivity rates.
- Provide 3-coat fuel resistive resinous flooring at light maintenance shops and associated corridors per UFGS 09 67 23.15. Provide striping safety markings. Coordinate colors, striping and grit level with the users. Follow recommendations in UFGS 09 67 23.15 to coordinate with the structural engineer doing the slab design to provide a below slab vapor barrier, and to design the slab to be as low vapor emitting as possible. Do not use spray-on curing compounds. Specify the manufacturer's Moisture Vapor

Reducer coating and just don't use it if the concrete test come in at acceptable vapor emissivity rates.

3-3.5 Elevators

Provide an elevator car of size and arrangement to meet ABA Accessibility requirements and to accommodate an ambulance stretcher. Provide elevators in accordance with NAVFAC ITG 2013-01 Elevator Design Guide or superseding Elevator UFC when published.

3-3.6 Bird Intrusion Prevention

Coordinate accepted intrusion prevention measures with environmental office for host facility. Design intrusion prevention systems to not restrict access to building systems. Design all access required as removable panels that can be removed and replaced with the normal means of access and tools used by maintenance personnel.

3-4 STRUCTURAL

Typical structural systems utilized in Aircraft Maintenance Hangars are described below. Refer to Chapters 5, 6, and 7 for Air Force, Army, and Navy specific applicability and exceptions to this section.

Aircraft Hangars are to be assigned Risk Category III unless the Authority Having Jurisdiction approves a different Risk Category based on the following conditions:

- Aircraft Hangars housing aircraft which are not "high value equipment" may be assigned to Risk Category II.
- Aircraft Hangars that house aircraft with a "mission critical" function, which are required to remain operational, may be assigned to Risk Category IV.

3-4.1 Foundations

Foundations are not to utilize the slab on ground to resist lateral forces. Foundations are to be separated from the slab on ground by an isolation joint. Hairpins or tie beams within the slab on ground are not allowed. Tie beams are allowed if they are completely independent of the slab on ground such as when the tie beams are located below the slab on ground.

3-4.2 Ground Floors

Design ground floors for all loadings anticipated to be supported by the floor system. These loads may include aircraft wheel loads, aircraft tug wheel loads, fire truck wheel loads, fork truck wheel loads, jacking loads, wall loads, and point loads. \1\ Confirm with using activity full range of intended aircraft to be housed within the hangar including whether it is to be used for "dense packing" of multiple aircraft in non-standard use during storms or other events. /1/

Design ground floors to be either deep foundation supported reinforced concrete structural slab (slab supported by deep foundations) or concrete slab on ground (slab supported by the subgrade). Design deep foundation supported reinforced concrete structural slabs in accordance with the structural requirements and criteria of UFC 3-301-01. In the Aircraft Maintenance Bay these structural slabs are also to be designed for the aircraft loads stated in this UFC. Design the slab on ground in the three different areas of the Aircraft Maintenance Hangar as follows:

3-4.2.1 Office/Administration Slabs on Ground

Design slab-on-ground systems for the offices and administration spaces of the hangar facility in accordance with the American Concrete Institute ACI 360R. The minimum thickness of the slab-on-ground is to be 5 inches (127 mm).

3-4.2.2 Shops Slabs on Ground

Design slab on ground systems for the shop spaces of the hangar facility in accordance with the American Concrete Institute ACI 360R. Design the slab for all shop equipment loads, fork truck wheel loads and other applicable wheel loads. The finished floor elevation of the shop spaces to be at or above the highest floor elevation of the Aircraft Maintenance Bay. The minimum thickness of the slab on ground is to be 6 inches (152 mm).

3-4.2.3 Aircraft Maintenance Bay Slab on Ground

Design the Aircraft Maintenance Bay slabs on ground for the minimum wheel loads shown in the Service-specific chapters of this UFC. Design in accordance with the procedure described below.

The Aircraft Maintenance Bay floor will be above the exterior grade and the floor slope will project beyond the face of the building to meet the exterior apron grade. Slope the Aircraft Maintenance Bay floor a minimum of 0.5% (1/16" per foot) towards the flight line door or trench drains (when provided). Additional cross-slopes may be necessary to meet other drainage requirements. Do not slope floors more than 1.5% (3/16 inch per foot).

3-4.2.3.1 Aircraft Maintenance Bay - Slab on Ground Design

Determine the concrete slab on ground thickness for the Aircraft Maintenance Bay in accordance with UFC 3-260-02, utilizing a non-reinforced concrete section with the Service-specific minimum loads shown in this UFC. It is acceptable to design and install reinforcing for temperature and/or crack control but the reinforcing cannot be used to decrease the slab on ground thickness from the calculated non-reinforced slab thickness. If point loads other than wheel loads require a thicker slab section, then reinforcing can be utilized in the area of the point load to keep from increasing the slab thickness for the point load. A typical cross-section is shown in

Figure 3-4: Typical Aircraft Maintenance Bay Slab on Ground Cross-Section. Other criteria is as follows.

- Minimum concrete slab on ground thickness will be 8 inches. Increase slab thickness in 1/2" increments.
- Minimum concrete flexural strength will be 550 pounds per square inch (psi) at 90 days.
- Maximum concrete flexural strength will be 650 psi at 90 days.

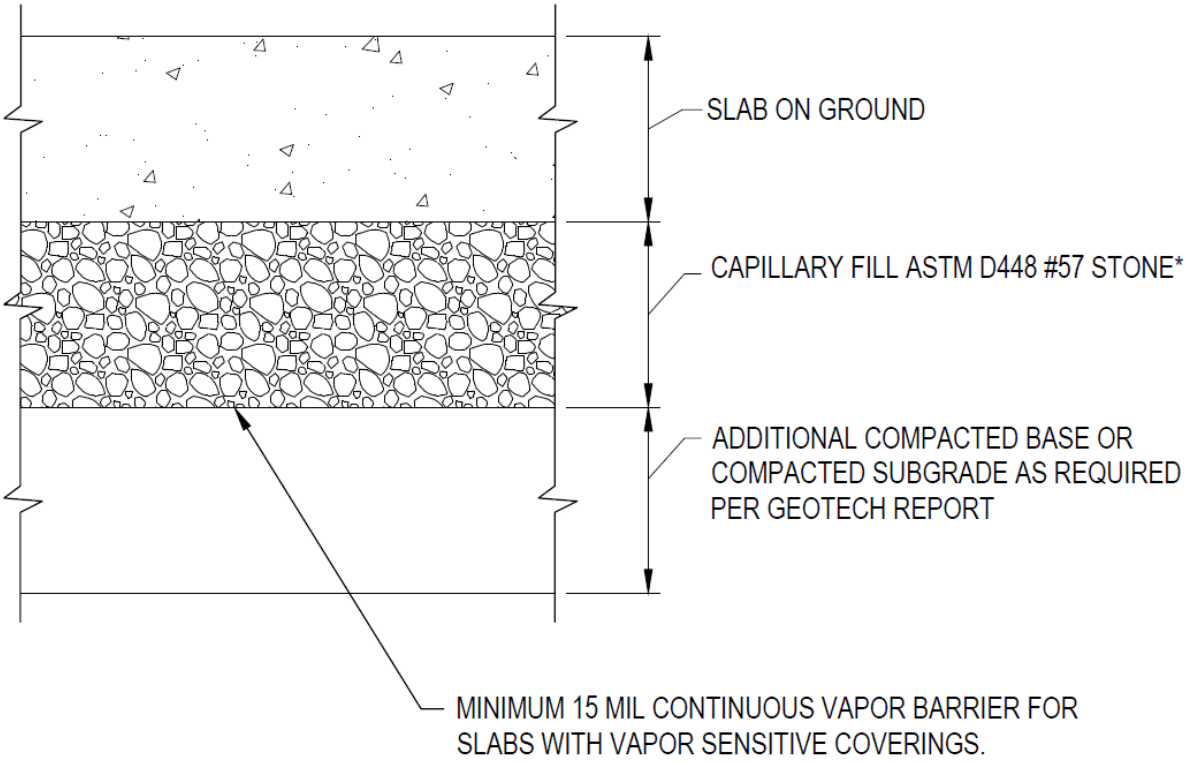
  \1\
- In hangar bays that allow for multiple aircraft parking positions, provide a uniform slab on ground design throughout the hangar bay. Do not reduce the slab on ground thickness in areas not subject to the design aircraft wheel loads.
- In single aircraft hangar bays that only allow for parking of one aircraft in one position, slab on ground thickness in areas that are not subject to the design aircraft loads may be optimized or reduced in thickness. Before optimizing the slab, using activity should confirm any additional loads including whether hangar is intended to be used for "dense packing" of multiple aircraft in non-standard use during storms or other events. For Navy Standard Hangar Types, variable slab thickness is not permitted per section 7-4.1Aircraft Maintenance Bay - Slab on Ground Loading.
- Where slab is not a uniform design, provide clear markings for special slab areas designated for wheel load paths, jacking, etc.

  /1/
- If welded wire fabric is utilized, it must be provided in flat sheets with a minimum wire size of W4.0.
- Do not use fiber reinforced concrete systems inside the hangar facility without prior approval.

For Navy: Utilize a minimum of 0.05% reinforcing steel in both directions in the aircraft maintenance bay slab on ground.

Figure 3-4: Typical Aircraft Maintenance Bay Slab on Ground Cross-Section

\3



*FUNCTIONS AS A CAPILLARY WATER BARRIER. PUMP OUT EXCESS WATER BEFORE SLAB ON GROUND PLACEMENT.

/3/

3-4.2.3.2 Aircraft Maintenance Bay - Concrete Slab on Ground Joint Spacing

Space the Aircraft Maintenance Bay slab on ground joints in accordance with Table 3-1: Aircraft Maintenance Bay Slab on Ground Joint Spacing. Locate the joints considering the column line spacing while not exceeding the maximums listed in Table 3-1: Aircraft Maintenance Bay Slab on Ground Joint Spacing.

Table 3-1: Aircraft Maintenance Bay Slab on Ground Joint Spacing

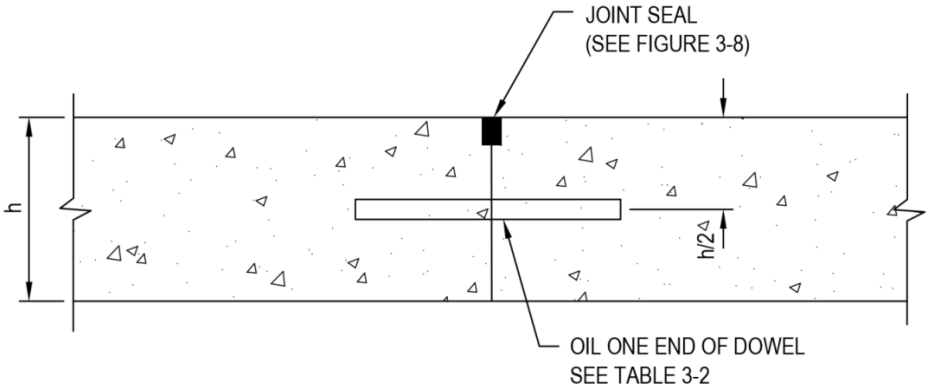
SLAB TYPE	CONCRETE THICKNESS* (T) MILLIMETERS (INCHES)	SPACING METERS (FEET)
NONREINFORCED SLAB	205 (8) ≤ T ≤ 230 (9) 230 (9) < T ≤ 305 (12) T > 305 (12)	3.8 TO 4.6 (12.5 TO 15) 4.6 TO 6.1 (15 TO 20) 6.1 (20) MAX
SLAB WITH REINFORCEMENT (MINIMUM 0.05% STEEL IN BOTH DIRECTIONS)	ALL THICKNESSES	7.6 (25) MAX

*Minimum thickness allowed is 205 mm (8 inches).

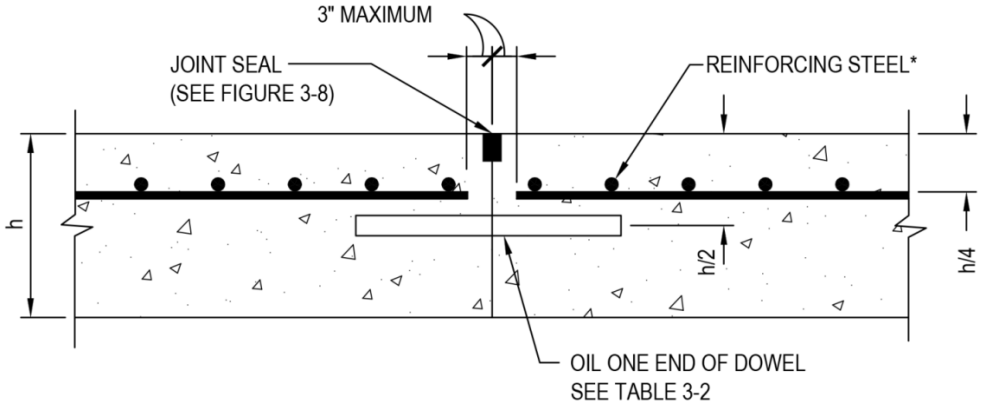
3-4.2.3.3 Aircraft Maintenance Bay - Concrete Slab on Ground Joint Details.

In the Aircraft Maintenance Bay use the following types of joints, joint sealant details and dowels.

Figure 3-5: Concrete Slab on Ground Construction Joint



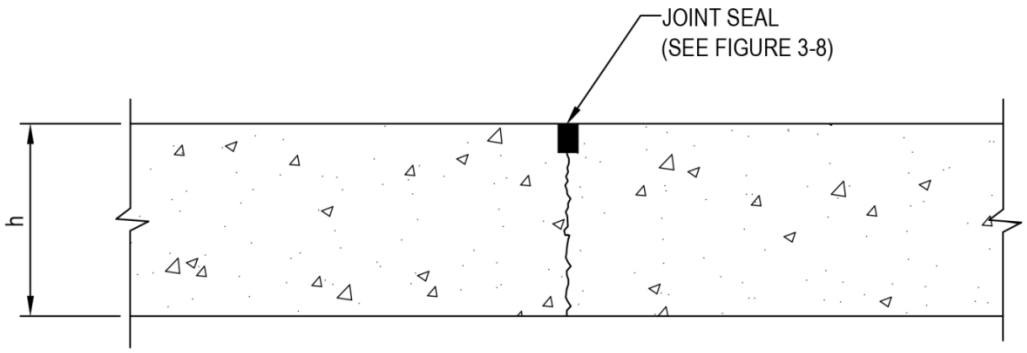
DETAIL A - NONREINFORCED SLAB



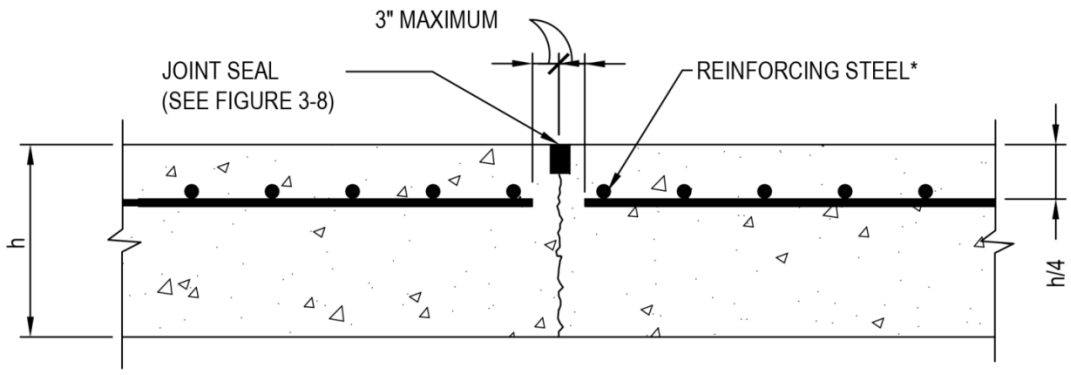
* DO NOT EXTEND REINFORCING STEEL THROUGH JOINT

DETAIL B - SLAB WITH REINFORCEMENT

Figure 3-6: Concrete Slab on Ground Contraction Joint



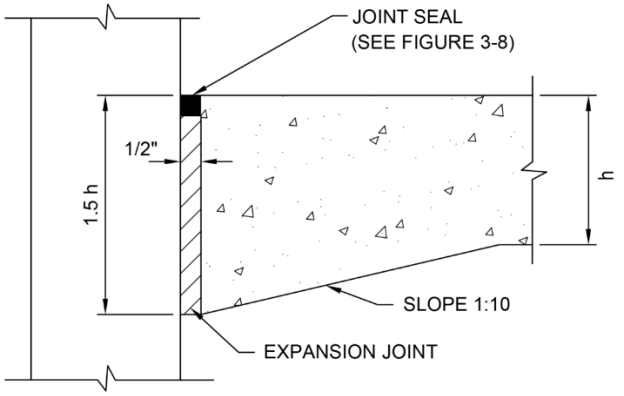
DETAIL A - NONREINFORCED SLAB



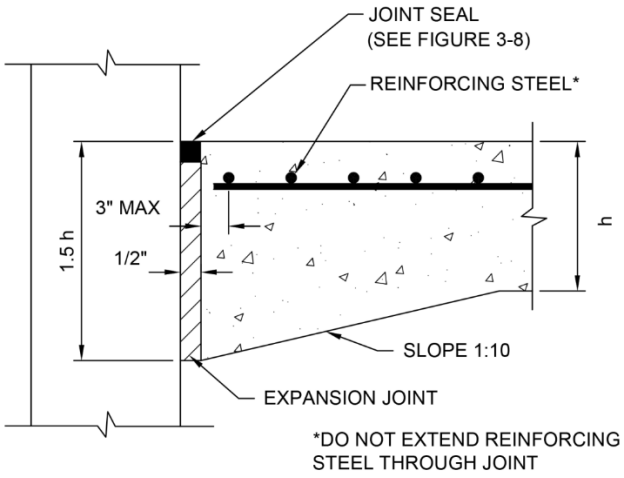
* DO NOT EXTEND REINFORCING STEEL THROUGH JOINT

DETAIL B - SLAB WITH REINFORCMENT

Figure 3-7: Concrete Slab on Ground Expansion Joint

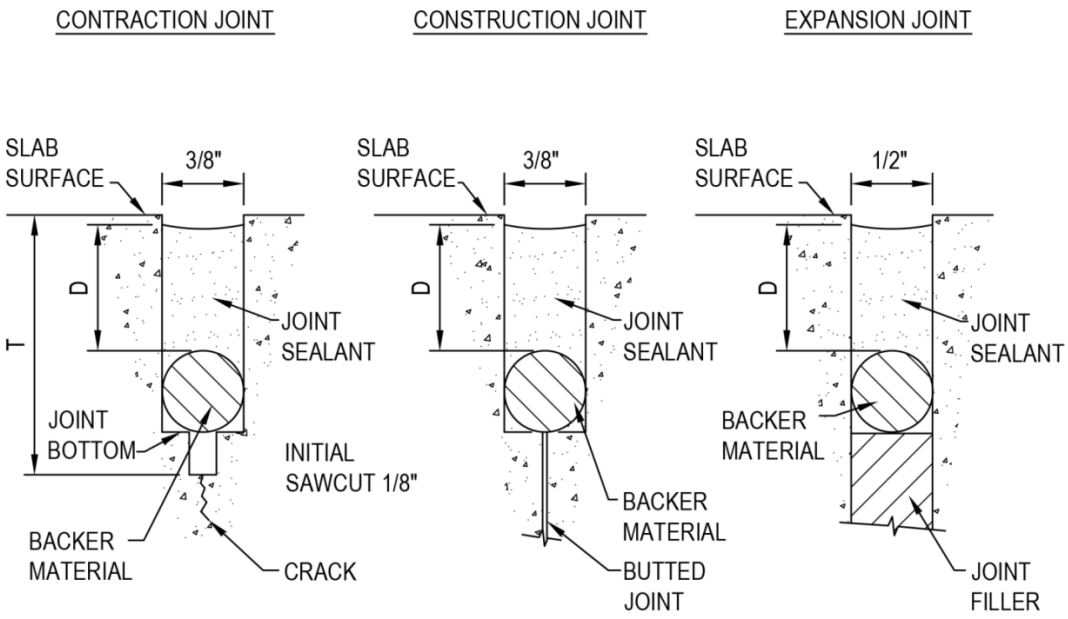


DETAIL A - NONREINFORCED SLAB



DETAIL B - SLAB WITH REINFORCMENT

Figure 3-8: Joint Sealant Details for Concrete Slabs on Ground



T = DEPTH OF INITIAL SAWCUT
- a. 1/4 SLAB THICKNESS ± 1/2" FOR SLABS LESS THAN 12 INCHES.
- b. 3 INCHES FOR SLABS 12-18 INCHES.
- c. 1/6 SLAB THICKNESS FOR SLABS MORE THAN 18 INCHES.
- d. DIAMETER OF BACKER MATERIAL = JOINT WIDTH PLUS 1/8 INCH

D = DEPTH OF SEALANT AS REQUIRED BY SEALANT MANUFACTURER

NOTE: TOP OF SEALANT TO BE 1/4" TO 1/16" BELOW TOP OF SLAB

CONVERSION FACTORS
METERS = 0.3048xFEET
MILLIMETERS = 25.4xINCHES

Table 3-2: Concrete Slab on Ground Dowel Size and Spacing

CONCRETE SLAB THICKNESS IN INCHES	\2\ MINIMUM DOWEL LENGTH IN INCHES /2/	\2\ MAXIMUM DOWEL SPACING IN INCHES /2/	DOWEL DIAMETER AND TYPE
8 TO AND INCLUDING 11.5	16	12	1 INCH BAR
12 TO AND INCLUDING 15.5	20	15	1 TO 1-1/4 INCH BAR
16 TO AND INCLUDING 20.5	20	18	1-1/4 TO 1-1/2 INCH BAR
21 TO AND INCLUDING 25.5	24	18	2 INCH BAR
OVER 26	30	18	3 INCH BAR

3-4.2.3.4 Aircraft Maintenance Bay - Slab on Ground Floor Heating

For slabs on ground with in floor heating, provide the following:

- A minimum 0.06% distributed reinforcement in each direction.
- Slab on ground thickness to be at least the depth of slab calculated by procedure described in this UFC, plus the additional depth of the radiant tubing.
- Under slab insulation as required by mechanical calculations for R value with sufficient strength to support the design loads without permanent deformation. Insulation to be placed under slab wherever there is radiant

floor tubing. Refer to ACI 360R-10, Chapter 13 for additional guidance on under slab insulation.

- Coordinate closely with the in-floor radiant heat systems supplier on the design of the hangar floor slab, location of insulation, location of radiant tubing and radiant tubing manifolds within the slab on ground.

3-4.3 Superstructures

3-4.3.1 Aircraft Maintenance Bay

Traditionally, the superstructure of the Aircraft Maintenance Bay is steel framed, however, alternate framing systems can be considered with approval. Design Pre-Engineered Metal Building systems to the standards applicable to traditional steel framing, including adherence to all requirements of the American Institute of Steel Construction and this UFC.

Design the aircraft maintenance hangar in accordance with UFC 4-010-01. Aircraft Maintenance Hangars are generally considered "inhabited" buildings due to the occupancy and population density within the administration and office areas. However, the Aircraft Maintenance Bay may be considered "low occupancy" buildings if it meets all the requirements of UFC 4-010-01.

3-4.3.2 Aircraft Maintenance Bay Superstructure and Hangar Doors

Design the sliding hangar door guide systems to allow total roof live load deflection. Coordinate the total anticipated roof deflection with the door guide manufacturer to ensure that the design stroke of the hangar door guides is not exceeded. Show on the construction documents the expected maximum deflection, both upward and downward, as well as the allowable deflection of the hangar door guide system. For cantilever roof systems, design the hangar door guide system to have adjustment capability to allow for final leveling after all loads are in place.

Design the Aircraft Maintenance Bay superstructure to be compatible with the requirements of the vertical-lift fabric door manufacturer. Show on the construction documents the expected maximum deflection, both upward and downward of the superstructure, as well as the allowable deflection of the Vertical Life Fabric Door (VLFD) framing. Design the VLFD door jamb members to be secondary members, independent of the main structural system, to allow for field adjustment during erection of the building.

3-4.3.3 Administration and Shops Superstructure

If the administration and shops area is constructed as an isolated structure from the Aircraft Maintenance Bay, it may be a bearing wall or frame system of concrete, steel, or reinforced masonry. If the administration and shops area is constructed as an integral part of a steel-framed Aircraft Maintenance Bay structure, the administration and shops structure must be steel-framed.

The framing system selected for the Administration and Shops area will provide areas free from isolated columns. Structural bracing will be located so as not to impair functionality of Administration and Shops areas. Exposed structural bracing will not be permitted in office areas without prior approval.

3-4.4 Main Structural Framing Materials

Select exposed steel shapes to minimize their surface area. Design all exposed steel connections to shed water. Design and detail exposed steel to permit the complete inspection of all fasteners and welds. Seal Hollow Structural Sections (HSS) to keep water from entering the section and animals from nesting inside.

Do not use weathering steel for framing material.

3-4.5 Secondary Structural Systems

Design the walls and partitions of the Aircraft Maintenance Bay to be non-load bearing and not be considered as elements of the lateral load resisting system. The walls of the office/shop portion of the facility may be designed as load-bearing if structurally isolated from the Aircraft Maintenance Bay structure. Limit the use of interior load bearing walls to allow for future reconfiguration of the spaces. Consider the relative stiffness of all wall and partition systems and the main framing and provide for structural isolation as required.

Roof framing system will be a galvanized structural steel roof deck on structural steel members, open-web steel joists or light-gage "Z" purlins. The steel deck cannot be used as a diaphragm for the principal building lateral force resisting system. Utilize horizontal truss or other system for the principal building lateral force resisting system. The steel deck can be utilized to brace secondary members, if the designer can show that there is deflection compatibility between the deck serving as a brace, and the main lateral force resisting system. Provide a positive load path from the steel deck to the structural system, which does not rely on the joist seats or purlins to transfer lateral loads. Properly brace roof framing members for stability during construction and for final configuration.

3-4.6 Strength Requirements

Design for all the loads described in or incorporated by reference to UFC 3-301-01, and for all loads imposed by bridge cranes, suspended work docs, personal fall arrest systems, hangar doors or other specialty equipment supported by the structure. Show all relevant design loading and stability assumptions on the construction drawings. Note elements that function as stability bracing and the members that are laterally unstable until the stability bracing is installed. All instances where the installation of multiple secondary elements is required for the proper stability of a primary element or when a bracing element in turn requires stability bracing.

Design to consider the effect of pattern loads resulting from multiple loaded crane hooks and work docks. All crane hardware and lifted loads will be treated as live loads in the load combinations defined in Chapter 16 of the IBC, except for patented tracks, tracks,

supports, sway braces and similar elements which are immobile and may be defined as dead loads.

3-4.7 Serviceability Requirements

Control deflections of structural elements to within the limits imposed by UFC 3-301-01 unless stricter control is necessary to support equipment, fascia or other appurtenances. Design the Aircraft Maintenance Bay roof and wall structural elements to meet a minimum deflection criteria of l/240. Design the office/shops area structural elements to meet the deflection requirements appropriate to finish type.

Control lateral drift (side sway) of the structure to within the limits imposed by UFC 3-301-01 unless stricter control is necessary for the serviceability of the structure and all its components, including, but not limited to, exterior walls and cladding, partition walls, hangar doors, bridge cranes, utilities and other appurtenances. If the Aircraft Maintenance Bay and the office/shops area framing is constructed as a single frame, design the structure to meet the most stringent requirements described above.

3-4.8 Thermal Requirements

In addition to the thermal loads of UFC 3-301-01, design to account for anticipated differential thermal effects from solar heating (e.g., on long sun-exposed exterior steel compared to shaded steel such as roof trusses, joists, or decking) or inside/outside differences (particularly an "attic" effect in the hangar bay). Consider the local climate conditions when selecting the final differential temperature range. Investigate the deflections caused by differential thermal effects using unfactored loads. Some architectural fascia elements and weather seals around hangar doors are particularly vulnerable to detrimental deflections.

3-5 MECHANICAL

Comply with the requirements of UFC-3-410-01, UFC 3-410-02, UFC 3-410-04N and other applicable UFCs. Additional criteria specific to aircraft hangar mechanical systems is included herein.

3-5.1 Heating, Ventilation and Air Conditioning (HVAC)

\3\ Heating and cooling system design loads for the purpose of sizing systems, appliances and equipment are determined in accordance with UFC 3-410-01. Include analysis of UFC 1-200-02, ICC IGCC, and ASHRAE 55 for thermal environmental conditions for human occupancy in the HVAC design. /3/

Size equipment and all system components to maintain the following indoor design conditions. Provide design conditions, including temperature, humidity, filtration, ventilation, and air changes required.

- Administrative/ Office/Shop cooling: 78ºF (26ºC) dry bulb (db) and a maximum of 55ºF (12.8ºC) dew point. Take into account the moisture gain

in the space. During unoccupied hours, set temperatures no lower than 85ºF (29.4ºC).

- Administrative/ Office/Shop heating: 68ºF (20ºC) db. During unoccupied hours, set temperatures no higher than 55ºF (12.8ºC).
- Aircraft Maintenance Bay heating: 55ºF (12.8ºC) db at 99% db outdoor design temperature. During unoccupied hours, set temperature no higher than 50ºF (10ºC) at 99% db outdoor design temperature. The appropriate unoccupied setpoint temperature depends on the system selected and the designer will take this into consideration when selecting the heating system for the facility. Humidification is not authorized. Take into account infiltration in the hangar bay heating loads.
- Locate HVAC air handling equipment serving administration and shop spaces in dedicated mechanical rooms or on the roof. Locate air handling systems(s) floor-mounted in the mechanical rooms and not within the actual spaces served. Make mechanical room large enough to allow a minimum of 2 ft. (610 mm) between the air-handling unit and the wall, adequate coil pull space, and unobstructed access to replace air filters. Provide additional access/maintenance space in accordance with equipment manufacturer's recommendations.

3-5.2 Heating

The type of heating system depends on the outdoor design temperatures. The options are overhead radiant heat, in-floor radiant heat, or forced-air heat. Conduct a 40-year life-cycle cost analysis to support selection from the heating system choices. Include an analysis of the anticipated user occupancy schedule. Include these results in the design analysis. If floor-type or forced-air heaters are installed, direct the discharged air to cover the entire floor area to help reduce accumulation of combustible and flammable vapors and arranged to draw warm air from the top of the hangar for distribution at occupied level. Provide floor-type heater fans with not less than six air changes per hour based on an artificial ceiling height of 15 ft. (4.6 m). Refer to 3-5.3: Ventilation for ventilation requirements.

\3\ In climates where freezing temperatures occur, protect hangar door tracks or the bottom edges of hangar doors with electric or hot water-glycol snow-melting coils in accordance with NFPA 409. Ensure that non-toxic antifreeze is used, such as propylene glycol, to avoid freezing and environmental spill concerns. Use a sump pump to inject the antifreeze into the system. Provide ratio of antifreeze to water between 30 and 50%, depending on the design temperature, to avoid freezing. If a backup generator is provided, connect snow-melting coils to backup circuit. If a backup generator is not provided, consider alternate emergency operation with external generator hook-up or other means. See 3-7.5 Backup Power for more information. /3/

3-5.2.1 Overhead Radiant Heating

Install gas infrared heaters at the height specified in NFPA 409. Install suspended or elevated heaters not less than 5 ft. (1,524 mm) above the hangar door or lower chord of

the roof truss. Use low-intensity tube-type gas infrared radiant heaters. If the outside air temperature is above 40ºF (4.4ºC) and the hangar door is open, automatically shut off the overhead gas-fired, radiant heating system. If the outside air temperature is below 40ºF (4.4ºC) operate the radiant heating system regardless of hangar door position.

For Air Force and Navy: High-intensity type radiant heaters with open flame or glowing elements are not to be installed.

For Army: Refer to Chapter 6 Army Specific Criteria for use of high-intensity type radiant heaters in Army Aircraft Maintenance Bays.

3-5.2.2 In-Floor Radiant Heating

In-floor, radiant heating systems can be considered in colder climates. They can provide savings on energy and operational costs when compared to conventional heating systems. Refer to 3-4.2.3.4: Aircraft Maintenance Bay - Slab on Ground Floor Heating. Include the efficiency of in-floor, radiant tube systems in the cost analysis of heating systems.

3-5.2.3 Humidification

For administration and shop spaces, where the indoor relative humidity for comfort heating is expected to fall below 20%, add humidification to increase the indoor relative humidity to 30%. Coordinate with the architect to design the building envelope to prevent condensation in the wall/roof systems during the time humidification is in operation. Include in the design analysis a dew point analysis profile (ASHRAE Fundamentals Chapter 23) for winter design conditions, showing condensation boundaries. The dew point analysis will consider the effect of air movement into the walls for buildings under positive pressurization relative to the outdoors.

3-5.3 Ventilation

Provide ventilation in shop administration spaces in accordance with the latest versions of ASHRAE 62 and UFC 3-410-01. This is typically provided by a dedicated outdoor air system (DOAS), which is separated from the space-cooling function. Include infiltration into ventilation system design.

The use of high-volume, low-speed (HVLS) fans or high velocity focused destratification fans can be considered for installation in hangar bays to provide air mixing and create air movement for comfort at the floor level. These are not a replacement for the exhaust system described below. These fans can redirect heat back down to the occupied level, can improve comfort and efficiency, and provide a homogeneous volume of air to reduce concentration of local vapors. Coordinate the installation of fans with overhead radiant heaters, fall protection, high-expansion foam generators, lights, bird netting, bridge cranes and sprinklers. Coordinate with sprinklers in accordance with the requirements of NFPA 13.

3-5.3.1 Exhaust

Provide exhaust systems at the heat or contamination sources. Exhaust systems will operate continuously while the building is occupied. Exhaust fans in spaces that are infrequently occupied such as conference rooms and break rooms, can be provided with occupancy sensors or manual switches for operation. Provide energy recovery from exhaust systems in accordance with ASHRAE 189.1. Provide exhaust systems in accordance with ASHRAE and NFPA 90A.

3-5.3.1.1 Rest Room Exhaust

Provide each rest room with an exhaust rate in accordance with the latest version of ASHRAE 62. Restroom exhaust can be combined with janitor's closet exhaust.

3-5.3.1.2 Printer/Copier Rooms Exhaust

Provide printer/copier rooms/areas and break rooms with a dedicated exhaust system. Interlock exhaust systems for printer/copier rooms with the HVAC system serving the area of the building in which the air is being exhausted. Provide minimum exhaust rate in accordance with ASHRAE 62.1.

3-5.3.1.3 Avionics/Electrical Repair Exhaust

Provide a permanently wall mounted local snorkel type exhaust system with articulating arm fume extractor for soldering work stations (if provided). Provide each unit with a stainless steel cabinet, a self-supportive, anti-static flex hose, an energy-efficient fan, and rated for solder use.

3-5.3.1.4 Parts Washers Exhaust

Recommend locating parts washers in separate rooms and not in hangar bays. Provide local exhaust hood above all parts washers. Provide hood size and exhaust rate per the ACGIH Industrial Ventilation Guide. Provide exhaust hood at least 6 inches (152 mm) larger in all horizontal dimensions than the parts washer surface. Size exhaust airflow to provide a capture velocity of between 75 and 100 feet per minute (0.38 and 0.50 meters per second). Locate the exhaust hood at least 36 inches (900 mm) above the parts washer.

3-5.3.1.5 Hangars Exhaust

Ventilate the hangar bay at a general rate of 0.5 cubic feet per minute (cfm)/square feet (2.54 liters/sec/m^2) when aircraft maintenance activities are being conducted for the purposes of odor and fume mitigation. Include ventilation exhaust fans with the exhaust ductwork extended down to a height of 8 ft. (2.5 m) above the hangar floor or lower along the back wall opposite the hangar doors. Install intake louvers with motorized dampers above the hangar doors or in adjacent walls to interlock with the exhaust fans. Refer to the Army Chapter for additional ventilation and exhaust criteria for Army hangars.

3-5.3.1.6 Repair and Maintenance Areas Exhaust

Provide general exhaust in weapons vault and non air-conditioned repair and maintenance areas at a minimum rate of 0.5 cfm/square foot (2.54 liters/sec/ $m^{2)}$ for purposes of odor and fume mitigation. Provide weapons vault with non-sparking exhaust fans, and all exhaust ducted to the exterior of the building. Operate exhaust systems continuously while the building is occupied. Direct exhaust outside through the roof to eliminate possibility of creating nuisances/hazardous situations to personnel at ground level. If Life Cycle Cost effective, include air quality monitoring to reduce the ventilation when it is not otherwise required.

3-5.3.1.7 Specialized or Localized Exhaust

Provide specialized or localized exhaust in shop spaces where indicated or required.

\2 If a battery maintenance shop is required, see UFC 3-520-05 for additional requirements. Lithium-Ion battery maintenance requires significant space and mechanical systems. ***/2/***

For Navy: 7-14.5: Functional Data Sheets for Navy Functional Data Sheets.

Comply with applicable OSHA standards and end user requirements where maintenance operations include working with heavy metals, grinding, sanding, and working with chemicals.

3-5.4 Air Conditioning

The following criteria applies to air conditioning of rooms within the maintenance hangar facility:

- Do not air condition hangar bays unless required for certain aircraft and their maintenance procedures. Verify and coordinate with end user and Facilities Requirements Document (FRD).
- Certain UAS/RPA aircraft have internal avionics systems that are sensitive to high temperatures and can alarm when the inside temperature gets up to 110ºF (43.3ºC) while the aircraft is inside the hangar during maintenance operations. These aircraft may also have fuel systems that need to be maintained below a certain temperature. A conditioned hangar bay can be provided for these aircraft in accordance with the requirements of the aircraft. In dry, arid climates, evaporative cooling systems can meet this requirement and should be evaluated in lieu of air conditioning.
- Provide air conditioning for all maintenance shops and for those functional areas where it is required for quality control of equipment, material, and task.
- Serve shop spaces with a separate air handling/air conditioning system from the administration type spaces.

- Administrative and shop areas will have positive pressurization with respect to the hangar bay area. Administrative areas will have positive pressurization with respect to shop areas.

Where the fire alarm equipment cannot be located in a normally occupied conditioned space as required by UFC 3-600-01 and 3-6.19.2.2 Location of Releasing System Components because this space does not exist (E.g. an Alert Shelter with minimal support space), condition the room housing the fire alarm equipment to meet the conditions defined in 3-6.19.2.2 Location of Releasing System Components.

The following air conditioning system design considerations apply to critical, high-density heat load spaces, such as server rooms and computer rooms, which contain critical equipment that is sensitive to high temperatures:

- Provide redundant cooling units. Ensure that if one cooling unit goes down, the remaining unit(s) can provide cooling for at least 75% of the load.
- Provide a high space temperature alarm that will notify the Energy Management Control System (EMCS).
- Provide condensate pumps in the cooling units if the condensate from the cooling units cannot gravity drain to a nearby drain.
- Depending on the outdoor design conditions, provide a humidifier in each cooling unit for winter humidification of the space.

3-5.5 Plumbing

Provide plumbing in accordance with UFC 3-420-01.

Provide a drainage system for hangar door mullion pits and sliding hangar door tracks.

For Air Force: Connect drainage system to sanitary or storm sewer based on requirements for other building drainage system and as required by Base Environmental Office.

For Army and Navy: Connect drainage system to industrial waste or storm or sanitary sewer based on requirements for other building drainage systems as required by Base Environmental Office.

3-5.5.1 Emergency Showers and Eye Wash Stations

Provide emergency shower/eye wash stations in hangar bay, pneudraulics repair, and shop areas where chemicals, oils, solvents or debris can be sprayed or blown into eyes, or spilled on clothing. Supply tepid water to emergency showers and eyewashes. Provide emergency showers and eyewashes in accordance with ANSI Z358.1 and OSHA standard 1910.151(c) and UFC 3-420-01. Floor drains at emergency shower eye wash stations can be provided if desired by the users, however they are not required.

Do not install floor drains adjacent to emergency shower eye wash stations for Air Force hangars.

3-5.5.2 Wall Hydrants and Hose Bibbs

Provide exterior wall hydrants on perimeter walls of building with a maximum spacing of 100 ft. (30.5 m). Provide freeze-proof exterior yard hydrant in mechanical yards containing chillers, condensers, condensing unit, and cooling towers. Provide all hydrants with a vacuum breaker to prevent back flow.

Provide a hose bibb in all mechanical rooms. Provide hose bibbs with a vacuum breaker to prevent back flow.

3-5.6 Water and Sewer

Size domestic water piping per ASHRAE and international plumbing code. Size the domestic water heating system with storage and recovery for delivery of hot water to every fixture per ASHRAE and international plumbing code. Provide usage diversity factor of one for the showers. Size water heater(s) based upon anticipated usage or this diversity factor. Instantaneous water heaters are permissible for remote fixtures. Install floor drains and cleanouts in accordance with the latest version of International Plumbing Code and UFC 3-420-01. Provide floor drains near ice machines, in rooms requiring HVAC condensate removal, restrooms, showers, and mechanical rooms.

Per Energy Independence Security Act (EISA) Section 523 and UFC 1-200-02, evaluate the cost effectiveness of solar domestic hot water.

3-5.7 Industrial Oil/Water Waste

Since hazardous materials are used in the aircraft maintenance process, provide floor drains in the hangar bay spaces or shops/storage rooms that are tied to the station industrial sewer with outlet to an oil/water separator tied to a collection system that will capture and hold these materials for proper disposal. Drainage from interior hangar door trench drains may be included in this system. Design in accordance with all applicable environmental codes. Coordination of the collection system is required with the Base or Station to determine the size of the collection system based on the frequency of evacuating it (such as weekly, bi-monthly, monthly), volume of potential liquid spill, and the size of the site where it is to be located.

Design trench drain system for easy cleanout of oil or other residue. Convey waste to an oil/water separator prior to discharge to the sanitary sewer system. Refer to 3-11.3: Trench Drains.

For Air Force: Do not install floor drains or trench drains in the hangar bay except where explicitly indicated in Chapter 5 Air Force Specific Criteria.

3-5.8 Process Systems

3-5.8.1 Compressed Air

Provide compressed air for all hangar bays and shop spaces. Include a refrigerated air dryer in the compressed air systems. In shops, provide wall-mounted compressed air drops, with lubricator on every wall at spacing of every 25 ft. (7.6 m). In hangar bays, provide compressed air drops, with lubricator, along back wall and side walls at spacing of every 50 ft. (15.2 m). Coordinate with users any requirements for compressed air hose reels in shops and hangar bays.

For Navy: Refer also to Chapter 7: Navy Specific Criteria, 7-14.5: Functional Data Sheets for Functional Data Sheets for specific requirements. **\2** Provide instrument quality compressed air. Size air compressor system to accommodate all tool loads, fuel cell evacuation equipment, fuel vacuum equipment, air pressure cabin leakage tester (APCLT), and any other high-volume, air-driven equipment. Create a loop by connecting the compressed air piping at the end of the system back to the compressed air main. Provide particulate filter, oil removal coalescing filter, air dryer, and receiver tank sized for minimum 10 minute recycle (stop - start) storage time to protect compressor motor from burn-out. Provide a cooler as necessary to limit compressed air temperature to 120F max. Provide high-volume compressed air drops, 150 scfm minimum, for every two hangar bays, minimum 1-1/4” pipe size. Provide 12-inch drip legs for water removal with forged steel globe valves at all risers and throughout the system. Refer to NAVAIR System Specification for the Aircraft Pressurized Cabin Leakage Tester (APCLT) Number PMA260C21/3490/V20. Request air consumption loads from maintenance activity for each piece of air-driven maintenance equipment. If loads are not available for specific equipment, assume 150 scfm and 125 psig per item. Size all compressed air piping per Compressed Air and Gas Institute (CAGI) Handbook with a load factor of 25%.***/2/***

For Army: In hangars, mount compressed air connections on utility pedestals located inside the perimeter access aisle.

3-5.8.2 Preconditioned Air Systems \2\

These criteria provide detailed requirements for the preconditioned air (PCA) system and incorporates lessons learned to ensure PCA systems are fully mission capable. The intent is to make the system accessible, minimize maintenance requirements, and maximize system reliability. Strict adherence to criteria herein is necessary to ensure system functionality and integrity. Provide PCA system in accordance with the requirements of the aircraft. The required flow rate, temperature, pressure, moisture content and particulate content of cooling air at the aircraft connection is specified by the aircraft program documentation and must be confirmed by the end user on a per project basis. See Chapter 4 \3\ AIRCRAFT SPECIFIC REQUIREMENTS for F-35 aircraft cooling air requirements. PCA systems are considered process loads in the building energy compliance calculations.

Provide one PCA unit per aircraft parking position. PCA units are not designed to serve multiple aircraft. Manifolded systems create unnecessary complexity. Do not manifold

units together. If PCA system backup is required, it is intended that the system is supplemented with user provided ground support equipment (GSE). Do not install any valves between the PCA unit and the aircraft. Design and provide PCA system in accordance with UFGS 23 75 15 *Aircraft Pre-Conditioned (PCA) Air System* and the requirements of this UFC.

For Air Force: PCA units are not real property and maintenance is the sole responsibility of the using organization.

3-5.8.2.1 PCA System Operating Procedure

The control points, components, and capabilities specified herein will support the PCA system standard operating procedures (SOP) as follows.

1. Remove dust cap from PCA piping.

2. Start PCA purge mode.

3. Prepare to connect flex duct to aircraft. If present, open manual blow-down valve(s) to purge any trapped condensation.

4. When desired temperature is reached as indicated at temperature gauge, and there is no visible moisture in the pipe, stop PCA purge mode.

5. Connect flexible duct to the PCA pipe and aircraft, then start PCA normal mode.

6. Stop PCA unit, disconnect flexible duct, and replace dust cap.

3-5.8.2.2 Preconditioned Air Unit Location

Locate PCA units and route associated piping above ground and in accessible trenches to minimize the length of flexible duct required between the PCA piping and the aircraft cooling connection. The heat gain and air leakage in insulated flexible duct is much greater than that of insulated rigid pipe. A long hangar with multiple aircraft bays can be served by PCA equipment on each end of the building to minimize PCA pipe length and the time required to cool the system down from ambient temperature. Locate PCA units outdoors in accordance with the requirements of the PCA manufacturer for clearances. If PCA units are located away from the hangar, route exterior piping in a trench with removable covers and a means for drainage. Avoid abrupt turns.

Design PCA equipment and piping supports to minimize vibration and noise levels as recommended by ASHRAE *Practical Guide to Noise and Vibration Control for HVAC Systems*, Second Edition. Do not locate PCA units on roofs above conference rooms, private offices, or training rooms. Do not locate PCA units within 10 feet (3m) of unpaved areas or near potential sources of air particulates/contaminants such as laundry, shop exhaust, sanitary vents, steam traps or relief valves, industrial exhaust, or boiler flue discharge. Locate units in shaded areas where possible.

3-5.8.2.3 Preconditioned Air Unit Maintenance and Airflow Clearances

Provide adequate clearance for PCA unit maintenance and heat rejection in accordance with manufacturer's requirements, OSHA regulations, and standard practices. Periodic maintenance includes changing filters, fan belts, motors, refrigeration components and coil cleaning.

Do not install solid wall enclosures, grates, screens, expanded louvers, or any other impediments to airflow around or above PCA equipment. Equipment may be located within the unobstructed area as defined by UFC 4-010-01 as long as the equipment provides no opportunity for concealment of explosive devices with heights of 6 inches (150 mm) or greater, or the equipment is secured to prevent concealment of the devices. Equipment located within the fenced flight line area is considered secured. If necessary, secure units with chain link fence only. Provide a thru-wall penetration as necessary for ducting a backup cooling cart.

3-5.8.2.4 Preconditioned Air Unit Sizing

Size PCA units for the greatest enthalpy condition when comparing the 0.4% dry-bulb and mean coincident wet-bulb (DB/MCWB) and the 0.4% humidity ratio and mean coincident dry-bulb (HR/MCDB) design conditions using weather data prescribed by UFC 3-400-02. The greatest enthalpy condition usually occurs at the 0.4% HR/MCDB condition. Include PCA pipe and flexible duct heat losses in PCA unit sizing. Use a safety factor of 10% when sizing PCA equipment. Specify PCA unit filtration to meet the aircraft air quality requirements, with a washable pre-filter and MERV-8 final filter.

3-5.8.2.5 Preconditioned Air Piping

Provide welded stainless steel piping suitable for pressures up to 15 psig (416 in. w.g.) for PCA distribution. Perform pipe thermal stress analysis calculations. Piping design including supports must allow and control thermal expansion. Provide bolted and gasketed flanged joints within 18" above the hangar floor and in the trench to preclude the need for hot work in hazardous locations.

A high pressure PCA unit fan can operate at much higher pressures than a typical HVAC fan which allows higher PCA air velocity and pressure. Size air distribution piping using a minimum air velocity of 1,300 ft/min (6.6 m/s). If lower velocity is used, provide a life cycle cost analysis to justify the cost of larger pipe. Assume 50% of PCA units run 40 hours per week.

3-5.8.2.6 Preconditioned Air Pipe Routing

PCA pipe must be routed outside of the crane operating envelope along interior walls and in accessible trenches. Do not route pipe so that it presents a tripping hazard or obstruction in the main circulation aisle between the aircraft and shop spaces. Route the PCA pipe in a trench in the hangar floor from the hangar walls to a flexible duct connection point at each aircraft parking position. Route PCA pipe in a combined trench with other utilities where possible. Routing PCA pipe underground or buried below the

hangar slab is prohibited. All PCA pipe must be fully accessible to allow for repair and replacement. PCA system utility pits are prohibited.

Coordinate PCA pipe and other trenched utilities to ensure PCA pipe is continuously sloped to the flexible duct connection point. Ensure adequate horizontal and vertical clearance to access PCA pipe and other trenched utilities. Provide a mechanical (non-gas) lift-assisted, hinged access cover with safety locking device rated for aircraft loading at each flexible duct connection point. Ensure access hatch weight is no greater than the approved lift weight per occupational safety requirements. PCA pipe must be supported and elevated minimum 6 inches (150 mm) off the bottom of the trench to prevent pipe and insulation from sitting in water and allow insulation to air dry. Slope the trench and PCA pipe with a minimum 0.5% grade, towards a recessed flexible duct connection point. Show PCA pipe slope requirements on drawings. \3\ PCA pipe must turn up and terminate within 6” of the hangar floor for ergonomic access to duct connection without entering the trench. Provide a manual blow-down valve at all PCA pipe low points to allow drainage of any trapped condensation. Provide a handle extension within 6” of the hangar floor so the blow down valve is operable without entering the trench. /3/

For Navy: PCA pipe and fire protection pipe must be in a combined trench. Fire protection pipe is an “other trenched utility” that must be coordinated with PCA pipe as described in this paragraph.

3-5.8.2.7 Preconditioned Air Flexible Duct and Accessories

\3\ Provide a quick-connect system at the connection between PCA piping and flexible duct. Provide 45-degree hard adapters to prevent kinking of flexible hose. Provide a minimum 6-inch (150 mm) diameter insulated flexible hose with a mobile basket or reel to connect from the PCA pipe connection to the aircraft PCA connection in accordance with UFGS 23 75 15 *Aircraft Pre-Conditioned (PCA) Air System*. Provide tapped mechanical temperature and pressure gauges in the PCA pipe immediately upstream of the flexible duct connection point. Provide a water tight, soft rubber cover with lanyard to protect the flexible duct connection opening while not in use. /3/

3-5.8.2.8 Preconditioned Air Pipe Insulation and Jacket

Provide PCA pipe with factory applied insulation. Provide pipe with water-tight embossed aluminum or high density polyurethane (HDPE) insulation jacket to prevent water from hangar floor wash down, foam system activations, and fuel spills from degrading the insulation or infiltrating the pipe. Perform heat transfer calculations. PCA system insulation must be specified to ensure no more than a 5 °F temperature rise between the PCA unit discharge and the aircraft connection at design conditions. Include heat gain within PCA pipe, fittings, and flexible duct in calculations. Heat gain calculations must use the 1.0% DB/MCWB conditions using weather data prescribed by UFC 3-400-02.

Perform a separate calculation determining the length of time it will take the system to achieve aircraft cooling air input specifications from a steady-state ambient condition. The ambient condition is defined as all piping, fittings, and flexible duct at the 0.4%

outdoor design dry-bulb outdoor air temperature. Thirty (30) minutes is the maximum allowed time duration to deliver required PCA temperature, moisture content, pressure and airflow at the aircraft connection from ambient condition. Perform calculation under low-pressure purge mode conditions.

3-5.8.2.9 Preconditioned Air Unit Controls

The PCA is considered a critical support system, and the controls must be designed for "least functionality" per UFC 4-010-06. PCA units must be provided with a low pressure purge mode for initial cool down of the system. Provide one remote control panel per PCA unit along the hangar back wall at each aircraft location with start button, stop button, purge mode start button, unit run status, alarm indication, and digital display of PCA unit discharge temperature (°F), humidity ratio (gr/lb), pressure (psig), and flow rate (lb/min). Provide each remote control panel housed in a gasketed NEMA Type 3R enclosure.

Provide a digital touchscreen control panel integral to each PCA unit capable of displaying the unit run status, alarms, discharge temperature (°F), humidity ratio (gr/lb), pressure (psig), and flow rate (lb/min). PCA unit set points must be adjustable at the PCA unit without the need for proprietary control interfaces, dongles, or removable operator interface terminals. PCA unit status and performance data may be monitored by the base EMCS system with expressed approval from the installation.

3-5.8.2.10 Preconditioned Air Unit Testing and Commissioning

Manufacturer's testing, field performance testing, endurance testing, and season of maximum load performance testing requirements must be performed in accordance with UFGS 23 75 15 *Aircraft Pre-Conditioned (PCA) Air System*. Provide pressure/temperature test ports in the piping immediately downstream of PCA units. ***/2/***

3-5.9 Energy Management System

3-5.9.1 HVAC Control

Follow the mandatory requirements of the section titled "Controls" of ASHRAE 90.1 as modified below. Provide all air distribution systems capable of shutdown to meet the requirements of Standard 18 of UFC 4-010-01.

3-5.9.2 Control Protocol

For Air Force, Navy and Marine Corp: ASHRAE's BACnet® protocol is the preferred control system architecture facilities. Design and construct Facility HVAC control systems based on the BACnet® protocol in accordance with ANSI/ASHRAE Standard 135 and UFGS 23 09 23.13 20.

For Army: LonWorks® protocol is the preferred control system architecture for facilities. Design and construct facility HVAC control systems based on the LonWorks® (American National Standards Institute/Consumer Electronics Association (ANSI/CEA)-

709.1 and related technologies) in accordance with UFC 3-410-02 and UFGS 23 09 23.01.

3-5.9.3 Networked Controls

Prior to designing the DDC system, confirm whether an existing energy management network is available for interface on the Base. Provide DDC equipment that is compatible with existing systems to the maximum extent practicable. Where use of a specific DDC system is mandatory, the Government will provide a Justification and Authorization (J&A) for the utilization of proprietary DDC equipment.

3-5.9.4 Minimum Control Points

Provide the ASHRAE's BACnet® protocol with a control system with at least the minimum points as indicated in UFC 3-410-01 Appendix D. Minimum control points for Lonworks® protocol systems are provided in UFC 3-410-02.

3-5.9.5 DDC Accreditation

Provide hardware equipment utilizing the latest technology which will accomplish the desired control and will meet the Risk Management Framework (RMF) for DoD Information Technology (IT) Process.

3-5.9.6 DDC Training

Require the DDC installer to provide training for government facility personnel on all new DDC equipment.

3-6 FIRE PROTECTION AND LIFE SAFETY

3-6.1 General and Service Requirements Applicability

Provide a building and systems in accordance with UFC 3-600-01 except where additional requirements are added by this UFC. Use NFPA 409 only where explicitly noted. If there is a conflict, this UFC supersedes UFC 3-600-01 and NFPA standards. Where required, provide specifically listed or approved components and assemblies used in this fire protection system and subsystems by a NRTL.

Hangar construction funded by a specific Service for their use on installations under the management control of another service will follow fire protection requirements of the funding service. Hangar constructed for the joint/share use of multiple services will follow the installation’s managing service criteria, unless, approval by all the involved services AHJs. New hangar fire protection criteria/features will not be based simply on which service maintains the real Property records or is responsible for the maintenance of the installed features. Existing hangars will not require new fire protection features simply because the principle user changes between services.

3-6.1.1 Fueled and Unfueled Aircraft

To allow for the greatest mission flexibility, protect hangars housing fueled and unfueled aircraft the same in accordance with this UFC. \2\ For Air Force, see additional guidance in Chapter 5-6 FIRE PROTECTION AND LIFE SAFETYor exceptions. /2/

3-6.1.2 UAV or RPA Aircraft

Where required by UFC 3-600-01, protect hangars housing Unmanned Aerial Vehicles (UAV) or Remotely Pilot Aircraft (RPA) in accordance with this UFC.

3-6.2 Construction, Life Safety, and Fire Fighter Access

Refer to 3-3.1: Construction, Life Safety, and Fire Fighter Access of this UFC for additional construction, life safety, and fire fighter access requirements.

3-6.3 Fire Hydrants

3-6.3.1 Fire Hydrant Supply

Supply fire hydrants from the domestic water service, where it can be supported.

3-6.3.2 Fire Hydrant Location

Install hydrants in accordance with UFC 3-600-01, except at modified below:

- Locate hydrants protecting the building at a maximum interval of 300 ft (91 m), unless noted otherwise.
- Hydrants are not permitted in front of the hangar bay door opening. Where the hangar bay door opening exceeds 300 ft. (91.4 m), place a hydrant at each end of the opening.
- Locate at least one hydrant within 100 ft. (30.5 m) of each corner of the building.
- \3\ Where apron pavement abuts the building, locate required hydrants protecting the building in these areas within 10 ft. (3.0 m) of the building./3/
- Install low profile, conventional hydrants, no higher than 2.5 ft. (700 mm) where within 25 ft. (7.6 m) of airfield pavement.
- Flush-mounted hydrants in the pavement are not permitted.

3-6.4 Fire Water Supply

Design the fire water supply to meet the following fire flow demands for the required duration. When the existing fire water supply cannot meet the flow or duration requirements, modify the system or provide an independent fire water supply to meet the requirements.

- Evaluate fire water supply for suppression systems located in support areas outside the hangar bay in accordance with UFC 3-600-01.
- \2\ For High-Expansion (Hi-Ex) foam and Low Level Water only Trench Nozzle systems within the hangar bay, provide a fire water supply to support the combined demand of the hangar bay ceiling sprinkler system and low level foam/water or low level water only fire suppression system for 45 minutes (min.). /2/
- For other suppression system(s) within the hangar bay, provide additional water supply in accordance with NFPA 409.
- Include the demand of the outside hose stream allowance where supplied from the same fire water supply.
- Include domestic and industrial demands where required by UFC 3-600-01.

3-6.4.1 Fire and Pressure Maintenance Pumps

Provide electric or diesel fire pumps as required by UFC 3-600-01.

3-6.4.1.1 Fire Pump Quantity

\2\ Where supplying a single hangar, provide a pump or pumps meeting the total fire water demand. When multiple pumps are required, they must be of equal capacity. A redundant pump is not required.

Where a fire pump house, station, or pump room supplies more than one hangar, provide a pump or pumps of equal capacity meeting the total fire water demand of the most demanding hangar. A redundant pump meeting the size of the largest pump must be provided. /2/

3-6.4.1.2 Fire Pump Capacity

Do not exceed a nominal fire pump rating of 2,500 gallons per minute (gpm) (9,464 liters per minute (lpm)).

3-6.4.1.3 Fire Pump Control

Start the fire pump automatically upon a drop in system pressure in accordance with NFPA 20. Where the drop in system pressure is not significant enough to automatically start the fire pump such as a fire pump installed in parallel with a large domestic water booster pump, provide the fire pump with a remote start signal from the Fire Alarm Control Unit (FACU).

When starting the fire pump, do not exceed ten seconds before the pump is operating at the design pressure.

3-6.4.1.4 Pressure Maintenance Pump

Provide a pressure maintenance (jockey) pump to maintain normal operating pressure on the system. Size and automatically operate the pump in accordance with NFPA 20. Provide pump controller with an adjustable timer to prevent short cycling. Operate pump for the minimum run time recommended by the manufacturer.

3-6.4.2 Fire Water Service Main

Provide ductile iron or non-metallic piping for fire water service mains.

3-6.4.2.1 Piping Materials

Black steel piping is not permitted for installation below grade.

When non-metallic piping is used, use pipe specifically listed for "Fire Service" applications by a NRTL. Non-metallic piping used for fire water distribution such as High Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), and filament-wound fiberglass, is not permitted to be routed above grade or exposed within the building.

3-6.4.2.2 Corrosion Protection

Cover bolts, nuts, rodding, and couplings located below grade with a bituminous coating and wrapped in a minimum 6 mil polyethylene plastic.

3-6.4.2.3 Piping Entrance into a Building Supplying the Foam/Water System

Enter the building in accordance with one of the following entrances. When a remote fire pump house/station is provided, which supplies the foam/water system, comply with one of the following entrances for the fire water piping entering and leaving the fire pump house/station.

- In geographic locations having a 99.6% dry bulb temperature greater than 40ºF (4.4ºC) per UFC 3-400-02 Engineering Weather Data, water service piping is permitted to rise above grade outside the building and enter the building through the exterior wall.
- Enter the building below grade with a continuous section of welded stainless steel fire water service piping from a point outside the building perimeter to a flanged fitting located at least 1 ft. (305 mm) above finished floor within the building. Non-welded fittings are not permitted within this section of piping such as flanges, mechanical couplings, and push-on fittings. Weld and hydrostatically test the stainless steel pipe at the fabrication shop or manufacturer. Welding in the field is not permitted. Perform the hydrostatic pressure test in accordance with NFPA 24. The fire water service piping is permitted below the building slab for this method of installation.

- Enter the building below grade and directly into a concrete pit with open steel grating. For this method of installation, do not install fire water service piping below the building slab. Only welded or flanged fittings are permitted to transition piping from horizontal to vertical within the pit. Where flanged fitting are used within the pit, only flanges that are threaded or welded to the piping are permitted. Provide thrust restraint bracing where the piping transitions from horizontal to vertical. A minimum 2 ft. (610 mm) clearance is required around the piping within the pit. Provide an access ladder and drainage from the pit.

3-6.5 Surge Arrestors

Provide listed or approved surge arrestors for fire protection systems with a minimum rated working pressure of 275 psi (1,895 kiloPascals (kPa)).

3-6.5.1 Surge Analysis

Manufacturer's calculations are required for determining the minimum surge arrestor capacities where the following distances are exceeded from the fire pump discharge to the most remote dry pipe, preaction, or foam/water riser. Include the surge arrestor calculations performed by the manufacturer in the design calculations.

- 1,500 ft. for a system not exceeding a working pressure of 175 psi.
- 1,000 ft. for a system not exceeding a working pressure of 250 psi.
- 500 ft. for a system not exceeding a working pressure of 175 psi, and plastic piping is used such as PVC or HDPE.
- 300. ft. for a system not exceeding a working pressure of 250 psi, and plastic piping is used such as PVC or HDPE.

3-6.5.2 Size and Location

At a minimum, provide the following surge arrestors. Increase the minimum capacities listed below, when manufacturer's calculations are required and demonstrate a large capacity.

- Provide 10 gallons (gal) (38 liters (L)) of capacity for each dry pipe or preaction riser located on the riser manifold supplying a hangar bay.
- Provide 25 gal (95 L) of capacity for each foam/water riser located on the riser manifold supplying a hangar bay.
- For each riser room, combine the surge capacity of the risers in the room into a single common surge arrestor. Where risers feed different fire areas, only use the greatest combined surge capacity from one fire area. Connect this common surge arrestor to the riser manifold immediately upstream of the protected risers.
- Where the fire pump is not located in the same room as the risers it serves, provide 100 gal (380 L) capacity surge arrestors for each fire

pump. Locate this surge arrestor immediately downstream of the isolation valve on the discharge side of the fire pump.

- The cumulative minimum capacity of each required fire pump surge arrestor may be combined into a single common surge arrestor. Connect this common surge arrestor to the fire pump header immediately downstream of the isolation valve on the discharge side of the most remote fire pump.
- Where surge arrestors are 100 gal (380 L) or larger in capacity, provide floor stands.

3-6.5.3 Surge Arrestor Installation

Provide each arrestor with an indicating isolation valve to separate it from the system. Electrically supervise this valve in the normally open position. Provide a drain after the isolation valve to relieve pressure from the surge arrestor during testing and maintenance. When connecting the surge arrestor to the riser, the use of piping, fittings, and valving smaller than the connecting orifice on the surge arrestor is not permitted.

After the surge arrestor is installed and pressurized in the field with nitrogen per the manufacturer's written directions, provide a permanent label indicating the set pressure of the arrestor. Do not pressurize the surge arrestor during hydrostatic testing of the system.

3-6.6 Backflow Prevention

Where backflow prevention is provided for cross connection control, provide piping and fitting materials upstream of the backflow preventer listed for use with potable water systems such as ductile iron, stainless steel, and galvanized steel. Where fire pumps are supplied directly from the domestic water system, install backflow prevention on the discharge side of the pump.

Exception: Backflow prevention may be installed on the inlet side of the fire pump when the following conditions are met with fire pump(s) operating at 150% capacity. The quantity of pumps used in this calculation is the number expected in normal operation to meet the system demand.

- Not less than 20 psi residual pressure at the backflow preventer inlet.
- Not less than 5 psi residual pressure at the fire pump inlet.
- Use outside stem & yoke (OS&Y) valving in the backflow preventer assembly and locate the assembly a minimum of 10 pipe diameters upstream of the pump suction flange.

3-6.7 Fire Protection Equipment Rooms

Locate foam concentrate tanks, pumping equipment, and riser control valves associated with the protection of the hangar bay in a dedicated fire protection equipment room with a minimum 1-hour fire barrier. Although not required, other fire suppression equipment

is permitted within this room such as the wet pipe system for the support area. Locate fire protection equipment rooms housing fire pumps and/or the incoming fire water service at grade with doors providing direct access to the exterior. Where secondary foam proportioning rooms are provided to facilitate the hydraulic design, provide this equipment in dedicated fire protection equipment rooms with minimum 1-hour fire barriers.

3-6.7.1 Equipment Access

Size equipment rooms to provide access for inspection, maintenance, and repair of all equipment. Configure equipment to permit removal of tanks, valves, pumps, and motors without the removal of other components. Provide double doors with adequate clearance for the removal of the largest piece of equipment. Provide metal roll-up doors when double doors are too small to accommodate the removal of equipment. Where equipment is located more than 8 ft. (2.4 m) above the floor and requires access at frequencies 2 years or less for testing and maintenance per UFC 3-601-02, provide an open steel grate mezzanine and permanent ladder meeting OSHA requirements to access this equipment. Chain operators are permitted for opening and closing valves more than 8 ft. (2.4 m) above the floor where not readily accessible from a mezzanine.

3-6.7.2 Temperature Monitoring

In geographic locations having a 99.6% dry bulb temperature less than 40ºF (4.4ºC) per UFC 3-400-02 Engineering Weather Data, provide temperature sensors in fire protection rooms and secondary foam proportioning rooms that have direct access to the exterior. Provide listed/approved fixed temperature sensors set at 32ºF (0ºC). Alarm low temperature conditions at the FACU as a supervisory condition and the Energy Management Control System.

3-6.8 Fire Suppression Pipe

Do not install piping below a concrete slab within the hangar building. Use concrete trenching with steel grating for all piping located below the floor line.

3-6.8.1 Fire Suppression Pipe Labeling

\2\ Mark all exposed interior piping with plastic wrap around-type pipe labels conforming to American Society of Mechanical Engineers/American National Standards Institute (ASME/ANSI) A13.1, Scheme for the Identification of Piping Systems. Indicate the type of fluid carried and direction of flow. Labels that stick-on (adhesive backed) or are held on with straps/adhesive tape are not permitted. Labels are not required on any fire suppression system branchlines regardless of size, or mains and cross-mains less than a nominal 2-1/2 in (64 mm). Labels are not required on piping routed below the floor line in trenches or pits. At a minimum, the following labels are required.

- FIRE PROTECTION WATER - Used on dedicated potable and non-potable fire protection water supply piping.
- FOAM CONCENTRATE - Used on foam concentrate piping.

- FIRE SPRINKLER - Used on water-only sprinkler piping.
- HIGH-EXPANSION FOAM - Used on Hi-Ex foam/water piping. /2/

3-6.8.2 Fire Suppression Drainage

\2\ Route clear water drains to the building exterior and discharge no greater than 2 ft. (0.6 m) above grade. Provide independent atmospheric and pressurized drainage systems, or provide a means of hydraulic isolation between the systems such as a check valve between the cup drain and the main drain. Drains from the Hi-Ex Foam risers will have the ability to be contained and collected. /2/

Provide a splash block below drain discharge, unless discharging to a paved or concrete surface. Do not locate drainage discharge adjacent to an exit door, nor permit drainage discharge to cross the path of egress from the building. Locate drainage discharge to not cause soil erosion when main drain or inspector's test connections are operated during testing.

3-6.8.3 Riser Manifold

Provide separate risers for systems supporting areas outside the hangar bay.

Provide a wye or basket strainer and an isolation valve for maintenance in the piping ahead of foam system risers. Provide strainer baskets with stainless steel mesh sized no greater than 1/4 in (6.4 mm).

For Navy: Do not exceed a mesh size of 1/16 in (1.8 mm).

3-6.8.4 Fire Department Connection

Do not provide fire department connections supplying foam/water systems.

3-6.9 \2\ Foam/Water or Water Only Flow Control Valves

Provide a flow control valve with remote resetting capability for each foam/water system. Provide flow control valve with automatic re-closing feature and adjustable speed control. Where an inductor is used for foam/water proportioning, provided field adjustable pressure reducing trim. Install the manual release for the flow control valve no higher than 5 ft. (1524 mm) above finished floor. For hydraulic calculations, include the manufacturer's minimum pressure drop across flow control valve for the features indicated. ***/2/***

3-6.10 Foam/Water Proportioning System

For Army: Refer to Chapter 6 Army Specific Criteria for foam/water proportioning system.

Provide a single foam inductor per foam/water riser meeting the requirements outlined below. Where more than one foam inductor is used, they may take suction from a common concentrate tank. Do not supply more than one fire area from a single inductor.

- Use a venturi to induct concentrate and proportion such concentrate into the flow stream reliably at the design system flow rate.
- \3\ For design calculations, use a pressure drop across the inductor of 42% regardless of the manufacturer’s recommended initial installation stated pressure drop. /3/
- Tune the inductor specifically for the system required flow rate, inlet pressure, back pressure, concentrate type, proportioning ratio, and lift height of a near empty concentrate tank. Off the shelf pre-tuned generic model inductors are not permitted.
- \2\ Design the inductor to 115% of the nominal injection rate such as the inductor for 3% concentrate would be designed for a 3.45% injection rate. /2/
- Size inductor for the exact orifice of foam/water pipe.
- Fit concentrate suction line of the inductor with a low loss brass, bronze, or stainless check valve assembly by the manufacturer that is included in the device's hydraulic design.
- \2\ Provide a design that indicates the inductor's flow rate, inlet pressure, back pressure, and concentrate lift height for a near empty concentrate tank. Hydraulically calculate the back pressure for the inductor using the Hazen-Williams equation with a C-factor of a 120 for all piping downstream of the inductor. /2/
- Potential manufacturers at the time of this publication include Fomtec, Skum, Matre Maskin, Wilson Foam, Ansul, Chemguard, and Delta Fire.
- Inductors meeting the performance criteria within this UFC are approved.

3-6.10.1 Inductor Installation

Install inductor in the horizontal piping over the top of the concentrate tank. Provide the minimum straight pipe on both sides of the inductor in accordance with the manufacturer. Install these sections of piping free of elbows, tees, and reducers. Provide liquid filled gauges, located no closer than 2 ft. (610 mm) before and after the inductor.

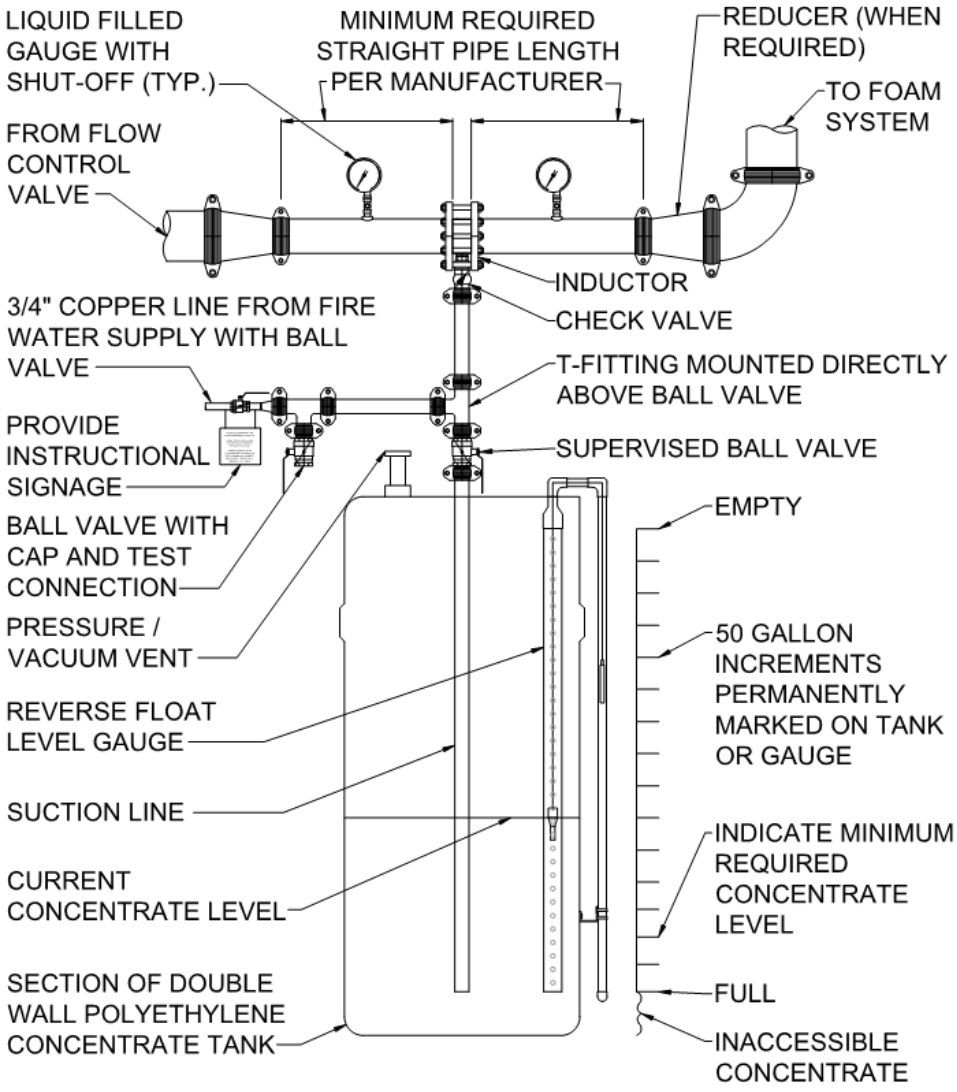
3-6.10.2 Concentrate Piping and Valving Installation

Provide a brass, bronze, or stainless steel full bore quarter turn ball valve with an electrically supervised tamper switch in the concentrate line. The use of automatically controlled valves in the concentrate line is prohibited. For testing purposes, equip the concentrate line with fittings and valving to accommodate the connection to an auxiliary tank of alternate test foam concentrate. Cap auxiliary tank connection at all times, except when testing.

Provide a 3/4 inch (19 mm) copper line with ball valve from the fire water supply that is used for flushing the concentrate line after use. Provide sign with the following

instructions, "Flush concentrate line after discharge or testing. Close concentrate tank shutoff valve prior to opening this valve. After flushing, drain concentrate line through test connection prior to re-opening concentrate tank shutoff valve." Refer to Figure 3-9: Inductor and Concentrate Tank Installation.

Figure 3-9: Inductor and Concentrate Tank Installation



3-6.11 Concentrate Storage Tank

Provide a closed cell double wall polyethylene concentrate storage tank compatible with the required concentrate. Provide a reverse float level gauge with minimum 50 gallon increments permanently marked on the tank or gauge. Indicate on the tank or gauge the empty, full, and minimum level required to operate the system. Do not include the inaccessible portion of concentrate at the bottom of the tank that cannot be accessed by the suction line, in the tank's capacity markings. Provide a closeable fill opening and pressure/vacuum vent assembly. When an inductor is used, enter the tank only through the top with no taps on the bottom or sides of the tank.

For Army: Exception, provide a single wall closed cell polyethylene concentrate storage tank.

A reserve supply of concentrate is not required where concentrate can be replenished within 24 hours. Where a reserve supply is required, it is permitted to be a secondary concentrate storage tank, or totes/drums of concentrate stored in the fire protection equipment or secondary foam proportioning rooms.

3-6.11.1 Concentrate Storage Tank Installation

Mount concentrate storage tank on a level surface. Spill or secondary containment outside the storage tank is not required.

For Army: Exception, provide secondary containment for the storage tank and associated foam concentrate pump pad capable of capturing the entire volume from the largest concentrate storage tank.

3-6.11.2 \2\ Deleted Paragraph retained to avoid numbering issues for references. /2/

3-6.11.3 Hi-Ex Foam Concentrate

Provide Hi-Ex foam concentrate listed/approved for use with the foam generation system. Provide a concentrate storage tank with a supply of concentrate to support a 15 minute discharge at the hydraulically calculated waterflow rate and 130% of the nominal concentrate injection rate.

3-6.11.4 \2\ Deleted Paragraph retained to avoid numbering issues for references. /2/

3-6.12 \2\ Foam/Water Solution and Low Level Water Only Piping /2/

Provide listed/approved gaskets for dry pipe service on all foam/water solution piping.

Seismically brace foam/water solution piping regardless of geographic location. Base bracing calculations on the Ss indicated in the seismic analysis.

3-6.12.1 \2\ Low Level Water Only Piping

Provide hot dipped galvanized piping downstream of the flow control valve on trench nozzle distribution systems. Galvanized components include all pipe, fittings, fasteners, hangars, and stands. Do not roll groove galvanized pipe. Clean cutting oils and debris from any cut grooves, threaded ends, and areas where the zinc coating has been damaged. Dry and paint damaged areas with two full coats of a cold galvanizing primer containing a minimum of 95% zinc.

Route water piping in trenches to trench nozzles. Routing piping across the hangar floor is not permitted. Provide end caps tapped with a valve at the end each of branchline in the trench nozzle system. Use these taps for the attachment of pressure gages during testing, and drainage of the piping system after activation. /2/

3-6.12.2 Hi-Ex Foam/Water Solution Piping

Provide black steel foam/water solution piping downstream of the flow control valve on the Hi-Ex distribution system. Galvanized foam/water solution piping is not permitted.

3-6.13 Test Header for Hi-Ex Foam Systems

Provide a linear test header to meet the fire water demand of the foam/water system.

For Air Force: The foam/water test system header and fire pump test header (when provided) may be combined. When a common test header is used, provide valving to permit independent testing of each foam/water riser and each fire pump.

3-6.13.1 Test Header Size

Provide one 2-1/2 inch (64 mm) hose valve connection for each 375 gpm (1420 Lpm) of flow, rounding up. Provide a control valve to isolate the test header from the remainder of the system.

3-6.13.2 Test Header Location

Locate test header inside the aircraft servicing area within 20 ft. (6.1 m) of an exterior door or directly outside the fire protection equipment room on an exterior wall. Locate test header to discharge effluent to a hard surface within 100 ft. (30.5 m) hose lay.

In geographic locations having a 99.6% dry bulb temperature less than 32ºF (0ºC) per UFC 3-400-02 Engineering Weather Data, provide test header with automatic ball drip routed to the exterior.

3-6.14 Hose Demand

3-6.14.1 Interior Hose Demand

Do not provide interior hose stations or fire hose connections in the hangar bay.

3-6.14.2 Exterior Hose Demand

Provide an exterior hose demand of 500 gpm.

3-6.15 Overhead Sprinkler System for the Hangar Bay

Protect the hangar bay with water only closed head wet pipe, dry pipe, or preaction sprinkler systems. Wet pipe automatic sprinkler systems are only permitted in the hangar bay when the following conditions are met:

- Where the geographical location of a hangar bay without doors has a 99.6% dry bulb temperature greater than 40ºF (4.4ºC) per UFC 3-400-02.
- Where the geographical location of a hangar bay with doors has a 99.6% dry bulb temperature greater than 0ºF (-17.8ºC) per UFC 3-400-02 and the hangar bay is provided with a heating system per this UFC.

3-6.15.1 Hydraulic Design

Hydraulically design the sprinkler system to provide 0.2 gpm/sq. ft. (8.0 Liters per minute per square meter (L/min/sq. m)) over the hydraulically most demanding 5,000 sq. ft. (464.5 sq. m) in the hangar bay.

Do not increase design area for sloped ceilings.

3-6.15.2 Sprinkler Systems

Provide upright quick-response sprinklers at the roof or ceiling level with a temperature rating of 175ºF (79.4ºC). Where the geographical location of the building has a 0.4% dry bulb temperature greater than 100ºF (37.8ºC) per UFC 3-400-02, provide sprinklers with an intermediate temperature rating of 200ºF (93.3ºC).

Design the sprinkler piping such that the majority or all of the system drains back to the riser. Minimize or eliminate the requirement for remote drainage connections in the hangar bay.

3-6.15.3 Wet Pipe Sprinkler Systems

Provide automatic air vents at high points in the system to vent at least 95% of the volumetric capacity of the system. Design the sprinkler system to reduce the quantity of automatic air vents such as connecting branchlines or providing a cross-main at the peak.

Where wet pipe systems are installed in areas with a 99.6% dry bulb temperature of 40ºF (4.4ºC) of less per UFC 3-400-02 Engineering Weather Data, adhere to the following piping installation requirements:

- Locate the inspector’s test connections at the riser. Test stations are not permitted in the hangar bay.
- Where drainage piping is required in the hangar bay, do not route the portion of the drainage piping normally containing water and associated drainage valve more than 5 ft. (1524 mm) below the level of the lowest sprinkler head in the hangar bay. Route the remaining normally empty drainage piping to the building exterior.

3-6.15.3.1 Wet Pipe Sprinkler System Temperature Monitoring

In geographic locations having a 99.6% dry bulb temperature less than 40ºF (4.4ºC) per UFC 3-400-02 *Engineering Weather Data*, provide temperature sensors in the hangar bay. Provide listed/approved fixed temperature sensors set at 32ºF (0.0ºC). Locate temperature sensors at the same level as the adjacent sprinkler head branchline. Provide center to center spacing not exceeding 200 ft. (61.0 m), or spacing from the wall not exceeding 100 ft. (30.5 m). Alarm low temperature conditions at the FACU as a supervisory condition and the Energy Management Control System.

3-6.15.4 Dry Pipe Sprinkler Systems

Provide an externally resettable dry pipe automatic water control valve. Provide valve with resettable capability that does not require opening the valve or use of special tools. Increase the design area by 30 percent for dry pipe systems.

3-6.15.5 Preaction Sprinkler Systems

Provide a single interlock, externally resettable preaction automatic water control valve. Provide valve with resettable capability that does not require opening the valve or use of special tools.

3-6.16 \2\ Low Level Water Trench Nozzle System

For Navy: Provide a hydraulically designed low level water only trench nozzle system for hangar bays. Refer to Chapter 7: Navy Specific Criteria for additional requirements regarding the trench nozzle system design.

3-6.16.1 Low Level Water System Performance

For the trench nozzle system, provide water at the most remote nozzle within 30 seconds upon water system activation such as from the manual releasing station. Maintain the discharge pressure for all nozzles between 40 psig (275 kPa) and 45 psig (310 kPa).

Where more than one trench nozzle system is present within a fire area, design the releasing system to only release the trench nozzle system associated with the fire event. Such as where a hangar is subdivided by a non-rated wall into two bays with independent trench nozzle systems or where a large hangar bay is provided with multiple trench nozzle systems, zone the initiation devices to only release the trench nozzle system associated with the fire event. Design the fire flow and concentrate supply to allow for sufficient simultaneous operation of all trench nozzle systems within the fire area that are wholly or partially within a 100 ft. (30.5 m) horizontal radius of any point on the hangar bay floor. /2/

3-6.17 Hi-Ex Foam System

For Air Force and Army: Provide a hydraulically designed low level Hi-Ex foam system for hangar bays. Refer to Chapters 5 and 6 for additional requirements regarding the Hi-Ex system design.

3-6.17.1 Hi-Ex Foam System Performance

\2\ Cover 90 percent of the aircraft's projected silhouette on the floor with Hi-Ex foam within one minute upon system actuation such as from a manual foam releasing station. For fixed winged aircraft, the areas under engines extending beyond the wing edge and under the tail plane are not considered part of the silhouette for this compliance criterion. Additionally, cover the aircraft servicing area and adjacent floor areas not cut-off from the hangar bay with self-closing or automatically closing doors/shutters, with Hi-Ex foam to a depth of 3.2 ft. (1000 mm) within four minutes. Where more than one Hi-Ex

foam system is located in a fire area, this performance criteria only applies to the aircraft and servicing areas protected by its associated Hi-Ex foam system. /2/

Where more than one Hi-Ex foam system is present within a fire area, design the releasing system to only release the Hi-Ex foam system associated with the fire event. Such as where a hangar bay is subdivided by a non-rated wall into two bays with independent Hi-Ex foam systems or where a large hangar bay is provided with multiple Hi-Ex foam systems, zone the initiation devices to only release the Hi-Ex foam system associated with the fire event. However, design the fire flow and concentrate supply to allow for sufficient simultaneous operation of all Hi-Ex foam systems within the fire area.

3-6.17.2 Hi-Ex Foam Generators

\3\ Provide unpowered aspirated, hydraulically (water) powered, or electrically powered foam generators. Electrically powered foam generators are permitted only when the following is provided: /3/

- Electric power to the generators is supplied ahead of the main building disconnect.
- Reliable power is provided in accordance with the definition in UFC 3-600-1 or an on-site standby generator is provided meeting the requirements defined in NFPA 20.

3-6.17.3 Hi-Ex Foam Generator Installation

Install Hi-Ex generators to provide a minimum 20 inches (510 mm) clearance in front of the generator inlet. Seismically brace generators regardless of geographic location. Base bracing calculations on an Ss of 0.95 or as indicated in the seismic analysis, whichever is greater. The use of all-thread rod or cabling for supporting or seismically bracing generators is not permitted.

Tap the generator foam/water supply piping with a valve to allow for the attachment of a pressure gauge or sampling hose during testing. \3\ Foam generators and piping shall be installed with appropriate pitch/slope to naturally drain foam-water solution. Where this is not possible, automatic low point drains must be provided. /3/

3-6.17.4 Hi-Ex Foam Generator Location

Locate Hi-Ex generators to discharge within close proximity, but not directly upon the aircraft or surrounding maintenance platforms. \2\Generators protecting helicopters may discharge within the rotor sweep pattern and discharge directly on rotors, provided there is no discharge directly on any other aircraft surface./2/ When mounting generators in the horizontal position, take into account the throw pattern of the Hi-Ex foam discharge. Do not locate the generator where the Hi-Ex foam discharge is obstructed by items such as structural members, lighting fixtures, or bird screen or in areas that obstruct the use of service equipment such as the crane travel path. Use the initial discharge from the foam generators to protect under the aircraft fuselage and underwing area, prior to spreading to the remaining hangar bay floor area.

Do not provide generators in locations where the developing foam blanket will block exits from the hangar bay within the first minute of discharge. Blocked exits are defined as an exit that is obstructed by a foam blanket exceeding 5 ft. (1.5 m) in depth. In small hangar bays where the entire floor may be covered with foam within the first minute, provide generator locations so exits are one of the last areas blocked.

3-6.18 Hydraulic Calculations

Provide the following calculations.

- \2\ Provide a combined hydraulic demand calculation of the foam/water or low level water only system and the most hydraulically demanding area of the sprinkler system in the hangar bay. Provide exterior hose demand where required. Demonstrate the combined fire water demand calculation does not exceed the available fire water supply. Use the resulting foam/water or low level water only demand from this calculation to determine the minimum quantity of foam concentrate. /2/
- For Hi-Ex foam systems, provide a combined hydraulic supply calculation of the high-expansion foam system and the most hydraulically demanding area of the sprinkler system in the hangar bay. Provide exterior hose demand where required. Use the fire water supply calculation for the sprinkler to determine the rate of foam breakdown.
- At a minimum, provide a hydraulic demand calculation of the most hydraulically demanding area for each additional suppression system in the support areas.
- For Hi-Ex foam systems, provide a foam spread calculation/diagram demonstrating the performance requirements to cover the aircraft silhouette are met within one minute. This calculation method is a reasonable approach to demonstrate the design meets the performance requirements, but does not take all aspects into consideration. This calculation method does not remove the obligation to demonstrate system compliance during testing. Include the following parameters in determining the maximum foam spread after one minute:
    - Time for the Releasing Service Fire Alarm Control Unit (RSFACU) to open the flow control valve after initiation of the manual foam releasing station.
    - Time for the foam/water reach the each generator based on the piping velocities in the hydraulic supply calculation.
    - Time for the foam to reach the floor of the hangar bay after discharging from the generator based on the height and orientation of each generator.
    - Time for the foam to spread across the floor based on the manufacturer's foam spread diagrams, or at a rate not to exceed 1 ft. /sec.

- \2\ For trench nozzle systems, provide a calculation demonstrating the most remote trench nozzle achieves the minimum discharge pressure within 30 seconds. This calculation method is a reasonable approach to demonstrate the design meets the performance requirements, but does not take all aspects into consideration. This calculation method does not remove the obligation to demonstrate system compliance during testing. Include the following parameters in determining the 30 second limitation is met:
  - Time for the RSFACU to open the flow control valve after initiation of the manual releasing station.
  - Time for the water reach the most remote trench nozzle based on the piping velocities in the hydraulic supply calculation. /2/

3-6.18.1 High-Expansion Foam Calculations

Where Hi-Ex foam is used, calculate the discharge rate as follows. However in no case is the discharge rate permitted to be less than 2.6 $ft.^3/min/ft^2$ (0.8 $m^3/min/m^2$). Hi-Ex foam generators may use either outside or inside air. Using air from inside the hazard requires no additional increase in foam discharge rates.

$R = ([V/T] + R_S) \times C_N \times C_L$

Where:

- R = Rate of foam discharge in $ft.^3/min$ (m^3/min)
- V = Submergence volume in $ft.^3$ (m^3). Determine the submergence volume by multiplying the area of the hangar bay and adjacent floor areas not cut-off from the hangar bay in $ft.^2$ (m^2) by a depth of 3.2 ft. (1000 mm)
- T = Submergence time of 4 minutes
- R_S = Rate of foam breakdown in ft^3/min (m^3/min). Determine the rate of foam breakdown by multiplying 10 $ft^3/min*gpm$ (0.0748 $m^3/min*L/min$) by the fire water supply calculation of the sprinkler discharge rate in the hangar bay.
- C_N = Provide a 1.15 compensation value for normal foam shrinkage.
- C_L = Provide a compensation for loss value of not less than 2.0 for hangar bays less than 15,000 ft^2 (1,394 m^2), 2.5 for hangar bays between 15,000 and 30,000 ft^2 (1,394 - 2,787 m^2), and 3.0 for all other hangar bays.

3-6.19 Fire Alarm and Releasing System

Provide a separate FACU and RSFACU for each building. Where multiple releasing systems are provided within a single building, they may be combined into a single RSFACU.

Install the FACU and RSFACU in a location readily accessible to the emergency responders and maintenance personnel.

3-6.19.1 \2\ Fire Alarm Control Unit/Autonomous Control Unit (FACU/ACU)

Provide a FACU for devices and appliances installed throughout the building that are not part of the foam/water or low level water only releasing system or other releasing systems such as a preaction system. Provide a mass notification system throughout the support areas and hangar bay in accordance with UFC 4-021-01 and this UFC. In addition to other building alarm, trouble, and supervisory signals required by other codes and standards, provide the following functional requirements in accordance with Table 3-3: \3\ Sample FACU Functional Matrix.

3-6.19.2 Releasing Service Fire Alarm Control Unit (RSFACU)

Provide a RSFACU for the control and release of the foam/water or low level water only system. Design the system so the loss of a FACU or another RSFACU in the fire alarm system does not prohibit the RSFACU from functioning as intended. Do not connect the RSFACU to other control unit through the use of a network cable. Communicate functionality between panels through addressable modules only. A common RSFACU may control multiple releasing systems or agents.

3-6.19.2.1 RSFACU Connected Devices

Connect and supervise only initiating and notification devices used by the foam/water or low level water only system as outlined in the RSFACU functional matrix in the Service-specific Chapters 5, 6, and 7. Release the foam/water or low level water only system only by the initiating devices indicated in these RSFACU functional matrices. Additional devices beyond those indicated in the RSFACU functional matrix are not permitted to release the foam/water or low level water only system, such as do not release the foam/water or low level water only system from the pressure switch on the foam/water or low level water only riser.

3-6.19.2.2 Location of Releasing System Components

\2\ Locate the RSFACU, releasing modules, and monitor modules integral to the releasing and stopping of the foam/water system in a normally conditioned space with the following parameters: temperature between 60-80ºF (15.6-26.7ºC) and a relative humidity of 85% at 86ºF (29.5ºC). Do not install these components in the hangar bay or unconditioned mechanical/electrical space. This equipment should not be used to justify conditioning a space normally not conditioned rather the equipment must be located to take advantage of spaces otherwise required to be conditioned. Locations must provide ready access to emergency responders and maintenance personnel.

3-6.19.2.3 Foam/Water, Low Level Water Only, and Preaction Supervised Solenoid Disconnect

Provide a key operated supervised disconnect switch to physically disable the solenoid for each foam/water, low level water only and preaction riser (if provided). Provide

switch that disables the releasing functions without the use of programming, while leaving all other functions of the panel operational. Do not provide a trouble signal upon operation of the disconnect. Monitor the disconnect switch at the RSFACU. Provide a supervisory signal to the receiving station upon operation of the disconnect.

Locate the disconnect switch in the riser room, in a readily accessible location near the solenoid. Provide a sign near the disconnect switch with a white background and a minimum 1/2 inch wide blue border, with "DISABLE FOAM SYSTEM", “DISABLE LOW LEVEL WATER ONLY SYSTEM”, or "DISABLE PREACTION SYSTEM" in red lettering not less than 1 inch (25.4 mm) high. Provide engraved labels on the disconnect switch indicating when the system is "ENABLED" or "DISABLED". Do not install backboxes or route conduit in front of sign in a manner that obstructs any lettering. /2/

3-6.19.2.4 Optical Flame Detection Inhibit Switch

Provide a 2-position non-key operated switch located within the RSFACU enclosure, that when activated disables the releasing function of all optical flame detectors in the hangar bay through programming at the RSFACU. \3\ When the switch is placed in inhibit mode, the releasing and alarm functions of the optical flame detectors are disabled while leaving all other functions of the RSFACU operational. /3/ Monitor the inhibit switch at the RSFACU. Provide a supervisory signal to the receiving station indicating the optical flame detectors are inhibited, a trouble signal is not permitted. Label the switch "INHIBIT OPTICAL FLAME DETECTION." Provide engraved labels on the inhibit switch indicating when the optical flame detectors are in "NORMAL" or "INHIBIT" mode.

3-6.19.3 Fire Alarm Reporting System

Provide a fire alarm reporting system that is fully compatible with the existing fire alarm receiving station without field modifications to system hardware. Independently circuit the FACU and RSFACU to a common fire alarm reporting system. Design the system so failure of the FACU does not prohibit the RSFACU from providing separate and distinctive release signals to the receiving station.

Provide notification from the fire alarm reporting system to the receiving station in accordance with the FACU and RSFACU matrixes.

Table 3-3: \3\ Sample FACU Functional Matrix /3/

NOTE: This sample table is intended to be specifically tailored/edited for each project.

		ANNUNCIATION AT LOCAL PANEL			NOTIFICATION											AUXILARY FUNCTIONS		
		AUDIO-VISUAL ALARM INDCATION	AUDIO-VISUAL TROUBLE INDICATION	AUDIO-VISUAL SUPERVISORY INDICATION	GENERAL FIRE ALARM SIGNAL TO RECEIVING STATION	COMMON FIRE ALARM TROUBLE SIGNAL TO RECEIVING STATION	COMMON FIRE ALARM SUPERVISORY SIGNAL TO RECEIVING STATION	COMMON FOAM SUPERVISORY SIGNAL TO RECEIVING STATION	FOAM SYSTEM DISABLED SUPERVISORY SIGNAL TO RECEIVING STATION	LOW TEMPERATURE SUPERVISORY SIGNAL TO RECEIVING STATION AND ENERGY MANAGEMENT CONTROL SYSTEM	FIRE SUPPRESSION CONTAINMENT SYSTEM SUPERVISORY SIGNAL TO RECEIVING STATION AND ENERGY MANAGEMENT CONTROL SYSTEM	INITIATE FIRE ALARM VISUAL NOTIFICATION	INITIATE GENERAL FIRE ALARM AUDIBLE NOTIFICATION	DISABLE GENERAL FIRE ALARM VOICE MESSAGE (IF ENABLED)	INITIATE FOAM RELEASE VOICE MESSAGE	FIRE PUMP START SIGNAL (IF PROVIDED)	ACTUATE DIVERTER VALVE FOR CONTAINMENT SYSTEM (IF PROVIDED)	SHUT DOWN SUPPLY, RECIRCULATING, EXHAUST, AND HIGH VOLUME SLOW ROTATING FANS IN HANGAR BAY
ALARM CONDITIONS	GENERAL FIRE ALARM *	X			X							X	X					
	GENERAL FIRE ALARM FROM RSFACU	X										X	X					
	FOAM/WATER RELEASE FROM RSFACU	X										X		X	X	X	X	X
	WATER FLOW/PRESSURE SWITCH FROM SPRINKLER SYSTEM **	X			X							X	X					
	FIRE PUMP RUN (IF PROVIDED)	X			X													
TROUBLE CONDITIONS	COMMON TROUBLE		X			X												
	COMMON FOAM/WATER TROUBLE FROM RSFACU		X															
	FIRE PUMP TROUBLE SIGNALS (IF PROVIDED)		X			X												
SUPERVISORY CONDITIONS	COMMON SUPERVISORY			X			X											
	COMMON FIRE ALARM SUPERVISORY FROM RSFACU			X														
	COMMON FOAM/WATER SUPERVISORY FROM RSFACU			X														
	OPTICAL FLAME DETECTION INHIBITED SUPERVISORY FROM RSFACU			X														
	OPTICAL FLAME DETECTION DISCONNECT SUPERVISORY FROM RSFACU (IF PROVIDED)			X														
	FIRE PUMP SUPERVISORY SIGNALS (IF PROVIDED)			X			X											
	HIGH/LOW NITROGEN/AIR PRESSURE (IF PROVIDED)			X			X											
	LOW TEMPERATURE SIGNALS (IF PROVIDED)			X						X								
	LOW FOAM CONCENTRATE LEVEL (IF PROVIDED)			X				X										
	NON-FOAM/WATER CONTROL VALVE SUPERVISORY			X			X											
	FOAM/WATER AND CONCENTRATE CONTROL VALVE SUPERVISORY			X					X									
	5% OF CONTAINMENT TANK VOLUME IS EXCEEDED (IF PROVIDED)			X							X							
	DIVERTER VALVE FOR CONTAINMENT SYSTEM IS OFF NORMAL (IF PROVIDED)			X							X							

* GENERAL FIRE ALARM CONDITIONS MAY INCLUDE MANUAL PULL STATIONS, SMOKE DETECTORS, AND OTHER DEVICES NOT USED FOR FOAM/WATER RELEASE BY THE RSFACU.
** WHERE PROVIDED AND NOT USED FOR FOAM/WATER RELEASE BY THE RSFACU.

3-6.19.4 FACU, RSFACU, Auxiliary Panels and Component Installation

\3\ Control units and panels located in finished areas where electrical and other utilities are concealed within walls or other chases must be recessed to provide an aesthetically similar appearance. When auxiliary batteries and charging is required, these may be located remotely to avoid recessing these components. Controls in industrial areas may be surfaced mounted when other utilities including electric conduits are surface mounted.

Where panels, devices, and appliances are subjected to water spray/runoff under normal operating conditions, provide National Electrical Manufacturers Association (NEMA) 250 Type 4 enclosures and water tight conduit. Regardless of environmental conditions, do not provide openings or conduit entry into the top of the RSFACU or any associated terminal cabinets containing releasing modules or EDIOs. /3/

3-6.19.5 Conduit Installation

Flexible conduit is only permitted when connecting to the following devices and appliances. Devices located on fire suppression equipment such as flow/pressure switches, solenoids, and tamper switches. Devices and appliances located in removable ceiling tiles, and where flexible conduit is specifically noted in this UFC such as for optical flame detectors. Where flexible conduit is permitted, it is limited to 6 ft. (1.8 m).

3-6.19.5.1 \2\ Conduit and Enclosure Installation within the Hangar Bay

Provide NEMA 250 Type 4 wall mounted devices and appliances within the hangar bay (including backboxes). Provide watertight conduit and junction boxes throughout the hangar bay.

Route conduit into the bottom of the backbox for manual foam and low level water releasing stations, stop stations, and flame detectors. Provide the low point of this conduit with a drain. Where the conduit is in a hazardously classified area, provide breathers in isolated portions of the conduit such as where sealed offs are provided. Rate drains and breathers for the electrical hazard classification in which they are installed, but not be less than NEMA 250 Type 4.

3-6.19.6 Surge Protective Devices (SPD)

Provide SPDs to protect all power supply circuits to the FACU and RSFACU, including any subpanels such as autonomous control units, amplifier panels, and Notification Appliance Circuit (NAC) booster panels. Provide SPDs to protect all fire alarm circuits leaving or entering the building. Devices mounted on an exterior wall such as wall mounted exterior speakers do not require a SPDs when Lightning protection is provided on the building. Provide SPDs in accordance with UFC 3-520-01. Mount SPDs in a separate enclosure, unless the SPD is listed and installed in the control panel by the factory. Installing SPDs not listed with the panel is prohibited.

3-6.19.7 Manual Fire Alarm Pull Stations

Where required by the UFC 3-600-01, provide general fire alarm manual pull stations that are red in color and labeled "FIRE".

3-6.19.8 Manual Foam and Low Level Water Releasing Stations

Provide distinctively different NEMA 250 Type 4 manual foam releasing stations and signage from the manual fire alarm pull stations. Provide station and tamper cover with colored portions in yellow and lettering reading "FOAM" or “LOW LEVEL WATER”; the words "FIRE", "ALARM", or "AGENT" are prohibited to appear on the cover or station. Provide locking type manual releasing stations that when activated require a key to be reset. Provide conventional manual releasing stations. Do not locate addressable monitor modules for the manual releasing stations in the hangar bay.

3-6.19.8.1 Manual Foam and Low Level Water Releasing Station location

Install manual releasing stations within the hangar bay so they are unobstructed, readily accessible, and located within 10 ft. (3.0 m) of each required exit or exit access from the hangar bay. Manual releasing stations are not required outside the hangar bay, unless required elsewhere in this UFC. Maintain a minimum separation distance of 5 ft. (1.5 m) between general fire alarm pull stations (if provided) and the manual releasing stations. Where possible, install the manual releasing stations on the opposite side of the door from the general fire alarm pull stations.

Where foam/water or low level water systems are zoned per 3-6.16.1: Low Level Water System Performance or 3-6.17: Hi-Ex Foam System Performance, provide manual releasing stations within each zone for the release of that zone. Provide additional 1 inch (25 mm) high black block lettering on the sign indicating which zone is served by the manual releasing station.

For Army: Zoned manual foam release stations are not permitted. Program the foam release stations to simultaneously release the foam/water discharge from all zones viewable from the foam release station.

3-6.19.8.2 Manual Foam and Low Level Water Releasing Station Protection

Protect releasing stations located in the hangar bay from mechanical damage. Provide a clear plastic tamper cover over the manual releasing station that when lifted emits an audible alarm. Exception: Audible alarm is not required where a manual releasing station is installed in a hazardous (classified) location.

3-6.19.9 Manual Foam and Low Level Water Stop Stations

Provide NEMA 250 Type 4 manual stop stations of the "dead-man" type at each manual releasing station. Use stop stations in conjunction with valves and equipment to stop the discharge of foam and water from the suppression system. Provide manual stop stations with distinctive signage at each device. Provide a red mushroom type push button and include the word "PUSH". Provide the colored portions of the station and tamper cover in blue and lettering reading "STOP"; the words "FIRE", "ALARM", or

"AGENT" are prohibited to appear on the cover or station. Do not locate addressable monitor modules for the manual stop stations in the hangar bay.

3-6.19.9.1 Manual Foam and Low Level Water Stop Station Operation

Once depressed, and so long as the button is held down, design the system so the stop station prevents/stops discharge of the foam and water system regardless of whether or not the foam and water system was activated automatically or manually, and whether or not the activation occurs prior to or after the stop station is pressed and held. Program the stop stations to simultaneously stop the foam and water discharge from all zones viewable from the depressed stop station. Unless the RSFACU has been reset and all activation alarms (manual and automatic) have been cleared; restore the foam and water system operation when the stop station button is released. Do not exceed 15 seconds to fully close the flow control valve when the stop station button is depressed under full flow. Where the foam and water system is still in alarm, do not exceed 5 seconds to fully open the flow control valve upon release of the stop station button.

3-6.19.9.2 Manual Foam and Low Level Water Stop Station Protection

Protect manual stop stations located in the aircraft servicing area from mechanical damage. Provide a clear plastic tamper cover (without audible alarm) over the manual stop station.

3-6.19.10 Manual Foam and Low Level Water Releasing and Stop Station Signage

Provide two separate but adjacent metal signs a minimum of 24 inches (610 mm) high by 20 inches (508 mm) wide. Provide no more than 12 inches of separation between the two signs. Do not use the words "FIRE", "ALARM", or "AGENT" on these signs. Do not install backboxes or route conduit in front of sign in a manner that obstructs any lettering. See Figure 3-10: Start Foam System Signage, Figure 3-11: Stop Low Level System Signage, Figure 3-12: Stop Foam System Signage and Figure 3-13: Stop Low Level System Signage.

3-6.19.10.1 Manual Foam and Low Level Water Releasing Sign

Provide the sign for the manual releasing station with a yellow or lime-yellow background with "START FOAM SYSTEM" or “START LOW LEVEL SYSTEM” as appropriate in red lettering not less than 3 inches (76 millimeters) high. Locate the manual releasing station with tamper cover on the lower portion of the sign. Provide the word "START" in minimum 1 inch (25.4 mm) high green lettering placed directly above the manual releasing station.

3-6.19.10.2 Manual Foam and Low Level Water Stop Sign

Provide the sign for the manual stop station with a white background and a minimum 1/2 inch wide blue border with "STOP FOAM SYSTEM" or “STOP LOW LEVEL SYSTEM” as appropriate in blue lettering not less than 3 inches (76 millimeters) high.

Locate the manual stop station with tamper cover on the lower left portion of the sign. Provide the word "STOP" in minimum 1 inch (25.4 mm) high red lettering placed directly above the manual stop station.

To the right of the stop button provide the following in minimum 1/2 inch (12 mm) high black lettering "To stop the system, press and continuously hold STOP button until relieved by emergency responders. There may be up to a 30 second delay after pressing the STOP button before the flow stops." /2/

Figure 3-10: Start Foam System Signage

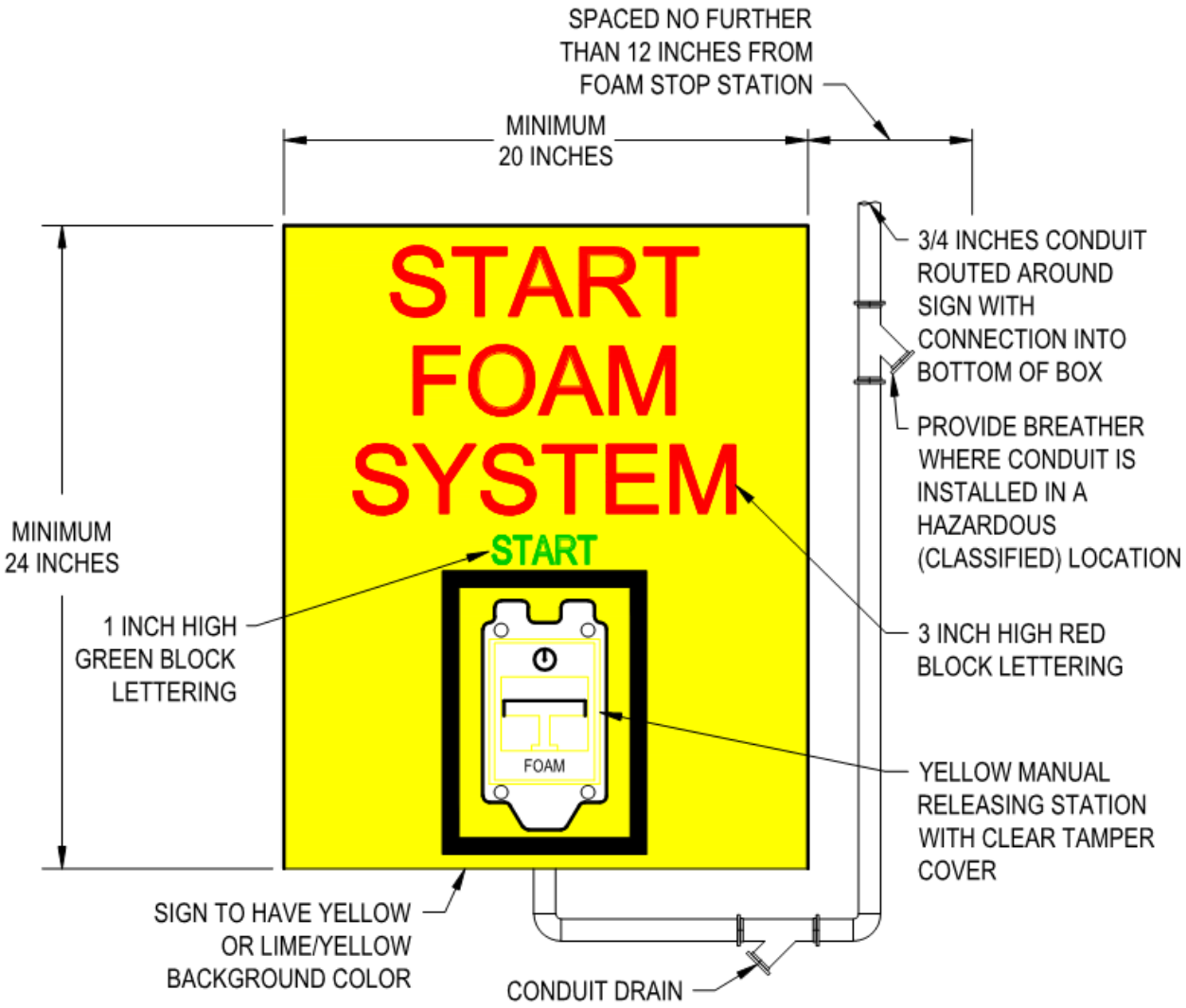


Figure 3-11: Stop Low Level System Signage

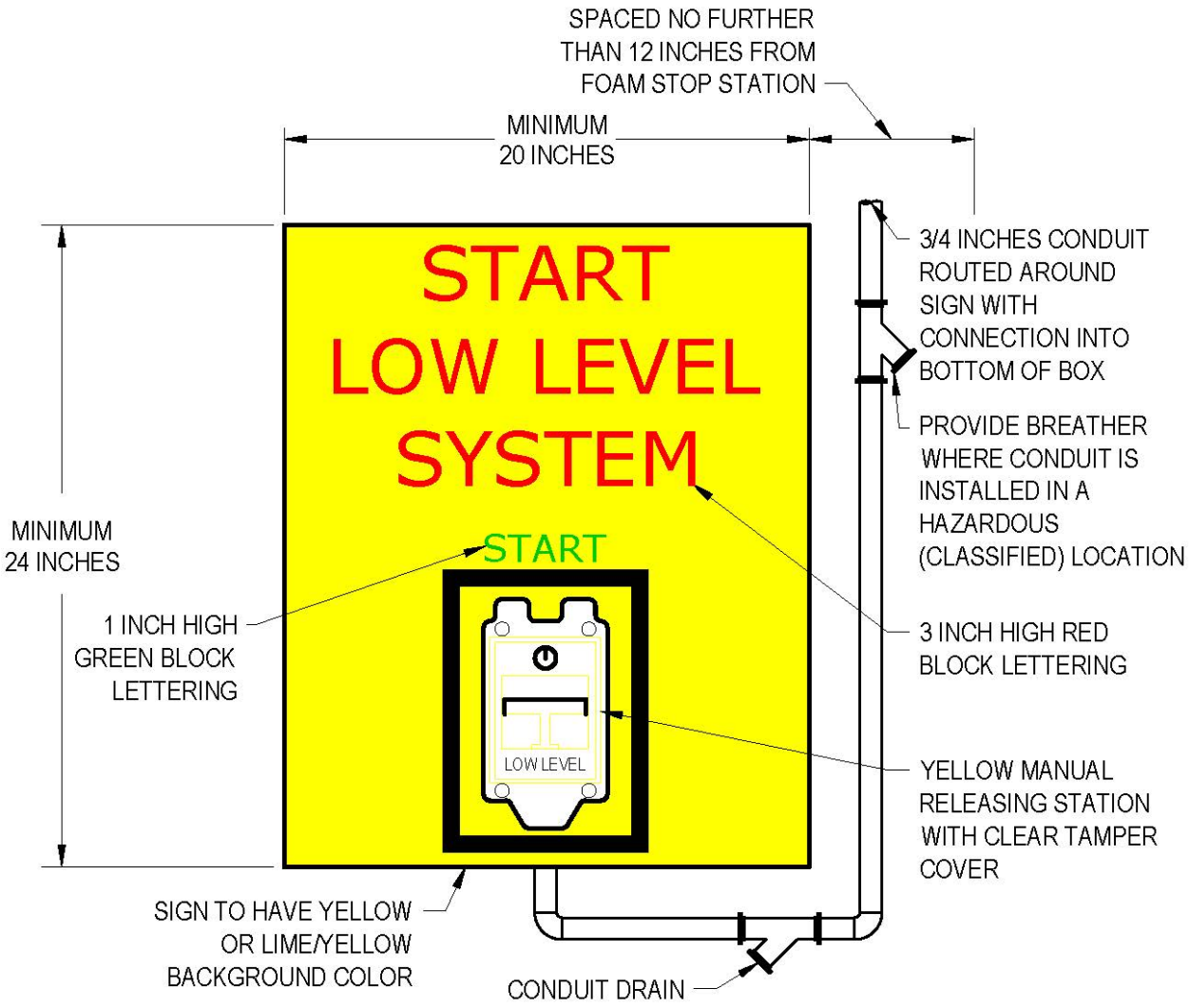


Figure 3-12: Stop Foam System Signage

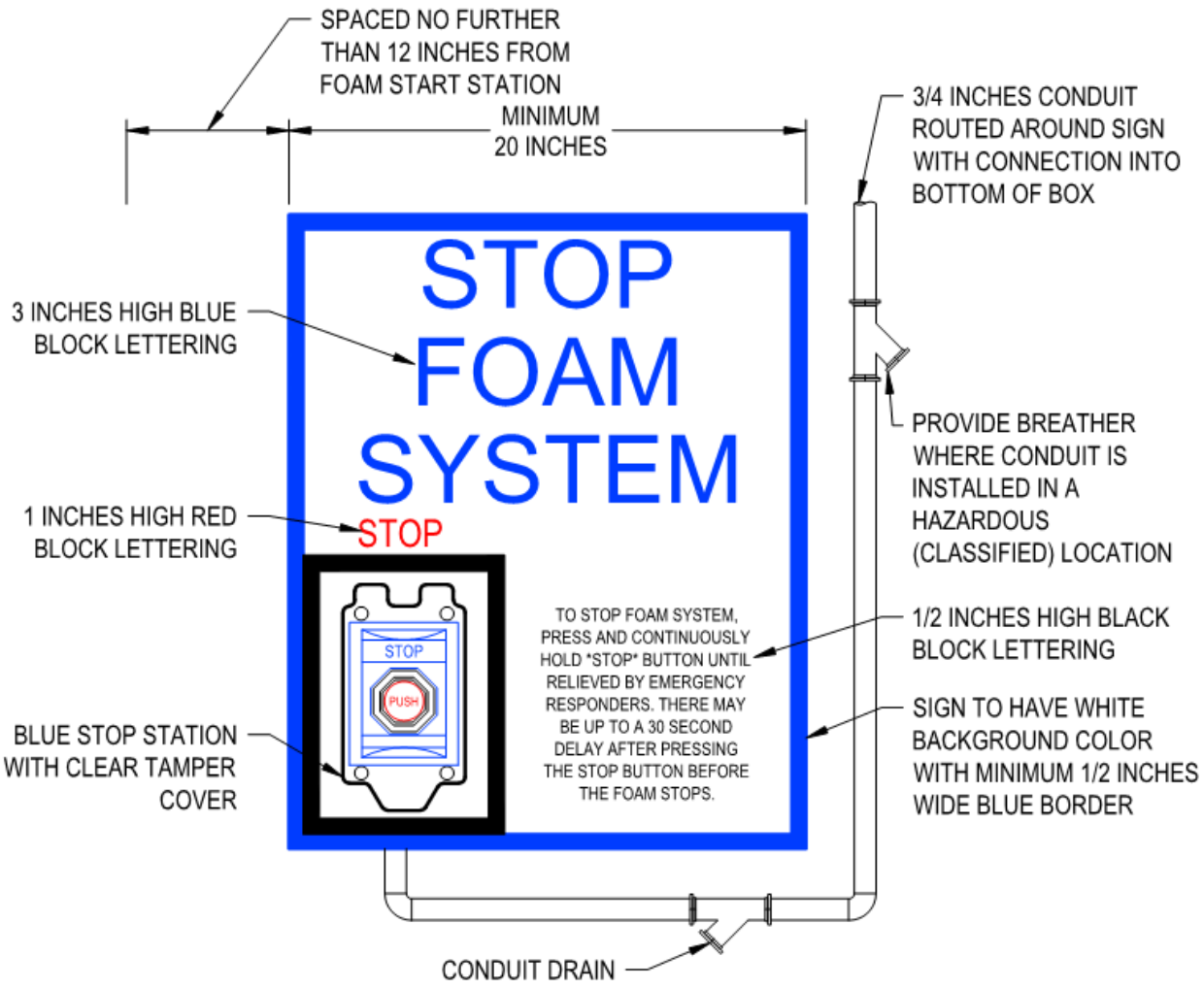
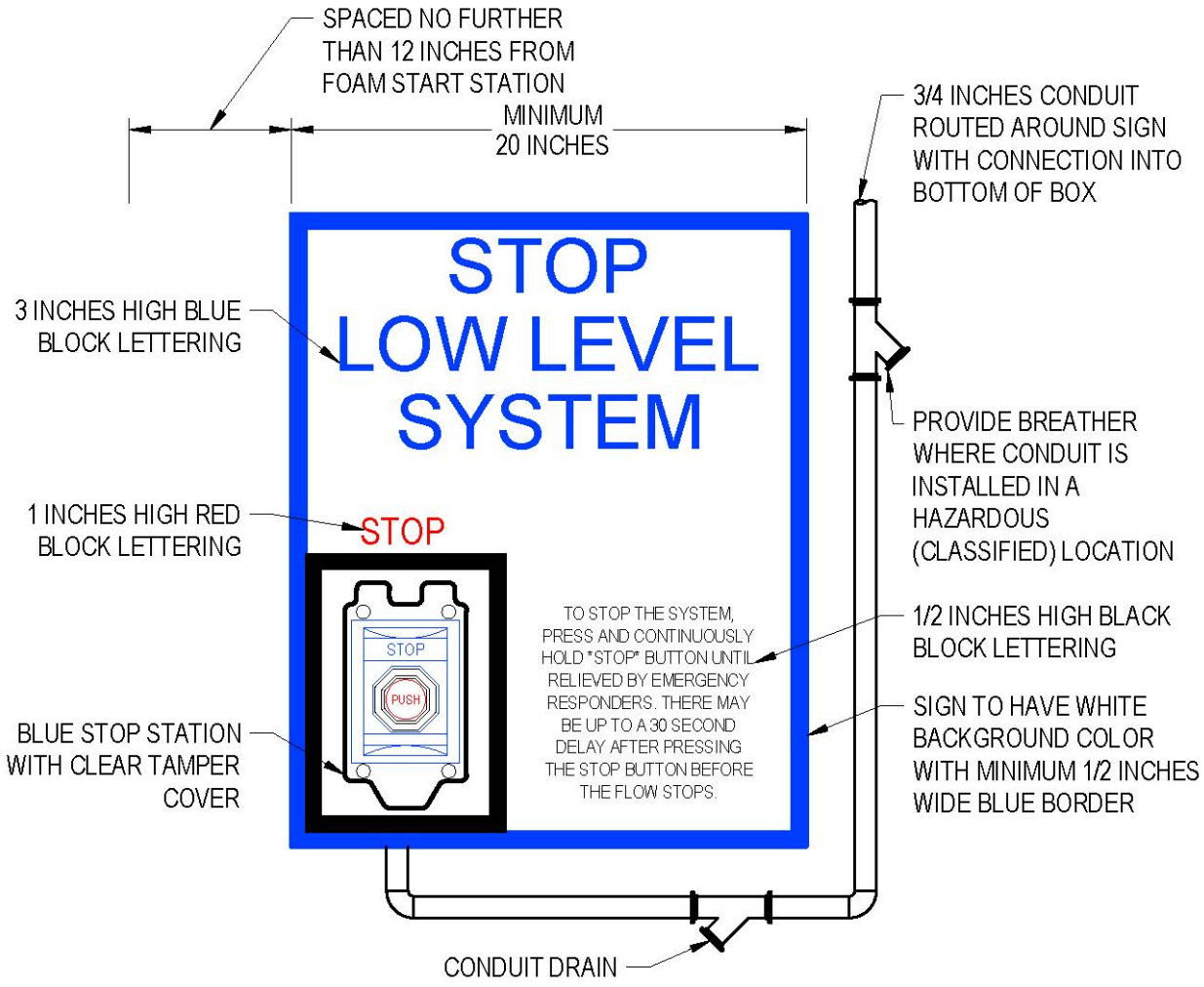


Figure 3-13: Stop Low Level System Signage



3-6.19.11 Optical Flame Detection

Provide optical flame detection in accordance with this section.

3-6.19.11.1 Optical Flame Detectors (OFD)

Provide triple infrared (IR) optical flame detectors that are listed/approved for the expected fuel hazards in the hangar bay. Provide detectors that are immune to radar and radio frequency emissions from hand held equipment or equipment on-board the aircraft. Provide shielded circuiting for both the SLC and power from the optical detectors to the RSFACU and ground shielding in accordance with the optical flame detector manufacturer.

3-6.19.11.2 Optical Flame Detector Location

Provide a sufficient number of optical flame detectors around the perimeter of the hangar bay, such that all portions of the hangar bay are within the range and cone-of-vision of at least three detectors. Exception: The area of the hangar bay within 5 ft. (1.5 m) of the perimeter wall is not required to be within the cone-of-vision of an optical flame detector. No aircraft silhouette will be solely visible from optical flame detectors located on one side of the fuselage. A minimum of two optical flame detectors covering the aircraft silhouette are required on each side of the fuselage.

Angle detectors and provide blinds (field of view inhibitors) so the cone-of-vision is contained within its designated suppression zone and does not extend more than 5 ft. (1.5 m) outside the hangar bay, into another fire area such as through a normally open roll-up fire door, or is within the view of hot sources such as radiant heaters. Locate optical flame detectors at a sufficient distance per the manufacturer's recommendations from sources that may cause false alarms such as welding, solar glare, radiant heaters, aircraft engine exhaust, strobes, hot surfaces and other relevant sources.

3-6.19.11.3 Optical Flame Detector Installation

Mount detectors in accordance with their listing at approximately 8 ft. (2.4 m) above the finished floor of the hangar bay. Do not mount optical detectors in inaccessible locations. Provide optical flame detectors with 5 ft. (1.5 m) of flexible conduit to allow for minor adjustments during testing or changes in the mission of the hangar bay.

3-6.19.11.4 Optical Flame Detector Performance.

Provide detector coverage to meet the performance criteria outlined in Service-specific Chapters 5, 6, and 7. Calibrate optical flame detectors to operate upon viewing the flame signature of the expected fuel(s) to be in the hangar bay. Use a 2 ft. x 2 ft. (610 mm x 610 mm) pool fire as the bases to set the sensitivity of the optical flame detectors. Upon the 2 ft. x 2 ft. (610 mm x 610 mm) pool fire reaching full development, all detectors within the cone-of-vision are required to activate within 30 seconds.

3-6.19.12 Thermal Fire Detectors for Preaction Sprinkler System

Provide an automatic thermal fire detection system to activate any preaction sprinkler systems in the hangar bay.

3-6.19.12.1 Thermal Fire Detector System

Provide one of the following heat detection systems located at the underside of the roof or suspended ceiling (if provided) in the hangar bay.

- Non-addressable rate-compensated heat detectors having a temperature rating between 160ºF (71ºC) and 170ºF (76ºC). Install heat detectors in accordance with NFPA 72. Except, space heat detectors in accordance with their listed spacing without reduction in spacing due to ceiling height. The maximum spacing between heat detectors is limited to 40 ft. (12.1 m).

- Linear thermistor (line-type electrical conductivity) fire detector having a temperature setting of 170ºF (76ºC). Space detection lines with a maximum spacing of 30 ft. (9.1 m). Use the manufacturer's approved testing method to verify the detector's response setting after installation. On curved roofs or roof exceeding a 2 in 12 pitch, install thermistor detectors perpendicular to the slope or arc (along the axis of the curve).

3-6.19.12.2 Thermal Fire Detector Installation

Provide a fire detection zone for each corresponding preaction sprinkler system. Activate the associated preaction valve for the floor area covered by the zone.

3-6.19.13 Waterflow Detection Devices

Provide waterflow detection devices on sprinkler systems. Waterflow detection devices for wet pipe sprinkler systems may either be a paddle type with built-in adjustable retard set to approximately 60 seconds or pressure type with retard chamber equivalent to approximately 60 seconds. Provide waterflow detection with no retard on preaction and dry pipe sprinkler systems.

3-6.19.14 Notification Appliances

3-6.19.14.1 Audible Notification

Provide voice evacuation / mass notification in support areas of the building and throughout the hangar bay. Broadcast prerecorded and live message content such that it is adequately understandable to occupants within the hangar bay. Within the hangar bay, meet or exceed the intelligibility criteria for cavernous-type open areas in accordance with UFC 4-021-01. Upon the activation of an initiating device within the hangar bay, provide the following conceptual message throughout the building. Adjusted the message for installation specific requirements.

Three Pulse Temporal Pattern <Three Rounds>

"May I have your attention. There is a fire emergency in the hangar bay. Please leave the building by the nearest exit. Do not exit through the hangar bay."

<Pause 2 seconds>

Repeat

3-6.19.14.2 Visual Notification

In addition to the visual notification required in support areas per UFC 3-600-01, provide visual notification for general fire alarm throughout the hangar bay. Where full coverage of the hangar bay cannot be accomplished using wall mounted strobes without exceeding 110 candela (cd), the following spacing criteria applies.

- Visual notification coverage is not required in the center of the hangar bay.

- Provide strobes not exceeding 110 cd around the perimeter of the hangar bay, not including the hangar bay door opening, in accordance with the room spacing requirements for wall-mounted visible appliances in NFPA 72.

For Air Force and Army: Strobes not exceeding 177 cd are permitted.

3-6.19.15 Supervision and Signage

Report supervisory alarms as independent addresses to the FACU, RSFACU, or Energy Management Control System as indicated on the functional matrixes. Grouped switches on common addresses are not permitted. Provide non-latching electronically supervisory devices.

3-6.19.15.1 Control Valves

Electrically supervise normally open control valves.

Electrical or mechanical supervision is not required for normally closed control valves, unless opening the valve is detrimental to the system operation. When supervision is required on normally closed valves, provide electrical supervision such as cable type monitoring.

3-6.19.15.2 Trim Valves

Mechanically lock or provide tamper seals such as zip-ties on trim valves, that when opened or closed are detrimental to the operation of the foam/water system such as the shutoff for the foam system pressure switch. Provide signage indicating the valve’s normal operating position.

3-6.19.15.3 Drain Valves

Mechanically lock or provide tamper seals such as zip-ties on drain or trim valving in the closed position, that when opened will cause the discharge of the foam/water system such as the manual release valve on the foam/water system riser. Provide this valve with the following signage, "OPENING THIS VALVE WILL RELEASE THE FOAM SYSTEM."

3-6.19.15.4 Emergency Foam/Water System Shutdown

Provide sequential signage on the control valves for the emergency shutdown of the foam/water system. Locate these signs so they are readily visible near each valve used in the shutdown sequence.

Provide signs with white background and a minimum 1/2 inch wide blue border with red lettering not less than 1 inch (25.4 mm) high. At a minimum, provide each sign with the language "EMERGENCY FOAM SHUTDOWN PROCEDURE" and the order and action to be performed such as "1 - CLOSE FOAM CONCENTRATE VALVE", "2 - CLOSE FOAM/WATER RISER CONTROL VALVE". Continue the sequence as required for shutdown.

3-6.20 Testing

At a minimum, provide the testing and reports outlined in this section. Coordinate testing personnel as required to demonstrate the coordination and communication of the fire protection systems through full functional testing. Independent testing of each individual fire protection system is not a substitute to the functional testing requirements. Such as depressing the stop button and witnessing the de-energizing of the solenoid, does not adequately demonstrate the flow control valve will stop the foam/water under full flow.

3-6.20.1 Testing Personnel

Provide a Qualified Fire Protection Engineer (QFPE) meeting the requirements of UFC 3-600-01 for the witnessing and/or review of testing/reports as outlined in this section.

At a minimum, provide a factory authorized representative for the startup and/or testing of the following systems as outlined below:

- Fire Suppression System (Preliminary and Final Testing)
- Foam Proportioning System (Preliminary and Final Testing)
- Fire Pump System, When Provided (Start Up)
- Fire Alarm and Mass Notification System (FACU/ACU) (Preliminary and Final Testing)
- Foam/Water Releasing System (RSFACU) (Preliminary and Final Testing)

3-6.20.2 Foam/Water Discharge Testing Plan

Provide a testing plan certified by the QFPE that includes the following:

- Who will perform the testing and who will be the onsite factory authorized representatives.
- What are the safety precautions taken during testing.
- How will the foam/water system be tested to demonstrate the performance criteria has been met.
- How will the event be recorded for future review.
- What are the testing procedures to demonstrate the coordination and communication of the fire protection systems associated with the foam/water discharge.
- How will the hangar bay be protected during the discharge of foam.
- How will the foam be captured during the discharge and disposed.

3-6.20.3 Preliminary Testing

Provide acceptance testing for the fire suppression and fire alarm systems complying with NFPA 11, 13, 20, 24, and 72 as applicable. At a minimum, provide the following preliminary testing reports.

- Contractor's Material and Testing Certificate for Underground Piping per NFPA 13 and 24. Provide photos of installation prior to burial. (Reviewed by the QFPE)
- Contractor's Material and Test Certificate for Aboveground Piping per NFPA 13 for each riser, manifold, and fire department connection. (Reviewed by the QFPE)
- Fire pump test report demonstrating compliance with NFPA 20 acceptance testing criteria. Where a concentrate pumping system is also provided, demonstrate compliance with NFPA 11 and 20 acceptance testing criteria. (Reviewed by QFPE)
- With the use of a time stamped video, demonstrate the performance criteria for foam coverage is within the limitations upon the actuation of a manual foam releasing station. The use of foam concentrate for this test is required to demonstrate preliminary compliance. (Witnessed by the QFPE)
- Demonstrate the performance criteria for opening and closing the flow control valve is met upon actuation of the manual foam stop stations. A water only test is acceptable. (Witnessed by the QFPE)
- **For Air Force and Navy:** Provide the residual pressure at the most remote nozzle or generator with only the foam/water system operating. Provide the inlet and outlet pressures of the flow control valve and inductor. A water only test is acceptable. Use this information to verify the hydraulic performance of the system. (Reviewed by the QFPE)
- **For Army**: Provide the residual pressure at the most remote generator with the simultaneous operation of the foam/water system, overhead hangar bay sprinkler system simulation, and exterior hose demand (when applicable). Simulate the overhead sprinkler system and hose demand through the test header. Provide pitot measurements and type of equipment used for this simulation. Provide the inlet and outlet pressures of the flow control valve. A water only test is acceptable. Use this information to verify the hydraulic performance of the system. (Reviewed by the QFPE)
- Provide a proportioning system test report demonstrating compliance in accordance with NFPA 11. (Reviewed by the QFPE)
- System record of Inspection and Testing, Notification appliance supplementary Record of Inspection and Testing, Initiating Device Supplementary Record of Inspection and Testing, Interface Component Supplementary Record of Inspection and Testing, and Mass Notification

System Supplementary Record of Inspection and Testing per NFPA 72 for the FACU and RSFACU. (Reviewed by the QFPE)

- Test the mass notification system in accordance with the requirements of UFC 4-021-01. At a minimum provide sound power levels (Decibel A Weighted Scale (dbA)) and intelligibility scores (CIS) throughout the facility. (Reviewed by the QFPE)
- Demonstrate the functionality of the fire alarm system is in compliance with the FACU and RFSACU functional matrixes. (Witnessed by the QFPE)
- \2\ Demonstrate the performance requirements of the optical flame detector coverage has been met through pan fire acceptance testing. Use a propane based testdevice calibrated to be equivalent to a JP 4/5/8 fuel fire in a 2 ft. x 2 ft. (610 mm x 610 mm) test pan, with closable lid. Refer to Figure E-17: Example of Fire Pan, for Acceptance Test of Optical Detectors. Minimum acceptable performance: (1) three detectors must activate within 30-seconds of full flame development (propane 2.0 seconds) with the test burner centered in the designated aircraft parking position. (2) With the test fire located 10 ft (3.0 m) outside the hangar bay opening entered on the parking position, no detector is permitted to operate after 30 seconds of full fire exposure. (Witnessed by the QFPE) /2/

3-6.20.4 Request for Final Testing

Provide a break-in period of at least 14 consecutive days after the FACU and RSFACU have been enabled, prior to any final testing. Provide a written request for a final test from the QFPE, after preliminary testing is complete, adjustments have been made to the system, and the system is ready for service.

3-6.20.5 Final Testing

Final testing to be witnessed by the AHJ, as defined by UFC 1-200-01. Such as for an Air Force project the AHJ is the Air Force Civil Engineer Center, Operations Director (AFCEC/CO), even if the project is constructed by NAVFAC or the Army Corps of Engineers. AFCEC/CO would witness final testing in this example. The final testing may be witnessed by a delegated representative at the discretion of the AHJ. With the exception of system flushing and hydrostatic testing, repeat preliminary tests during the final testing at the discretion of the AHJ. Correct system failures or other deficiencies identified during the final testing and retest in the presence of the AHJ, at their discretion.

3-7 ELECTRICAL

Provide a 3-phase wye-connected, underground secondary service rated at 480 Volts Alternating Current (VAC). For projects outside of the United States and its territories and possessions, provide electric power in accordance with UFC 3-510-01.

3-7.1 Hazardous (Classified) Locations

Design hazardous (classified) locations including the hangar bay and adjacent spaces in accordance with NFPA 70 requirements for hazardous locations. At a minimum, classify adjacent spaces that are not suitably cutoff as Class I Division 2 up to 18 inches (460 mm) above the floor of the hangar bay adjacent to the space.

\2\ Note: The area within 5 feet of any aircraft fuel vents and any fuel containing portion of the aircraft is Class I Division 2. For practical use and mission-flexibility, this is generally simplified to within 5 feet horizontally of any aircraft surface and vertically from 5 feet above the surface down to the floor. /2/

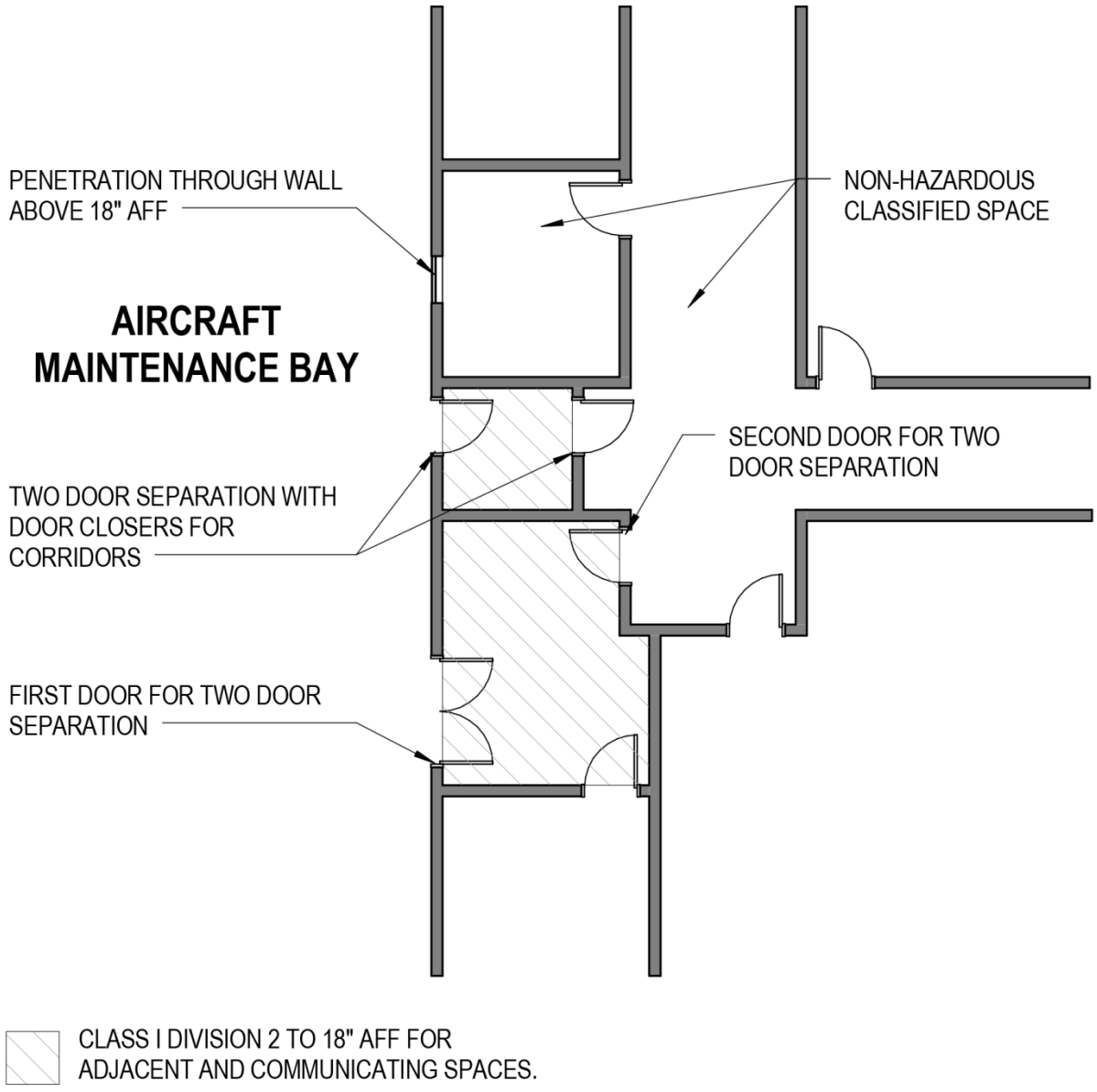
If a space is adjacent and communicates with a hazardous location, the term "suitably cutoff" in NFPA 70 is defined as either of the following conditions as shown in Figure 3-14: Adjacent Space Electrical Hazardous Classifications:

- Two normally closed (self-closing) doors in series with a minimum separation of 5 ft. (1.5 m). Classify the space between these doors as Class I Division 2 up to 18 inches (460 mm) above the floor of the hangar bay adjacent to the space.
- A wall that has sealed openings up to a minimum of 18 inches (460 mm) above the floor of the hangar bay adjacent to the space. This condition is not permitted where the hazardous classification of hangar bay adjacent to the space is greater than 18 inches (460 mm).

\2 If a battery maintenance shop is required, see UFC 3-520-05 for additional requirements. Lithium-Ion battery maintenance requires significant space and mechanical systems. ***/2/***

\3 For Navy, see 7-7.1 Hazardous Classification. Additionally, see 3-9.3 Hazardous Classification for bridge crane operating environment and requirements. /3/

Figure 3-14: Adjacent Space Electrical Hazardous Classifications



3-7.2 Hangar Bay Door Power

Provide a separate and dedicated power supply from the facility transformer or ahead of the main service disconnecting means. Provide power to the hangar bay door such that the door remains energized when the main disconnect switches for general hangar power are shut off.

Provide a key-operated or other access-controlled switch on the exterior of the facility to open the hangar bay door in the event of an emergency.

3-7.2.1 Hangar Bay Door Portable Generator Connection

As a minimum, provide a portable generator connection on the exterior of the building with a manual transfer switch for hangar bay doors.

3-7.2.2 Vertical Lift Fabric Doors

Design the power source for vertical lift fabric doors to have the capability of being operated by an emergency generator or an Aerospace Ground Equipment (AGE) power cart during power outages. At a minimum, size the service to allow operation of one door panel at a time.

3-7.3 Electric Door Track Heating

Provide an electric door track heating system in accordance with heating requirements listed in 3-5.2: Heating. A heated antifreeze system may be used in lieu of an electric door track heating system. Coordinate which system is to be used with the mechanical design.

3-7.4 Renewable Energy Sources

\2 Photovoltaic (PV) systems on flight line facilities are a concern due their glare. See 2-1.6 Solar Glare Hazard Analysis. Also see UFC 3-540-08 *Utility-Scale Renewable Energy Systems* and UFC 3-440-01 *Facility-Scale Renewable Energy Systems* for facility requirements of renewable energy systems. See also UFC 3-260-01 *Airfield and Heliport Planning and Design* for system siting information, requirements and other approvals on airfields. ***/2/***

3-7.5 Backup Power

3-7.5.1 Portable Generator Connection

Provide a portable connection size and type based on the following criteria.

- Activities and missions, approved in accordance with UFC 3-540-01, to be supported by the generator connection.
- Type of portable generators and connections available at the installation.

3-7.5.2 Backup Generator

Backup generators and Uninterruptible Power Supply (UPS) backup power systems are not generally required for this facility type.

\3\ Backup generators may be considered for situations in which backup power is required for the hangar door operation (door opening and heat coils for rails) or for missions attached to the hangar. When authorized, provide backup generator power in accordance with UFC 3-540-01. See 3-5.2 Heating for snow-melting coils. See C-10.2 for discussion on Vertical Lift Fabric Door operations. /3/

3-7.6 Aircraft Power Distribution

Aircraft have specific power requirements, including unique voltages, frequencies, and capacities. Review the aircraft requirements of the aircraft being maintained in the hangar bay to determine the appropriate services. Provide appropriate services in voltage, frequency, and capacity to service the aircraft.

Provide permanently-mounted equipment located within the hangar bay or an adjacent space as follows.

- Permanently-mounted equipment may be installed within the hangar bay or within an adjacent space to the hangar bay. If equipment is installed in the hangar bay it may be either floor-mounted or mounted on the wall at a higher elevation. If the equipment is mounted at a higher elevation, coordinate the support of the equipment with the structural engineer. If the equipment is mounted on the floor, provide a stand for the equipment to elevate the equipment a minimum of 18 inches (0.46 m) AFF to avoid having the equipment in the Class I Division 2 hazardous space. Coordinate location of equipment to maintain the clear zone. Refer to 2-3: Minimum Aircraft Maintenance Bay Clearances for clear zone requirements.
- Provide solid-state equipment for special power units.
- Permanently-mounted equipment typically has controls mounted on the face of the equipment. If the equipment is mounted at a higher elevation, or an adjacent space provide remote control and displays at an elevation with the hangar bay that is accessible by the user.

3-7.6.1 Power Distribution Service Points

\3\ Distribute aircraft power from permanently-mounted equipment located on the wall. /3/

3-7.6.1.1 Wall-mounted connection points

Different aircraft have different power requirements and connections. Match receptacle and cable type to aircraft being maintained. Provide wall-mounted connection points close to the distribution equipment. Coordinate the location of the connection points with the location of the aircraft connection point to minimize the length of the cable from the wall to the aircraft. Provide one of the following connections:

- Provide wall-mounted cable storage racks for storage of the cable when receptacles are installed. Mount receptacles above electrical hazardous location. Provide floor-mounted cable protectors from the wall across the service lane to the aircraft side of the service lane. Lay cables in the cable protector to protect cable from cross traffic while the cables are extended and in use.
- When approved, electrically or air driven reels may be provided. Install electric motors above the electrical hazardous location. Provide reel controls as part of the cable assembly. Coordinate motor size and type with length and weight of cable provided.
- **For Army and Navy:** Cables connecting to the service point may or may not be provided as part of the service.
- **For Air Force:** Refer to Chapter 5 Air Force Specific Criteria for additional requirements.

3-7.6.1.2 Permanently-Mounted Pedestal

For Air Force and Navy: Permanently-mounted pedestals are not permitted.

For Army: Refer to Chapter 6 Army Specific Criteria for additional requirements.

3-7.6.1.3 Retractable (Pop-up) Pedestal

Retractable (Pop-up) pedestals are not permitted.

3-7.6.1.4 Aircraft Power Distribution Point Utility Coordination

Other services including compressed gasses, water, and preconditioned air are required to maintain aircraft. Coordinate the location of electrical services with all other utilities.

3-7.7 Aircraft Power Systems

Aircraft have specific power requirements, including unique voltages, frequencies, and capacities. Review the requirements of the aircraft being maintained in the hangar bay to determine the appropriate special power systems required. Provide the appropriate aircraft power systems in voltage, frequency, and capacity to service the aircraft being maintained.

3-7.7.1 Aircraft 400 Hertz (Hz) Service

Design a complete, functioning 200Y/115VAC, 400 Hz power system, including converter, cables and connectors, to support the aircraft maintenance activities. Provide 400 Hz service in the hangar bay and in shops where 400 Hz is required by the users. Coordinate the exact number and sizes of converters with the users supported. Design the system to provide power to each aircraft parking spot. Design system to compensate for voltage drop and sufficient voltage at the point of service. Provide voltage drop calculations, in accordance with the equation below, to meet the voltage

requirement at the aircraft point-of-service and to meet the requirements of the aircraft power monitor.

For Army and Navy: The use of centralized systems servicing more than two aircraft are prohibited.

400 Hz Equation

2L x I x Xr1 / 10,000 = VD single-phase line to neutral of three-phase

SQRT(3)L x I x Xr1 / 10,000 = VD three-phase line to line

L = circuit length in feet.

I = current in Amps.

Xr1 = Impedance of a particular size wire, = SQRT(R^2 + $X1^2$)

R = AC resistance of the wire.

VD = voltage drop in Volts.

X1 = Reactance

For Army and Navy: 400 Hz converters, cables, and connector are Real Property Installed Equipment (RPIE) equipment. The use of centralized systems servicing more than two aircraft are prohibited.

For Air Force: Refer to Chapter 5 Air Force Specific Criteria for additional requirements.

3-7.7.1.1 Aircraft 400 Hertz (Hz) Special Power Distribution Cables

Provide 30-100 ft. (9.1 - 30.5 m) 400 Hz cable consisting of six power conductors, two per phase, helically laid around one central neutral conductor and six control conductors, minimum of #18 American Wire Gage (AWG), specifically designed for 400 Hz applications. Base the size of the power conductors on the kilovolt-amperes (kVA) rating of the aircraft. Base the length of the cable on the distance from the distribution equipment to the aircraft location.

Coordinate how the cables are being provided for the project with the users. The cables may be part of the Military Construction (MILCON) or the cables may be equipment provided by the user. If the cables are permanently affixed to the facility distribution system, the cable is considered to be part of the MILCON. If the cables can be disconnected from the facility distribution system, the cable is provided by the user.

3-7.7.2 Aircraft 28 Volts Direct Current (VDC) Service

Design a complete and functioning 28VDC ground power unit. Provide 28VDC service in the hangar bay and in shops where 28VDC is required by the users. Coordinate the

exact number and sizes of ground power units with the users supported. Design the system to provide power to each aircraft parking spot.

For Army and Navy: 28VDC ground power units, cables and connector are RPIE equipment. The use of centralized systems servicing more than two aircraft are prohibited.

For Air Force: Refer to Chapter 5 Air Force Specific Criteria for additional requirements.

3-7.7.2.1 Aircraft 28VDC Distribution Cable

Provide 30-100 ft. (9.1 - 30.5 m) 28VDC cable consisting of two individual power conductors banded together with non-metallic bands, strain relief, and appropriate connector. Base the size of the conductor on the kVA rating of the aircraft. Base the length of the cable on the distance from the distribution equipment to the aircraft location.

Coordinate how the cables are being provided for the project with the users. The cables may be part of the Military Construction (MILCON) or the cables may be equipment provided by the user. If the cables are permanently affixed to the equipment, the cable is considered to be part of the MILCON. If the cables can be disconnected from the facility distribution system, the cable is provided by the user.

3-7.7.3 Aircraft 270VDC Service

For Air Force and Navy: Design a complete and functioning 270VDC ground power unit. Provide 270VDC service in the hangar bay and in shops where 270VDC is required by the users. Coordinate the exact number and sizes of ground power units with the users supported. Design the system to provide power to each aircraft parking spot.

For Air Force: Refer to Chapter 5 Air Force Specific Criteria for additional requirements.

For Navy: Refer to Chapter 7: Navy Specific Criteria for additional requirements.

3-7.7.3.1 Aircraft 270VDC Distribution Cable

Provide 30-100 ft. (9.1 - 30.5 m) 270VDC cable consisting of a single jacketed multi-conductor cable with power and controls incorporated into the cable with the appropriate connector. Base the size of the conductor on the kVA rating of the aircraft. Base the length of the cable on the distance from the distribution equipment to the aircraft location.

Coordinate how the cables are being provided for the project with the users. The cables may be part of the Military Construction (MILCON) or the cables may be equipment provided by the user. If the cables are permanently affixed to the equipment, the cable

is considered to be part of the MILCON. If the cables can be disconnected from the facility distribution system, the cable is provided by the user.

3-7.8 Grounding and Bonding

Provide grounding and bonding in accordance with UFC 3-575-01.

Coordinate the requirement for ordnance grounding with the users supported. Areas of consideration may include, but is not limited to, the following:

- Seat maintenance for seats with explosives
- Canopy maintenance for canopies with explosives
- Seat storage for seats with explosives
- Canopy storage for canopies with explosives
- Canopy shop and storage areas
- Armament Room

For Air Force: Refer to Chapter 5 Air Force Specific Criteria for additional ordnance grounding requirements.

For Army: Refer to Chapter 6 Army Specific Criteria for for additional ordnance grounding requirements.

For Navy: Refer to Chapter 7: Navy Specific Criteria for additional ordnance grounding requirements.

3-7.9 Lightning Protection

Provide lightning protection in accordance with UFC 3-575-01.

3-7.10 Lighting and Lighting Controls

Design lighting and lighting controls in accordance with UFC 3-530-01.

3-7.10.1 Apron Lighting

Lighting may be provided on the exterior of the facility for apron lighting. Coordinate lighting with activities on the apron. Design apron lighting in accordance with UFC 3-530-01.

3-7.10.2 Aviation Obstruction

Provide aviation obstruction lighting in accordance with UFC 3-535-01.

For Navy: Refer to Chapter 7: Navy Specific Criteria for additional requirements.

3-7.11 Industrial Controls

Coordinate industrial controls systems including, but not limited to, energy management systems, building management systems, HVAC controls, mechanical controls systems, crane controls systems, diverter valves, and plumbing control systems, with project location existing systems. Provide the ability to connect industrial controls systems with local site control systems as required, to report to installation-wide systems. Design industrial control system in accordance with NFPA 70 and manufacturer's requirements for each system.

Plan, design, acquire, execute and maintain all control systems (including systems separate from an energy management control system) in accordance with DoD Instruction 8500.01 and DoD Instruction 8510.01, and as required by individual Service implementation.

3-7.12 Associated Mission Requirements

Mission(s) associated with the aircraft may be incorporated into the maintenance hangar. These missions may include but are not limited to the following:

- UAS/RPA operations
- Command Operations
- Medical Evacuation Operations
- Flight Operations
- North Atlantic Treaty Organization (NATO) Operations
- Training Operations

These mission(s) may have significant impact on the electrical system including:

- The requirement for emergency generators
- Increase sized of electrical utility service to the building
- Special grounding requirements
- Power filtering requirements
- Radio Frequency (RF) shielding requirements

If mission-associated activities and spaces are attached to the maintenance hangar, coordinate and incorporate all specific requirements for the mission.

3-7.13 \2\ Aerospace Ground Equipment (AGE) Electrical Power Provisions

Permanently installed electrical power receptacles supporting portable AGE equipment provided with electrical control interlocking shall utilize the electrical interlocking circuit. • Hangar mounted AGE equipment receptacles shall not provide three phase power until the interlocking pins have been correctly mated, utilizing a control interlock circuit. • It has been shown that specific AGE plugs, such as 480VAC 60 Hz Hydraulic Mule 200-

300 amp equipment, can be inserted into AGE supporting receptacles 180 degrees out of rotation causing a personnel safety and equipment risk. Electrical circuit control interlocking is required to reduce this risk. /2/

\3\

3-7.14 Dedicated Electrical Distribution for Fire Protection Features

Provide a dedicated branch off of the service entrance equipment for fire protection, life safety, and mass notification (when provided) features. /3/

3-8 COMMUNICATIONS

3-8.1 Communication Systems Infrastructure

Provide communication infrastructure in accordance with UFC 3-580-01.

Coordinate with the users and provide additional communications infrastructure, as required by the mission. Segregate and construct the infrastructure systems, as required by the specific system requirements. Additional required communications systems may include:

- Global Positioning System (GPS) systems in the hangar bay
- Secret Internet Protocol Network (SIPRNet)
- Combined Enterprise Intelligence Exchange System (CENTRIXS)
- Joint Worldwide Intelligence Communications System (JWICS)
- Logistics Maintenance System (LMS) Triton
- Notebook/Laptop networked storage cabinets
- Integrated Maintenance Information System (IMIS)
- Unit Level Logistics System - Aviation (ULLS-A)

3-8.1.1 Classified Communication Systems Infrastructure

Coordinate the requirements for classified communication with user activities. Provide classified communication infrastructure and Protected Distribution System (PDS), in accordance with UFC 3-580-01.

3-8.1.2 Wireless Communications

Provide Wireless Access Points (WAP) in the hangar bay, as required for maintenance activities, and use of notebook/laptops. Wireless networks may require encryption for some aircraft. Coordinate the use of wireless and encryption with the maintenance user group and local telecommunications manager. If wireless is provided, coordinate the wireless frequency with the local frequency manager.

Consider potential obstructions that may cause interference, including aircraft and maintenance stands, when designing the wireless system.

3-8.2 Public Address

Provide a Public Address (PA) system with coverage to all areas of the facility. Provide a complete and functioning integrated public address system. Coordinate the PA system with the activities. Integrate the PA system with the MNS per UFC 4-021-01. Interface the PA system with the telephone system such that the telephone system provides access to the PA system.

3-8.3 Cable Television (CATV) Systems

Where required, provide CATV system in accordance with UFC 3-580-01.

3-8.4 Audio/Visual System

Provide the infrastructure to support all Government Furnished Government Installed (GFGI) and Government Furnished Contractor Installed (GFCI) Audio/Video (A/V) systems including but not limited to, projectors, sound systems, video teleconferencing, combined audio/visual systems, smartboards, screens, monitors, microphones, and specialized communication systems. Coordinate location and connection of all devices with the architectural and interior design.

A/V System infrastructure includes raceway systems and cabling only. Coordinate cabling types and raceway size with the GFGI and GFCI equipment provided. Provide power for A/V equipment per the A/V requirements.

3-8.5 Closed Circuit Television (Non-Security) System

Closed Circuit Television Systems (CCTV) may be required to monitor maintenance operations within the hangar bay and on the apron adjacent to the hangar. Provide a CCTV infrastructure system including raceways, and cables where required and authorized, as follows.

- Coordinate the infrastructure size and location with the design of the CCTV system.
- Provide power for CCTV equipment per the CCTV requirements.

Where specifically authorized to also provide CCTV equipment as follows.

- Provide cameras within the hangar bay and on the exterior of the building to monitor the apron.
- Provide monitoring equipment in user identified locations.

Refer to 3-8.7: Electronic Security Systems for CCTV for security systems is covered under Electronic Security Systems.

3-8.6 Radio and Satellite Systems

When required by the users and authorized, provide radio system antenna, cable and raceways to support GFGI radio systems. Provide radio system drops in locations identified by the users.

When required by the users and authorized, provide satellite system cable and raceways to support GFGI satellite systems. Provide satellite system drops in locations identified by the users.

3-8.7 Electronic Security Systems

When required by the users and authorized, provide Electronic Security Systems (ESS) in accordance with UFC 4-021-02.

3-8.8 Associated Mission Requirements

3-8.8.1 Mission Types

Missions associated with the aircraft may be incorporated into the maintenance hangar. These missions may include, but are not limited to, the following:

- UAS/RPA operations
- Command Operations
- Medical Evacuation Operations
- Flight Operations
- NATO Operations

3-8.8.2 Mission Impacts

These missions may have significant impact on the communication system including:

- The requirement for a data center
- Specialized radio, satellite, and communication systems
- Communication separation requirements.

If mission-associated activities and spaces are attached to the maintenance hangar coordinate and incorporate all specific requirements of the mission authorized.

3-9 OVERHEAD BRIDGE CRANES

Provide all cranes in accordance with the relevant portions of the following standards:

- Crane Manufacturing Association of America (CMAA) 70, *Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes*

- Crane Manufacturing Association of America CMAA 74, *Specification for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist*.
- American National Standards Institute ANSI MH27.1, *Specifications for Patented Track Underhung Cranes and Monorail Systems*.
- ASME HST-1, *Performance Standard for Electric Chain Hoists*.
- ASME HST-4, *Performance Standard for Electric Wire Rope Hoists*.
- All cranes to be a minimum Duty Service Class C.

3-9.1 Crane Operating Envelope

The crane operating envelope, including clearances, will not have interferences with the electrical, HVAC, or similar equipment, as specified by OSHA 29 Code of Federal Regulations (CFR) 1910.179. Clearly identify the crane operating envelope on the floor plans and building section drawings.

3-9.1.1 Hook Height

The minimum hook clearance height requirements, (measured from the finished floor elevation to the saddle of the hook at full elevation) are referenced in each specific Service's Chapter.

3-9.1.2 Hook Coverage

Provide loaded hook coverage to the maximum extent possible in the Aircraft Maintenance Bay. Design the crane equipment, hooks and wire ropes to clear the catwalk of 3-10.1.3 - Catwalk, in all operating configurations. Service-specific requirements are listed in appropriate Chapters of this UFC.

3-9.2 Motors and Controls

Provide overhead bridge crane with infinitely variable-speed electric motors and controls for the bridge, trolley and hoist. Crane is to be operable from the floor. Provide a crane disconnecting means for maintenance in a location that is accessible without the use of lifts or ladders.

3-9.2.1 Controls

Provide crane control interfaces, which are accessible at floor level. Provide controls for accessibility of the entire coverage area, horizontally and vertically.

Cranes may have wire connected controls or wireless controls. Coordinate the selection of wire connected controls and wireless controls with the users. When wireless controls are provided, coordinate the frequency of wireless controls with local frequency manager.

3-9.3 Hazardous Classification

\3\ Consider the operational environment of the crane and if that may be considered hazardous per NFPA 70 as is the case in the hangar bay. Crane elements entering hazardous area such as near the floor or around aircraft (Crane control pendant, hook or hoist and cable) may need to be upgraded per NFPA 70 or be anti-spark. For Navy, see 7-9 Overhead Bridge Cranes. /3/

3-10 HANGAR DOORS

Provide either a vertical lift fabric door system or horizontal sliding hangar doors. Coordinate with the user to provide type of hangar door and controls required for maintenance operations. Refer to C-10: HANGAR DOOR for guidance on best practices for hangar door selection and design. Refer to 2-4: Net to Gross Area in Aircraft Maintenance Hangars for requirements on calculating building gross square footage at different types of hangar doors. Hangar doors are to be fully operational when subjected to wind pressures up to a minimum of 15 psf. Include signage noting operational wind speed at which doors should be closed and secured with wind lock activation.

Design hangar doors to resist the component and cladding wind pressures determined in accordance with UFC 1-200-01. Consider the full deflection range and wind uplift to design the interface between the superstructure and the door systems. Design hangar doors in accordance with all provisions of UFC 4-010-01 where applicable.

\2\ NOTE: Certain door types are limited in hurricane and high windborne debris zones. See UFC 3-301-01 Structural Engineering for additional requirements and restrictions. /2/

3-10.1 Vertical Lift Fabric Doors (VLFD)

3-10.1.1 Doors

Provide the vertical lift fabric doors, as a complete system from a single source manufacturer for the purpose of closing a hangar maintenance bay space. Design the Aircraft Maintenance Bay superstructure to support the doors vertically and laterally. Design for the different load combinations imposed by open and closed door panels resulting in eccentric wind loads or mechanical loads from the door and mullion hoisting equipment. The mullions of the door system connect to pits at grade which serve to restrain the mullions from motion perpendicular to the face of the doors. Design the pits to resist the concentrated mullion loads and provide a means of draining water from the pits.

\3\ Design VLFD hangar doors to be individually operated with an upward acting lightweight framing system with polyvinyl fabric facing. Design doors in sections with lifting mullions between door sections. Design features include electric operation, personnel exit doors, and translucent fabric. See 3-7.5 Backup Power for emergency door operation. /3/

3-10.1.2 Safety

Provide an intrinsically safe electric safety edge on the bottom of the edge of each door, continuous over the full length of the door.

Provide fabric doors with a wind lock to secure the door prior to extreme wind conditions and to prevent door uplift. Provide the wind lock with a proximity switch to show proper engagement of the wind lock for the operator's benefit. Design VLFDs in accordance with UFGS 08.34.16.20.

3-10.1.3 Catwalk

Provide a catwalk for accessing the motors and other serviceable items of the fabric door. Provide access to maintain vertical lift fabric door equipment, motors, limit switches, and other serviceable door parts. Provide access to the catwalk from inside the hangar. **\2** The catwalk must be provided for safety of critical maintenance, repairs, and manual emergency operations and must not be omitted for any reason. ***/2/***

3-10.2 Horizontal Sliding Steel Hangar Doors

Hangar doors are to be a series of insulated, horizontal sliding leaves with protected, preformed metal or sheet-steel siding. Support each sliding door on hardened steel wheels rolling on continuously supported recessed rails with guide rails at the top of the doors. Hangar doors are to be of hot-rolled steel construction and designed and built to the same standards as the main Aircraft Maintenance Bay superstructure. Provide hot-rolled steel tension and compression bracing members. Hangar door frames will not depend on the metal or steel siding to provide diaphragm actions. Provide insulation values equal to the minimum values required for the exterior walls of the Aircraft Maintenance Bay. Provide waterproof weather stripping at all door system joints.

\3\ Support the hangar doors at grade with a concrete hangar door rail foundation. Design the foundation to be compatible with the building foundation and consider the potential for differential settlement. In the hangar door rail support foundation, provide for surface drainage with intermediate drainage, at a maximum spacing of 10 ft. (3.0 m). In cold climates provide a door track heating system. Design the hangar door rail foundation to have contraction joints constructed in the top slab placement to prevent random cracking of the surface of the hangar door rail foundation. Integrate the contraction joints with the door rail drainage structures. See 3-5.2 Heating for door track heating coils and see 3-7.5 Backup Power for emergency operation. /3/

3-10.2.1 Ingress/Egress Operations

Sliding door leaves need to be moved out of the way for aircraft to ingress or egress. In hangars with a small number of aircraft parking positions a door pocket is required of sufficient depth to stack the leaves out of the way to allow a 100% clear opening. Enclose all door pockets. As the number of parking positions rises, door pockets are still preferred, but are not required because the door leaves can be temporarily stacked on multiple tracks within the door opening and only a small percentage of the aircraft parking positions are blocked. Refer to Table 3-4: Sliding Hangar Door Pockets to

determine if the hangar requires a door pocket or if door pockets are allowed to be excluded. Coordinate with user to allow for efficient aircraft ingress/egress operations and conformance with required safety clearances. The requirements of Table 3-4: Sliding Hangar Door Pockets does not apply to hangars with an interior taxi lane leading to multiple aircraft parking positions.

Table 3-4: Sliding Hangar Door Pockets

<table>
<tr><th>NUMBER OF DESIGN AIRCRAFT IN HANGAR</th><th>AIR FORCE</th><th>ARMY</th><th>NAVY</th></tr>
<tr><td>1</td><td rowspan="3">POCKET REQUIRED FOR 100% OF THE DOOR PANELS TO ALLOW 100% CLEAR OPENING</td><td rowspan="2">POCKET REQUIRED FOR 100% OF THE DOOR PANELS TO ALLOW 100% CLEAR OPENING</td><td rowspan="3">POCKET REQUIRED FOR 100% OF THE DOOR PANELS TO ALLOW 100% CLEAR OPENING</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td>NO POCKET REQUIRED - STACK DOORS ON MULTIPLE TRACKS, BLOCKING NO MORE THAN 33% OF THE DOOR OPENING</td></tr>
<tr><td>4</td><td rowspan="2">NO POCKET REQUIRED - STACK DOORS ON MULTIPLE TRACKS, BLOCKING NO MORE THAN 25% OF THE DOOR OPENING</td><td rowspan="2">NO POCKET REQUIRED - STACK DOORS ON MULTIPLE TRACKS, BLOCKING NO MORE THAN 50% OF THE DOOR OPENING</td><td rowspan="2">NO POCKET REQUIRED - STACK DOORS ON MULTIPLE TRACKS, BLOCKING NO MORE THAN 25% OF THE DOOR OPENING</td></tr>
<tr><td>> 4</td></tr>
<tr><td colspan="4">NOTE: CLEAR 100% DOOR OPENING IS PREFERRED EVEN WHEN NOT REQUIRED. COORDINATE REQUIREMENTS WITH USERS.</td></tr>
</table>

Hangar door panels may be individually electric motor operated and controlled or may be operated in groups. Coordinate with the user to provide hangar door controls as required for maintenance operations. Individually operated panels are preferred because they are the most flexible system. They allow any panel to be moved anywhere in the door opening without moving any other panels. The least flexible operation is anchored groups. The lead panel of an anchored group is motorized and all other panels in the group are interconnected by a cable system anchored to the building, typically in a door pocket. All panels in each anchored group start to move at the same time and arrive at their fully-open or fully-closed positions simultaneously. Floating groups are more flexible than anchored groups, but not as flexible as individually operated panels. The panels on each end of a floating group are motorized and each can collect the other doors of the group as they move in either direction. Floating groups can be collected and stored anywhere on in the opening, or in a pocket, but operate as a group. Design each drive unit with a release mechanism and provide a means of movement in the event of power failure. The normal mode of operation will be an electric drive and the minimum speed of door travel will be 60 feet per minute. Control the doors with momentary contact-type push buttons located near the leading edge of

the door and limit switches on each door leaf. Install safety devices to prevent injury to personnel and damage to equipment during movement of the door sections. Design steel sliding hangar doors in accordance with UFGS 08 34 16.10.

For Navy: Refer to Chapter 7: Navy Specific Criteria for criteria for hangar door types, operation and control.

3-10.3 Hangar Door Power

Refer to 3-7.2: Hangar Bay Door Power for hangar door electrical requirements.

3-11 FLOOR AND TRENCH DRAINS

3-11.1 Floor Slope

Arrange floor elevations within the hangar bay to prevent fuel/liquid spills within the hangar bay from flowing into adjacent shop/storage areas or from one aircraft to an adjacent aircraft. The finished floor elevation of the remainder of the facility is required to be above the highest floor elevation of the hangar bay. Coordinate hangar floor elevations with the existing sanitary sewer elevation to avoid the need for ejection pumps where feasible. Provide hangar floor sloping at a minimum 0.5% towards the flight line door. Provide additional cross-slopes to keep liquid spills from flowing into adjacent bays, or to direct flows towards trench drains, when provided.

3-11.2 Existing Apron Slope

At existing facilities, if the required grade cannot be achieved, provide an appropriately sized trench drain across the entire apron side of the hangar with a discharge to a remote safe location in accordance with environmental requirements for stormwater and spill containment.

3-11.3 Trench Drains

Provide trench drains where required by Service-specific Chapters 5, 6, and 7.

3-11.3.1 Trench Design

Slope drainage trench inverts at a minimum 0.5% towards and empty into the hangar bay door trench. Provide drainage from the door trench. Capture oily wastewater contaminants from the hangar bay trench system, as directed by the department overseeing environmental policy for the installation; this may include an oil/water separator.

\2 Trench covers will be ductile iron or galvanized steel. Typical trench covers are ductile iron but can be upgraded to galvanized steel where conditions may warrant but this is not common. Trench covers must be designed and manufactured to withstand a minimum proof-load from all vehicle wheel loads anticipated to be supported by the slab and wheel loads listed in the Service-specific chapters. ***/2/***

3-11.3.2 Location and spacing

Locate trench drains within the hangar bay to restrict the spread of fuel in order to reduce the fire and explosion hazards from fuel spillage. A trench drain is often provided just inside and parallel to the hangar bay doors to intercept wind-driven rain that may enter through the hangar doors.

3-12 FUEL CELL MAINTENANCE

For Navy: Refer to Chapter 7: Navy Specific Criteria for criteria for fuel cell maintenance bays

For Air Force: Refer to Chapter 5 Air Force Specific Criteria for additional criteria for fuel cell maintenance bays.

3-13 WASH BAY

3-13.1 General

If limited aircraft wash function is expected to be performed within a hangar bay provide the features as described below. This function within the hangar bay is not intended to replace the function of an outdoor wash rack or wash apron, nor is it intended for full aircraft cleaning, dry media stripping or Painting/Chemical De-Paint operations. High pressure washing is not allowed and not intended to be covered by these requirements. Refer to UFC 4-211-02 for Aircraft Corrosion Control and Paint Facilities including wash racks in hangar bays.

3-13.2 Architecture

Provide moisture resistant interior face of walls such as painted Concrete Masonry Unit (CMU) up to 10 ft. (3.0 m) above finished floor elevation. Provide a moisture-resistant interior face on the hangar door such as enameled metal panels up to 10 ft. (3.0 m) above finished floor elevation.

3-13.3 Plumbing

Provide the following for any aircraft bay in the hangar used for limited aircraft wash:

- Cold water hose bibb located on the wall or utility pedestal.
- Optional hot water hose bibb located on the wall or utility pedestal.
- Floor drain or trench drain connected to industrial waste system or storm or sanitary sewer based on requirements for other building drainage system as required by Base Environmental Office.
- Hose reels for storage of hoses.

3-13.4 Electrical

Provide the following for any aircraft bay in the hangar used for limited aircraft wash:

- NEMA 250 Type 3R rated electrical enclosures.
- Weatherproof while in use covers for convenience receptacles.
- Weatherproof receptacle and receptacle covers for electrical connections.
- Galvanized rigid steel conduit.
- Wet location light fixtures within 10 ft. (3.0 m) of the aircraft envelope.

3-13.5 Communications

Installation of communication outlets is prohibited in any aircraft bay if the hangar is used for limited aircraft wash.

3-14 FALL PREVENTION AND PROTECTION SYSTEMS

Design the aircraft maintenance facility to eliminate fall hazards. If fall hazards cannot be eliminated, ensure that a viable fall prevention and protection system is identified by the user and provide where applicable. Provide path and fall protection system for all roof-mounted lighting, equipment and platforms from the interior roof access platform.

These systems can be facility based systems such as horizontal life lines and retractable life lines and non-facility based systems such as aircraft stands/platforms, aircraft safety line attachments, or mobile cranes. Refer to APPENDIX C: BEST PRACTICES, for further discussion.

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CHAPTER 4 \3\ AIRCRAFT SPECIFIC REQUIREMENTS

4-1 UNIQUE AIRCRAFT REQUIREMENTS /3/

Chapter 4 provides aircraft specific requirements that are in addition to other requirements of this UFC. These requirements apply only to Aircraft Maintenance Hangars designed for the specific aircraft below.

The airframe manufacturer's Facility Requirements Document (FRD) or equivalent document is an integral requirement of hangar design that contains additional airframe specific facilities requirements that must be considered and satisfied in addition to this UFC. The FRD is particularly useful for new or emerging aircraft requirements that have not yet become an established feature of this UFC or standard hangar designs of the DoD. FRD's are typically authored by the airframe manufacturer and can contain many specific details, be quite voluminous and difficult to obtain. The FRD may have additional technical facility requirements, special spaces, special clearances, special maintenance procedures, systems, data or other items that may impact the hangar design. This UFC is not a substitute for the FRD of the design airframe(s) being hangared.

4-2 F-35 JOINT STRIKE FIGHTER

The F-35 Lightning II (F-35) is a 5th Generation fighter, combining advanced stealth with fighter speed and agility, fully fused sensor information, network-enabled operations and advanced sustainment. There are three variants to the F-35 that will replace fighter aircraft of the US armed forces as well as at least 10 other countries. The F-35A fixed-wing variant will replace the A-10 and F-16 for the US Air Force. The F-35B VTOL variant will replace the AV-8B Harrier for the U.S. Marine Corps. The carrier variant F-35C will replace the F/A-18 for the US Navy and the U.S. Marine Corps.

4-2.1 Architectural

For Navy: F-35 hangars may require a Special Access Program Facility (SAPF) space. Refer to 2-2.3 - Secure Spaces for standards that apply to the construction of secure spaces. Refer to Chapter 7: Navy Specific Criteria for additional Navy SAPF requirements.

4-2.1.1 Minimum Aircraft Maintenance Bay Clearances

Coordinate with the maintenance unit staff to determine if additional space is required to maintain the aircraft beyond the clearances indicated in Table 2-1: Minimum Aircraft Maintenance Bay Clearances. Specific airframe or Service requirements may increase these minimum clearances. Provide additional clearances where required by an approved document such as the design aircraft's Facility Requirements Document (FRD) or a Service-specific standard design, defined Service hangar type, or other approved criteria. For example, the FRD may require additional clearance aft of the aircraft to remove the engine.

4-2.2 Mechanical Systems \2\

See 3-5.8.2 Preconditioned Air Systemsfor PCA system design requirements.

PCA requirements of the F-35 are as follows:

Fluid Element	Aircraft Cooling Air Spec
Capacity/Minute	46.5 lb/min. (21.14 kg/min)
Temperature	35 °F - 55 ˚F (1.67°C -12.78˚C)
Minimum Pressure at Aircraft, PSIG	5.25 [-0.25/+0.50 psig]
Moisture per pound of air	0-55 grains with no condensed moisture (No Droplets)
Particulates per pound of air	0.02 grams with maximum particle size of 50 microns

PCA air quality specifications are based on the Lockheed Martin 2020 FRD Rev Q and are minimum requirements. Validate against the most recent FRD and use the most restrictive requirements. Maximum time duration noted in this UFC to deliver the required PCA must not be increased regardless of any circumstances. ***/2/***

\3\ **Compressed Air Requirements**: Lubricators are not required for compressed air drops. /3/

4-2.3 Electrical Systems

4-2.3.1 Hangar Bay Requirements

Refer to 3-7: Electrical for aircraft service requirements.

4-2.4 Communication Systems

The F-35 system requires the Autonomic Logistics Information Systems (ALIS) communication systems. Segregate the ALIS System from all other communication systems within the maintenance hangar building.

Coordinate locations of ALIS and network connections with the user. The Navy requires SAPF for all ALIS spaces. Air Force and Army may require a SAPF. Coordinate the requirement for secured spaces with the project's site security officer. Refer to 2-2.3: Secure Spaces for additional information on secured spaces.

For Navy: Refer to Chapter 7: Navy Specific Criteria for additional requirements.

4-3 UNMANNED AIRCRAFT SYSTEMS AND REMOTELY PILOTED AIRCRAFT

New Unmanned Aircraft Systems (UAS) and Remotely Piloted Aircraft (RPA) are being introduced at a relatively fast rate and may be considered emerging aircraft. Specific requirements and direction are provided in previous Chapters.

For Air Force: Refer to Chapter 5 Air Force Specific Criteria for additional RPA specific requirements.

For Army: Refer to Chapter 6 Army Specific Criteria for additional UAS specific requirements.

For Navy: Refer to Chapter 7: Navy Specific Criteria for additional UAS specific requirements.

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CHAPTER 5 AIR FORCE SPECIFIC CRITERIA

5-1 INTRODUCTION

This UFC is organized with general requirements and Service-specific requirements. Apply Chapters 1, 2, 3, 4 and Appendices to all Services. Additionally apply Chapters 5, 6 and 7 to Air Force, Army and Navy respectively for Service-specific requirements. This UFC additionally applies to all Air Force RPA hangars. Refer to the Air Force RPA General Maintenance Hangar Facility Design Guide located on the Whole Building Design Guide for additional RPA hangar requirements.

5-1.1 US Air Force Aircraft Maintenance Strategy

Current US Air Force aircraft maintenance strategy indicates centralized services are provided at an installation level for most maintenance functions performed on the aircraft. Typical unit maintenance operations include removing and replacing components within the hangar and transporting components to the centralized service location for repair.

The US Air Force has the largest variety of aircraft of the three branches of the US armed Services. Due to the variability of both type and size of the aircraft within the Air Force, aircraft maintenance facilities are built specifically for each aircraft or similar type of aircraft.

5-1.2 \2\ US Air Force Standard Designs for Aircraft Maintenance Hangars

US Air Force Standard Designs for Aircraft Maintenance Hangars refer to the US Air Force Standard Designs for Aircraft Maintenance Hangars for functional program areas requirements and descriptions. US Air Force Standard Designs are available on the Whole Building Design Guide: http://www.wbdg.org/ffc/af-afcec/prototypes-standard-designs. ***/2/***

5-2 CIVIL

5-2.1 Airfield Pavement Markings

Design and layout all Airfield pavement markings for Air Force in accordance with ETL 04-2, AF1 32-1042 and UFC 3-260-04 *(Draft) Standard Airfield Pavement Marking Schemes*.

5-2.2 Containment of Fuel Spill in Hangar Bay

\3\ A fuel spill capture trench drain is provided in the hangar bay. Route the captured fuel to an underground containment tank unless required otherwise by local environmental regulations. See 5-11 Floors and Trench Drains for additional guidance.

[C] 5-2.2 Maximum rate of fuel spillage is the maximum discharge rated at the aircraft fuel dump **valve**. /3/

5-2.2.1 Environmental Regulations

Remove and dispose of a captured fuel spill as directed by the department overseeing environmental policy for the installation.

5-2.2.2 Capacity

Provide capacity to contain the maximum fuel spilled from the failure of a single fuel tank/bladder on the anticipated aircraft(s) in the hangar bay. Do not provide less than 5,000 gallons of containment. Do not include any anticipated fire suppression discharge in this containment volume. Design the containment system to accommodate the anticipated fuel spill. Do not use the trenches or piping of the containment system to contain any of the required volume.

5-2.2.3 Containment System Monitoring

Provide the containment system with a remote capacity monitoring panel. Provide monitoring panel with audible and visual (yellow strobe or beacon) alarms. Automatically activate audible and visual alarms when the capacity level exceeds 5%. Provide a silence switch for the audible alarm. Constantly illuminate visual alarms at the panel until the level condition is returned to normal. Locate containment system monitoring panel in the hangar bay. Provide an alarm to the FACU and Energy Management Control System when the capacity level exceeds 5%.

5-2.2.4 Monitoring System Construction

Provide a containment system monitoring panel with a minimum NEMA 250 Type 4 panel.

Rate any devices, conduits, or electrical enclosures installed below grade for prolonged submersion, minimum NEMA 250 Type 6P. Provide any devices, conduits, or electrical enclosures within the tank for an electrical (hazard) classification of Class I Division 1.

5-3 ARCHITECTURAL

5-3.1 Internal Fire-Rated Separations

At a minimum, provide a 2-hour fire barrier between dissimilar hangar bay operations including:

- Fuel Cell Maintenance
- Integrated Combat Turn
- Indoor Defueling and Refueling Operations
- General Maintenance Areas
- Corrosion Control

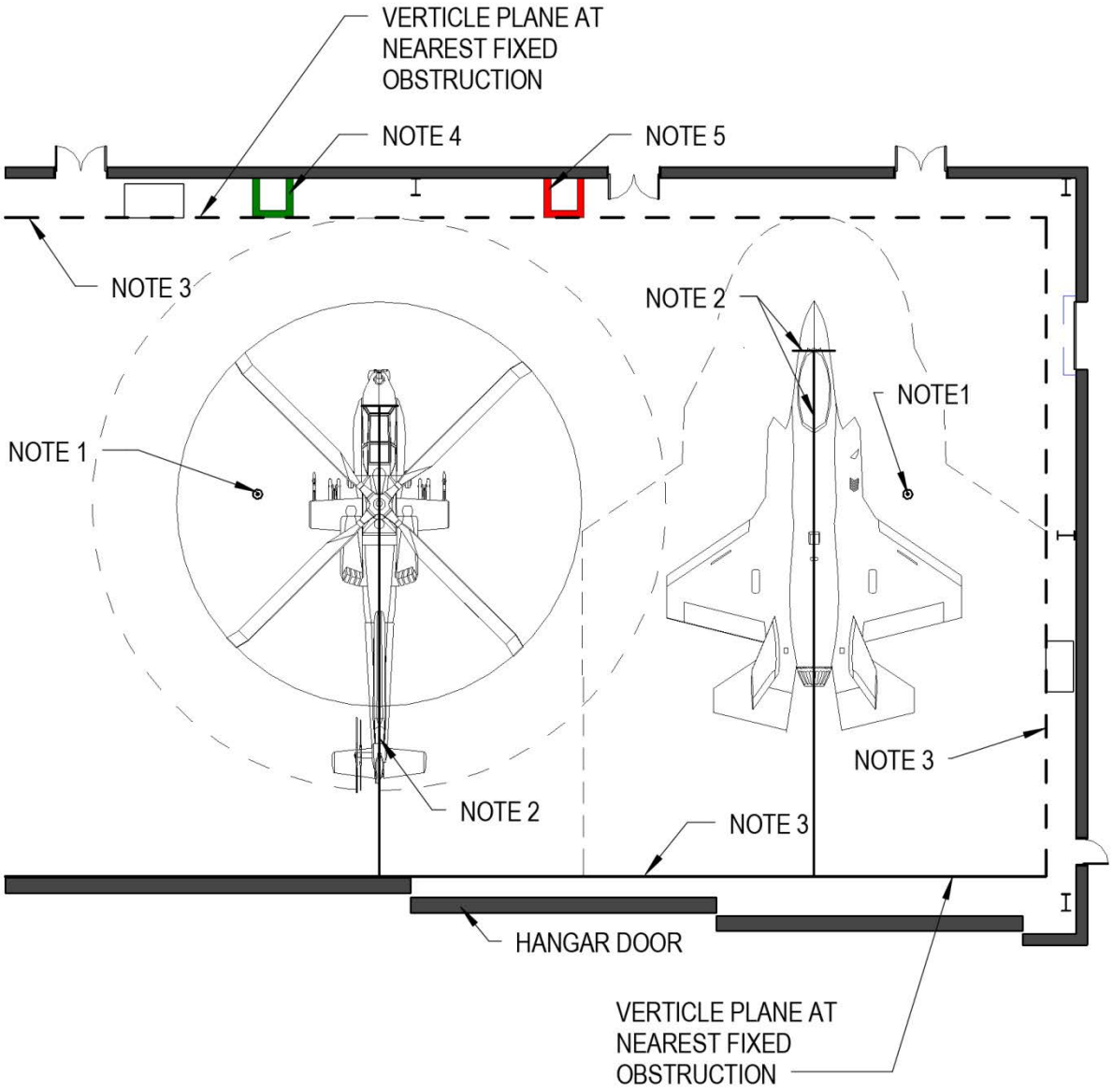
Where a 2-hour fire barrier is required for internal fire-rated separation between fire areas or different operations, a 1-hour fire barrier may be substituted where constructed

of concrete construction such as masonry, cast-in-place, pre-cast, tilt-up, block, or similar.

5-3.2 Aircraft Maintenance Bay Striping Requirements

Provide striping in the aircraft maintenance bay per paragraph 3-3.4.3: Protective Coatings and Figure 5-1: Aircraft Maintenance Bay Striping Requirements.

Figure 5-1: Aircraft Maintenance Bay Striping Requirements



Striping Notes:

1. Grounding receptacle; paint per UFC 3-575-01, figure 2-3.

2. **\2** Aircraft position centerline & nose gear stop; 6 in (152 mm) wide stripe; color – yellow or white to match the marking from outside the hangar to inside the hangar. **/2/**

3. Aircraft clearance boundary line; 6 in (152 mm) wide stripe; color - yellow.

4. Safety eyewash/shower; color - green; provide 2 ft. (610 mm) clearance from safety equipment.

5. Fire Extinguishers; color - red. Provide 2 ft. (610 mm) clearance from extinguishers.

5-4 STRUCTURAL

5-4.1 Aircraft Maintenance Bay - Slab on Ground Loading

Air Force traffic loadings are designated in Table 3-1 of UFC 3-260-02 Pavement Design for Airfields. Air Force hangar pavement thickness will be designed in accordance with UFC 3-260-02, Chapter 3, paragraph 2c, titled Type C Traffic Areas. Obtain approval for deviations of aircraft traffic mixes or deviation of airfield design type (heavy, modified-heavy, medium, light) from the AFCEC pavements engineer.

5-5 MECHANICAL

5-5.1 Plumbing

Refer to 5-11: Floors and Trench Drains for trench drain criteria.

5-6 FIRE PROTECTION AND LIFE SAFETY

\2\ deleted /2/

5-6.1 General

\3\ Classify hangars as Group I, II, III, or IV in accordance with NFPA 409. /3/

5-6.1.1 Group III Hangars

Buildings used exclusively for small aircraft such as T-3, T-41, TG-3, TG-4, TG-7, TG-9, and S-10, aero club aircraft, and similar aircraft that meet the space requirements of NFPA 409 for Group III structures are permitted to be classified as Group III hangars. Comply with criteria in NFPA 409 for Group III hangars and the requirements in this UFC specific to Group III hangars for these facilities.

Where Group III hangars are provided, hydraulically design an overhead fire suppression system to provide 0.3 gpm/sq. ft. (12.0 L/min/sq. m) over the hydraulically most demanding 3,000 sq. ft. (278.7 sq. m). A Hi-Ex foam system is not required in the hangar bay.

5-6.1.2 Group IV Hangars

Group IV hangars as defined by NFPA 409 (tension fabric structures on metal structural frames) are permitted when sited and constructed in accordance with this UFC specific to Group IV hangars.

Where Group IV hangars are provided, protect them in accordance with the requirements of this UFC, including overhead sprinkler protection, Hi-Ex foam, fire alarm and mass notification, and hangar bay egress.

5-6.2 \2\ Deleted /2/

5-6.3 Releasing Service Fire Alarm Control Unit (RSFACU)

\3\ Provide a factory assembled Model EQ30XX Eagle Quantum Premier releasing service fire alarm control unit to monitoring and control the optical flame detectors, manual start stations, manual stop stations, and high-expansion releasing devices. Only activate the high-expansion foam fire suppression system by the manual activation of a foam start station or the simultaneous flame detection of two or more non-latching optical flame detectors.

Provide a 2-position non-key operated switch located within the RSFACU enclosure, that when activated inhibits the releasing and notification function of all optical flame detectors in the hangar bay through programming at the RSFACU. When the switch is placed in the inhibit mode, only the releasing and alarm functions of optical flame detectors are disabled while leaving all other functions of the RSFACU operational. See Table 5-1: \3\ Sample Air Force RSFACU Functional Matrix for additional control requirements.

[C] 5-6.3 UTC Fire & Security, Detector Electronics Corporation, 6901 W 110th St, Minneapolis, MN 55438 manufacture the Model EQ30XX releasing service fire alarm control unit. Each project will require an individual Sole Source Justification and Approval (J&A) document as required by the Federal Acquisition Regulations (FAR) (Subpart 6.3) that justifies and obtains approval for contract solicitations that use Other than Full and Open Competition (FOC). /3/”

5-6.4 \2\ Radiant Energy (Optical) Flame Detection

\3\ Provide Model X3301 Multi-spectrum IR Flame Detectors. Detectors will be factory configured with the manufacturer's "Hangar Mode".

[C] 5-6.4 UTC Fire & Security, Detector Electronics Corporation, 6901 W 110th St, Minneapolis, MN 55438 manufacture the Model X3301 detector. Each project will require an individual Sole Source Justification and Approval (J&A) document as required by the Federal Acquisition Regulations (FAR) (Subpart 6.3) that justifies and obtains approval for contract solicitations that use Other than Full and Open Competition (FOC).

[C] 5-6.4 No current commercial optical detector including the Model X3301is suitable for aircraft hangars, HAS, hot refueling shelters, weather shelters or other structures where aircraft engines are started/run or aircraft taxi into or out of the structures. Contact AFCEC/COSM for additional guidance./3/

/3/

Table 5-1: \3\ Sample Air Force RSFACU Functional Matrix

NOTE: This sample table is intended to be specifically tailored/edited for each project.

\3\ /3/	ANNUNCIATION AT LOCAL PANEL			NOTIFICATION							AUXILARY FUNCTIONS				
ALARM CONDITIONS	AUDIO-VISUAL ALARM INDCATION	AUDIO-VISUAL TROUBLE INDICATION	AUDIO-VISUAL SUPERVISORY INDICATION	GENERAL FIRE ALARM SIGNAL TO FACU AND RECEIVING STATION	FOAM/WATER RELEASE SIGNAL TO FACU AND RECEIVING STATION	COMMON FOAM/WATER TROUBLE SIGNAL TO FACU AND RECEIVING STATION	COMMON FIRE ALARM SUPERVIORY SIGNAL TO FACU AND RECEIVING STATION	COMMON FOAM/WATER SUPERVISORY SIGNAL TO FACU AND RECEIVING STATION	OPTICAL FLAME DETECTION INHIBITED SUPERVISORY SIGNAL TO FACU AND RECEIVING STATION	ENABLBE BLUE BEACONS IN HANGAR BAY	OPEN FLOW CONTROL VALVE FOR FOAM/WATER SYSTEM	CLOSE FLOW CONTROL VALVE FOR FOAM/WATER SYSTEM	RE-OPEN FLOW CONTROL VALVE FOR FOAM/WATER SYSTEM IF STILL IN ALARM	RELEASE PRE-ACTION SPRINKLER SYSTEM (IF PROVIDED)	DISABLE THE RELEASING AND ALARM FUNCTION OF THE THE OPTICAL DETECTORS THROUGH THE RSFACU
MANUAL FOAM RELEASING STATION	X				X					X	X				
ONE OPTICAL FLAME DETECTOR WITHIN THE PROTECTED ZONE	X			X						X					
TWO SIMULTANEOUS OPTICAL FLAME DETECTORS WITHIN THE PROTECTED ZONE	X				X					X	X				
PRESSURE SWITCH ON FOAM/WATER RISER *	X				X					X					
HEAT DETECTION IN THE HANGAR BAY (IF PROVIDED)	X			X										X	
TROUBLE CONDITIONS															
COMMON TROUBLE						X									
SUPERVISORY CONDITIONS															
COMMON SUPERVISORY								X							
DEPRESS FOAM STOP STATION BUTTON			X					X				X			
RELEASE FOAM STOP STATION BUTTON													X		
FOAM/WATER SUPERVISED SOLENOID DISCONNECT			X					X							
PREACTION SUPERVISED SOLENOID DISCONNECT (IF PROVIDED)			X				X								
OPTICAL FLAME DETECTION INHIBIT SWITCH			X						X						X

* DO NOT RELEASE THE FLOW CONTROL VALVE FROM THE PRESSURE SWITCH.

/3/

5-6.5 Auxiliary Notification Devices

\3\ Provide blue rotating or flashing beacons not less than 400 cd (120/208VAC) or equivalent 360 degree LEDs. Control the beacon activation through the RSFACU. A backup power supply or supervision of the power supply supplying the beacons is not required when supplied from the dedicated fire protection features panel. Mount beacons 20 - 30 ft. (6.1 - 9.1 m) above the floor of the hangar bay. Provide a sign below each device with 3-inch red letter on a yellow or lime-yellow background, with wording

"FOAM RELEASE". Blue beacons are in addition to any general fire alarm clear visual notification devices. /3/

- For single door hangars, provide one beacon approximately centered on each of the three walls.
- For drive through hangars, provide one beacon 10-25 ft. (3.0-7.6 m) from each corner of the hangar bay. /2/

\3\ 5-6.6 through 5-6.7.9 moved and revised. /3/

5-7 ELECTRICAL

5-7.1 Aircraft Power Distribution

Aircraft power distribution equipment is government furnished. Power distribution equipment may be provided as Service Equipment (SE) carts or permanently mounted equipment.

Government-furnished SE carts may be diesel powered or electrical powered. If an SE cart is diesel powered, park the SE equipment outside of the hangar bay and extend cables to the aircraft from the SE equipment. If an SE cart is electrical powered, provide a 480V, 3-phase plug on the wall or pedestal and extend the power from the connection to the equipment. SE carts are government furnished equipment. Coordinate the sizes and type of connection with the users and equipment available at the installation.

5-7.1.1 Aircraft Power Distribution Service Points

Distribute aircraft power from government furnished SE carts. Government-furnished SE equipment is mobile and provides a flexible solution. The aircraft cables are typically connected to the SE cart. The equipment is owned and maintained by the maintenance mission and typically the equipment will be shared for hangar and on-ramp maintenance. A storage area may also be required for the equipment.

The cables connecting to the aircraft power distribution service point may or may not be provided as part of the service. Coordinate the provision of the cables with the mission owner.

5-7.2 Aircraft 400 Hz Service Distribution

Aircraft 400 Hz systems are provided using government-furnished SE or government-furnished fixed equipment. A fixed 400 Hz system may be provided for a building, if approved by Civil Engineering (CE).

5-7.3 Aircraft 28VDC Service Distribution

Aircraft 28VDC systems are provided using government-furnished SE cart or government furnished fixed equipment. A fixed 28VDC system may be provided for a building, if approved by CE.

5-7.4 Aircraft 270VDC Service Distribution

Aircraft 270VDC systems are provided using government-furnished SE carts or government-furnished fixed equipment. A fixed 270VDC system may be provided for building if approved by CE.

5-7.5 Grounding and Bonding

Provide ordnance grounding in accordance with Air Force Manual (AFMAN) 91-201. Provide the design in accordance with specific details from NAVSEA OP-5.

5-7.6 Aviation Obstruction Lighting

The Air Force prohibits the use of Light Emitting Diode (LED) Obstruction Lighting.

5-8 COMMUNICATIONS

5-8.1 CATV Systems

Refer to the Air Force dynamic prototypes for required CATV locations.

5-8.2 Audible Warning System

Where required and authorized, provide an audible warning horn and warning lights for aircraft maintenance safety. Provide an audible warning system capable of being heard or seen at any location in the hangar bay. Provide unique color warning lights and horn tones to differentiate the system from other warning systems in the hangar bay.

Activate the audible warning system to alert maintenance personnel of maintenance activities including pressurizing the aircraft hydraulics.

5-9 OVERHEAD BRIDGE CRANES

Refer to Air Force dynamic prototypes for required overhead bridge cranes.

5-10 HANGAR DOORS

Provide hangar doors in accordance with 3-10: Hangar Doors.

5-11 FLOORS AND TRENCH DRAINS

5-11.1 \3\ Trench Drains – Fuel Spill Capture

Provide a fuel spill capture trench drain in the hangar bay to remove an inadvertent fuel spill from a ruptured aircraft fuel tank/bladder. This is the only drain required in the aircraft servicing area floor. Exception: A fuel spill capture trench drain is not required in a wash bay provided in accordance with this UFC.

[C] 5-11.1 This is the only **drain** required in the aircraft servicing area floor. /3/

5-11.1.1 Trench Design.

Size the trench drain to account for the anticipated flow from a ruptured aircraft fuel tank or bladder.

5-11.1.2 Trench Location and Floor Slope

Locate the trench drain inside the hangar bay, within 5 ft. (1.5 m) of the hangar bay door opening. Do not locate the trench drain near or under the aircraft. Use hangar bay floor sloping to direct the discharge from a rupture aircraft fuel tank/bladder away from the aircraft and towards the hangar bay door opening.

5-11.1.3 Trench Cover

Provide ductile iron or galvanized steel trench covers, manufactured to withstand a minimum proof-load of 50,000 pounds from a tire with a 250 psi pressure or the most critical of the aircraft wheel loads listed in this UFC, whichever is greater.

5-12 FUEL CELL MAINTENANCE HANGARS

5-12.1 General

The use of segregated repair facilities/areas for fuel systems repair is essential for safe and efficient operations and is primarily an Air Force Hangar operation. The repair facilities/areas described in this paragraph provide necessary protection for both the aircraft and personnel from a variety of hazards. This paragraph is based on Chapter 3 of Technical Manual TO 1-1-3 Inspection and Repair of Aircraft Integral Tanks and Fuel Cells

Facilities meeting the previous fire and safety requirements for fuel systems repair facilities in accordance with Air Force guidelines are compliant if they meet the requirements of ETL 98-8, Existing Aircraft Hangars.

5-12.2 Permitted Operations

Fuel systems repair facilities are intended to support the complete range of operations normally restricted from being conducted inside other hangars and structures. Normally restricted operations permitted in fuel systems repair facilities include, but are not limited to: fuel cell repair, partial/complete defuel/refuel, fuel transfer, de-

puddling/purging of fuel tanks/cells and fuel systems components and fuel tank/cell pressurization testing.

5-12.3 Definitions

Conduct open fuel tank/cell repair only in predesignated repair facilities/areas approved by the appropriate using organization. The facilities and areas are defined as follows:

5-12.3.1 Primary Repair Facility

A primary repair facility is one that was specifically built, or modified, for use as an aircraft fuel systems repair hangar. Open fuel tank/cell repair operations are required to be performed in a safe condition and in a safe space not occupied by aircraft maintenance actions and in a facility meeting the requirements of this UFC.

5-12.3.2 Alternate Repair Facility

An alternate repair facility is one that was specifically built, or modified, for use as an aircraft fuel systems repair hangar, and serves as a "back-up" or "overflow" repair facility. If the unit has a designated alternate repair facility, it is the next recommended or preferred location at which to perform open fuel tank/cell repair; it should be used when the primary repair facility is unavailable. An alternate repair facility is required to meet the same requirements as a primary repair facility.

5-12.3.3 Fuel Cell Hangar

A hangar facility primarily utilized for fuel cell maintenance and repair. The space may also be used for general maintenance, but not at the same time.

5-12.3.4 Fuel Foam/Cell Repair Room

\2\ A fuel foam /cell repair room must be separated from the aircraft maintenance area and provides a location where a fuel bladder or fuel cell foam removed from the aircraft is stored, repaired, maintained, or tested. Fuel foam/cell repair rooms are only required if the installation assigned aircraft use fuel bladders or fuel cell foam. If an alternate tank repair "area" is required to service an unassigned aircraft with bladders or foam, see T.O. 1-1-3 for options. /2/

5-12.3.5 Positive / Negative Pressure

Positive pressure is pressure greater than the surrounding environment. Consequently, any leak will egress into the surrounding environment. The opposite is true for negative pressure.

5-12.3.6 General Ventilation

Exchanges of inside and outside air to prevent the buildup of vapors and gases that may be flammable or explosive or harmful to occupants.

5-12.3.7 Trench Drain Ventilation

Ventilation is not specifically required for the trench; however the system should provide a passive means to prevent the accumulation of vapors, by utilizing monitoring equipment and general or emergency ventilation to maintain proper conditions.

5-12.3.8 Purge Ventilation

Ventilation used to purge fuel cells while maintenance is performed. Although the preferred method is the use of supply and exhaust fans, the use of exhaust- or supply-only is also an acceptable method of purging the fuel cell.

5-12.3.9 Emergency Ventilation

Exhaust system used to quickly pull air directly out of the space and away from the hangar. This system is designed to remove vapors and prevent the buildup of contaminants above the lower flammable/explosive limit established by this UFC.

5-12.4 Fire Protection, Life Safety, and Other Design Criteria

Provide a well-coordinated multi-disciplined approach (e.g., fire protection, electrical, mechanical, architectural, civil.) and application of applicable design criteria to the design of fuel system repair facilities.

5-12.4.1 Fire Protection

Provide fire protection systems in accordance with this UFC.

5-12.4.2 Life Safety

Provide life safety systems in accordance with this UFC

5-12.4.3 Facility Design and Construction Standards

Fuel systems repair facilities are to be designed and constructed in accordance with this UFC. Address facility design and construction standards or other technical support questions to the AFCEC Reach Back Center at AFCEC.RBC@us.af.mil

NOTE: Due to changes in fuel cell maintenance hangar requirements, some related references may be inaccurate/inadequate in mandating additional fume and sensing alarms, and wash down drainage trenches. Fume Sensing and Alarm systems are not installed as part of the facility project but are to be provided as equipment. Wash-down drainage trenches are not to be provided in United States Air Force (USAF) fuel system repair facilities.

5-12.5 Architectural

5-12.5.1 Internal Fire-Rated Separation

Provide internal fire-rated separation in accordance with this UFC. An internal fire barrier is not required between adjacent fuel system aircraft servicing areas, unless they

are designed as separate fire areas. Where these are separate fire areas, provide internal fire barriers in accordance with this UFC.

5-12.5.2 Emergency Eyewash/Shower

Provide operational emergency eyewash/shower with privacy enclosures to permit complete disrobing in the aircraft servicing area. Install units in locations to meet the requirements of AFI 91-203, OSHA, ANSI Z358.1 and the manufacturer of the unit. Refer to paragraph 3-4.5: Secondary Structural Systems of this UFC.

5-12.5.3 Washing Facilities

Provide changing areas, locker space, scrub sinks and personnel showers for both male and female personnel. To prevent fuel contamination, design these areas for accessibility to aircraft servicing areas without passing through break rooms or offices. Where two or more fuel systems repair facilities are located adjacent to one another, changing areas, locker space and personnel showers for the total personnel assigned to all facilities may be combined and located in one facility. **\2** To prevent fuel contamination, design these areas to allow for direct access from aircraft servicing areas without passing through break rooms, hallways, or offices. ***/2/***

5-12.5.4 Scrub Sinks

Provide scrub sinks in facility and locate them adjacent to fuel system maintenance operations. In facilities without changing areas, locker space and showers, scrub sinks may be located in the aircraft servicing area.

5-12.5.5 Shop Spaces

Provide shop space to include fuel foam/cell repair rooms to service/repair fuel systems components as required.

5-12.5.6 Support Spaces

Provide office space, break room, support equipment/tool room, restrooms, and locker rooms as required.

5-12.5.7 Utility Spaces

Provide rooms for telecommunications, utility/mechanical and fire protection systems as needed.

5-12.6 Mechanical

Heating, Ventilation and Air Conditioning (HVAC) Systems. Draw return air from the aircraft servicing area above 10 ft. (3.0 m). Refer to UFC 3-410-01 for direction regarding heating/cooling the hangar. In general, heating is required, and cooling is not allowed unless required for the task.

Climate Control Units (CCU). Provide CCUs to provide environmentally-stable conditions for air purging, sealant cure and general repair. The air intake for CCUs should be located in areas free from contamination.

5-12.6.1 Ventilation

Provide ventilation in accordance with this UFC, UFC 3-410-01, and UFC 3-410-04N. The ability to vary the amount of outside air needs to be in the design. Locate outside air intakes in areas free from contamination.

- Toxic Fumes and/or Combustible Vapors. Exhaust toxic fumes and combustible vapors that are produced in work areas directly to the outside. Provide fuel-systems repair facilities, including the Fuel Foam/Cell Repair Room, which are likely producers of toxic vapors and gases, with exhaust ventilation.
- Maintenance Hangar Bay. Provide fuel cell vapor exhaust system capable of ventilating the bay up to 1.7 cfm/ft^2 during periods of normal maintenance. Ventilate the hangar bay space at all other times at a minimum ventilation rate of 0.05 cfm/ft^2. Provide a system capable of ventilating the bay up to 1.7 cfm/ft^2 during periods of normal maintenance. Control the ventilation system by monitoring the concentration of vapors in the space. The use of photoionization detectors (PID) is the preferred method. The level should be maintained below 100 milligram per meter cubed milligram per meter cubed (mg/m^3) (14.4 parts per million (ppm)) for JP-8 per the National Institute of Occupational Safety & Health (NIOSH) recommended exposure limit. During maintenance periods, operate the system to maintain fuel vapor concentrations below 14.4 ppm. A minimum of three monitoring points should be used, unless the size of the hangar is such that the use of two sensors will adequately protect the space.
- Fuel Foam/Cell Repair Room. Provide a fuel foam/cell repair room vapor exhaust system. As a minimum, provide ventilation in accordance with Maintenance Hangar Bay Vapor exhaust requirements as outlined in previous paragraph.
- Positive Pressure Ventilation. Provide office space, break room, and support equipment/tool room with positive pressure ventilation to prevent vapors and gases from migrating from the aircraft repair area.
- Negative/Neutral Pressure Ventilation. When appropriate, provide negative pressure ventilation in restrooms and locker rooms. When these spaces are located next to, and thus will pull air from, areas with fuel/toxic vapors, provide sufficient supply air to allow this space to be at a neutral pressure (to prevent fuel/toxic vapor infiltration.)
- Purge Ventilation System. Provide a system for purging the fuel line and the tanks to fuel systems maintenance/repair facilities. Provide a system to ventilate the aircraft fuel tank using filtered outside air. Exhaust air from the fuel tank directly to the outdoors. Monitor the inside of the tanks being

worked on and maintain purge system exhaust below 600 ppm or 10% of the Lower Explosive Limit (LEL) for JP-8 to ensure the space is adequately ventilated prior to and during maintenance. The use of a supply and exhaust fan is the preferred method, followed by exhaust only, supply only and finally no ventilation if the vapors in the tank are shown to remain within the limits above. Locate outside-air intakes at locations free from contamination by the exhaust of other ventilation systems.

- Emergency Ventilation System. A separate emergency ventilation system will be used to ventilate the hangar bay in the event of high fuel vapor concentrations in the hangar. The emergency ventilation system will energize to maintain the space at or below 14.4 ppm. The ventilation rate should be based on providing a minimum of 20 air changes per hour (ACH) at up to 2 ft. (610 mm) above the finished floor. In hangar bays with lifts, landing gear pits and recessed inspection areas, locate an additional detector in each below-floor area, and increase the emergency ventilation rate to 30 ACH to ensure proper ventilation and removal of the vapors.

5-12.6.1.1 Exhaust Systems

Exhaust systems discharging to the exterior of the facility may draw air at any level above the floor, but exhaust location should be selected to best remove fuel/toxic vapors.

5-12.6.1.2 Trench Drain Ventilation

Repair of trench drain ventilation is not specifically required as long as the general and/or the emergency ventilation can maintain the ventilation concentrations within the trench below 14.4 ppm. Provide a separate detector in each trench drain.

5-12.6.1.3 Air Purifying System

Provide a permanently-installed air purifying system suitable for respirator use, with connections (in groups of 3) throughout the fuel cell hangar. If a permanently-installed air purifying system is not available, make provisions for fresh air inlet hoses to be routed outside of the facility.

5-12.6.1.4 Heating Systems

Heating devices with a flame or glowing element open to the atmosphere are not permitted in the aircraft servicing area or fuel cell rooms. Provide steam or hot-water forced air heating throughout the facility. Radiant tube heating systems may be used in the aircraft repair area if the flame is contained in a sealed chamber with combustion air taken from outside the repair area, and the combustion products are exhausted outside the repair area. Where radiant heating is used, install only overhead radiant tube systems. Refer to UFC 3-410-01 for additional direction regarding heating, and the types of heating systems allowed.

5-12.6.2 Plumbing

Emergency Eyewash/Shower. Provide privacy enclosures at emergency eyewash/shower combinations to permit complete disrobing in the aircraft servicing area. \3\ Provide tepid water to emergency eyewash/showers. /3/

Scrub Sink and Showers. Provide hands-free type scrub sinks to permit the washing of hands and arms to the shoulder. Provide water to scrub sinks and showers through a thermostatic mixing valve.

5-12.6.2.1 Drainage

Wash-down drains and drainage trenches are not required in new USAF fuel system repair facilities except where specifically noted in Chapter 5 Air Force Specific Criteria. If existing drainage is provided, drainage trench ventilation is not required.

5-12.7 Electrical

Grounding. Provide sufficient grounding points throughout the facility to include grounding bars in the hangar bay along the walls with a maximum space of 50 linear feet (15.24 m) and along the walls near tank storage and repair workbenches in the Fuel Foam/Cell Repair Room.

5-12.7.1 Hazardous (Classified) Locations

\2 Design hazardous (classified) locations including the fuel cell hangar bay, fuel bladder/cell repair room, and adjacent spaces in accordance with 3-7.1: Hazardous (Classified) Locations and TO 00-25-172 *Ground Service of Aircraft and Static Grounding/Bonding* paragraph 1.2.7 for definitions and 4-14 specific requirements and TO 1-1-3 *Inspection and Repair of Aircraft Integral Tanks and Fuel Cells.* ***/2/***

Design the fuel bladder/cell repair room as a Class I Division 2 hazardous (classified) location to the ceiling/deck in accordance with NFPA 70. At a minimum, classify adjacent spaces that are not suitability cutoff as defined in 3-7.1 Hazardous (Classified) Locations as Class I Division 2 up to 18 inches (460 mm) above the floor of the fuel bladder/cell repair room. In the hangar bay, provide wall mounted outlets designed for Class I Division 1 or 2 hazardous (classified) locations even though they may be outside the classified area. This is an aircraft maintenance (user) safety requirement, and is intended to prohibit the use of unclassified tools or equipment in the classified area around the aircraft. \3\ When operations in hangar bay will include refueling or defueling, regardless of fuel type (other than testing during fuel system maintenance), electrical equipment above the floor in the aircraft servicing area up to the height of the highest hangar door must satisfy NEC criteria for Class I Division 2 locations./3/

5-13 WASH BAY

Provide in accordance with 3-13: Wash Bay.

5-14 FACILITIES FOR UNFUELED AIRCRAFT

\2 Air Force Air Logistics Complexes (ALCs) have existing programmed depot maintenance (PDM) hangars where aircraft are disassembled, repaired, maintained, refurbished, and/or returned to flying status. These hangars are dedicated to specific industrial processes as part of the intermediate and depot level maintenance activities. Air Force Plants (AFPs) are Government-Owned/Contractor-Operated (GOCO) industrial installations which have production, fabrication, and test facilities dedicated to specific industrial processes as part of their aircraft production activities. These facilities were constructed in accordance with protection features detailed in NFPA 409 Aircraft Hangars and previous Air Force Engineering Technical Letters (ETL) for never-fueled or unfueled aircraft.

5-14.1.1 Unfueled Requirement

Aircraft are considered to be unfueled after having been defueled in accordance with Air Force Technical Order (T.O.) 00-25-172 and having all residual fuel drained from all the fuel system low points drains. Aircraft processed in accordance with Air Force Technical Order (T.O.) 1-1-3 are also considered to be unfueled.

5-14.1.2 Limitations

Defueling, alone, is not considered adequate to render an aircraft unfueled regardless of the fuel quantity remaining in the aircraft tanks and systems.

The maximum cumulative fuel remaining in aircraft within a single fire area must not exceed 240 gallons of fuel (JP-4, JP-8, Jet-A, Jet A-1)with a flash point equal to or less than 139 °F or 660 gallons of fuel (JP-5) with a flash point of 140 °F and greater.

5-14.1.3 Upgrade Thresholds for PDM and AFP Hangars for Unfueled or Never-Fueled Aircraft

Existing PDM and AFP hangars are not required to comply with this UFC, unless they house fueled aircraft, regardless of how infrequently. These facilities must continue to only house never-fueled or unfueled aircraft.

When UFC 3-600-01 Chapter 34 would require fire protection features in these facilities to meet new construction, existing serviceable fire suppression systems complying with NFPA 409 for never-fueled or unfueled aircraft must be retained and maintained in service.

When UFC 3-600-01 Chapter 34 would otherwise require fire protection features in these facilities to meet new construction and the existing installed fire suppression features requires life cycle replacement; the suppression requirements of NFPA 409 must be followed for unfueled and never-fueled aircraft, provided the mission is unimpaired by the continued prohibition of any aircraft not complying with the requirements for unfueled aircraft.

5-14.1.4 Marking

These facilities must be identified by permanent ANSI or OSHA compliant warning signs indicating “Only unfueled aircraft are permitted to be stored or serviced in this hangar See UFC 4-211-01 & T.O. 1-1-3”. Signs must be not less than 12” wide x 18” tall. Signs must be displayed on the exterior and interior of the hangar at the following locations. The exterior side of the hangar aircraft movement doors within 5 feet of the opening edge. Each interior wall centered along the wall’s length. Signs must be mounted 7 feet to the bottom edge of the sign above the hangar floor or pavement surface. See Figure 5-2: ANSI Warning Sign.

Figure 5-2: ANSI Warning Sign



5-15 \3\ HANGARS FOR WHERE FUEL SERVICING EXCEPTION IS APPROVED

Aircraft fuel servicing is not permitted in hangars by simply complying with this UFC per USAF Technical Order (T.O.) 00-25-172 and NFPA 417 Aircraft Fuel Servicing. Inside facility refueling must be approved specifically through the System Safety Engineering Analysis (SSEA) for a specific aircraft type in the specific hangar that complies with requirements of this UFC and section 5-15 \3\ Hangars for Where Fuel Servicing exception is approved in its entirety. The complete SSEA process can only be accomplished after the construction is complete and the aircraft is available. The system safety engineering process is managed by AFMC/AFLCMC and AFSEC. /2/

In-hangar fuel servicing criterion is based on a single aircraft in a fire-separated area undergoing fuel servicing in accordance with approved SSEA operating procedures after a Formal SSEA approval process through AF/SE. A System Safety Engineering Analysis (SSEA) may require additional facility features for specific aircraft, fueling methods, facility types before fuel servicing is allowed.

[C] 5-15 Under the conditions of pressurized fuel servicing fuel type (AVGAS, JP-4, JP-5, JP-8, JP-10, and all similar fuels) does not change/modify the requirements of 5-15. This criteria in 5-15 is not appropriate/adequate for gaseous or liquefied gaseous fuels, propellants or oxidizers.

5-15.1 Facility Criteria Limitation

Fuel servicing operations inside of structures must be authorized in accordance with AFI 91-202 . Compliance with this facility criteria alone is not authority to conduct fuel servicing operations inside of structures. The criteria in this Section are the minimum general facility requirements necessary to apply for a SSEA specific evaluation for approval of fuel servicing inside structures.

[C] 5-15.1 Previous SSEA approvals do not apply to new construction or existing construction not specifically identified in the in the SSEA report.

5-15.2 Minimum Facility Requirements For Aircraft Fueling Servicing Inside New Structures

5-15.2.1 Fire Protection/Suppression

As required by this UFC 4-211-01

5-15.2.2 Separation

2-hour fire resistive wall construction in accordance with 3-3.1.3 between aircraft fuel servicing area the rest of the building and/or other servicing areas.

[C] 5-15.2.2 Only one aircraft may be in a fuel servicing area during fuel servicing operations.

5-15.2.3 Drainage

Listed ignitable liquid drainage floor system, or 18-inch wide concrete box trench set on 25 ft centers. Drainage collection – approved double wall tank(s) capable of containing the largest single aircraft fuel tank capacity.

5-15.2.4 Electrical

Class I Division2 (CID2) to not less than the height of highest door.

5-15.2.5 Fueling System

Type V fuel system preferred; in absence of Type V, pantographs inside the hangar supplied by aircraft refueler vehicle connected to a single point connection outside the hangar. The requirements of section 1.2 will apply to fuel system maintenance hangars when a Type V fuel system is provided.

[C] 5-15.2.5 Authorization to use fuel supply methods other than the requirements in 1.2.5 is outside this installed facility criteria and is a post construction operational safety approval process.

5-15.2.6 Wall Surfaces

Wall surfaces in direct line with aircraft fuel vents must have an impervious surface that is unaffected by aircraft fuels and fuel sprays. Concrete, CMU, and metal surfaces painted or unpainted meet this requirements, sheetrock including type X and other moisture resistant types painted or unpainted do not meet this requirement. Other materials must be submitted for individual approval

5-15.2.7 General Fuel Servicing Area Ventilation

Provide ventilation in accordance with this UFC, UFC 3-410-01, and UFC 3-410-04N. The ability to vary the amount of outside air needs to be in the design. Locate outside air intakes in areas free from contamination. Provide a system capable of ventilating the bay at not less than 1.7 cfm/ft2 during fuel servicing and for a period of time not less than 1 hour following fuel servicing. Ventilate the hangar bay space at all other times at a minimum ventilation rate of 0.05 cfm/ft2. Control the ventilation system by monitoring the concentration of vapors in the space. The use of photoionization detectors (PID) is the preferred method. The level should be maintained below 100 milligram per meter cubed milligram per meter cubed (mg/m3) (14.4 parts per million (ppm)) for JP-8 per the National Institute of Occupational Safety & Health (NIOSH) recommended exposure limit. During maintenance periods, operate the system to maintain fuel vapor concentrations below 14.4 ppm. A minimum of three monitoring points is required, unless the size of the hangar is such that the use of two sensors will adequately protect the space.

5-15.2.8 Emergency Fuel Servicing Area Ventilation

A separate emergency ventilation system will be used to ventilate the hangar bay in the event of high fuel vapor concentrations in the hangar. The emergency ventilation

system will energize to maintain the space at or below 14.4 ppm. The ventilation rate is based on providing a minimum of 20 air changes per hour (ACH) at up to 2 ft. (610 mm) above the finished floor. In hangar bays with lifts, landing gear pits and recessed inspection areas, locate an additional detector in each below-floor area, and increase the emergency ventilation rate to 30 ACH to ensure proper ventilation and removal of the vapors.

5-15.2.9 Positive Pressure Ventilation

Provide office space, break room, and support equipment/tool room with positive pressure ventilation to prevent vapors and gases from migrating from the aircraft fuel servicing area.

5-15.2.10 Negative/Neutral Pressure Ventilation

When appropriate, provide negative pressure ventilation in restrooms and locker rooms. When these spaces are located next to, and thus will pull air from, areas with fuel/toxic vapors, provide sufficient supply air to allow this space to be at a neutral pressure (to prevent fuel/toxic vapor infiltration.)

5-15.3 Facility Requirements For Aircraft Fueling Servicing Inside Existing Structures

Existing legacy approvals to conduct fuel servicing inside, documented in Service technical guidance remain valid. This criterion applies to the facility requirements for facilities being considered for approvals to conduct fuel-servicing operations in existing structures.

5-15.3.1 Fire Suppression

As required by UFC 4-211-01 or other previously approved aircraft hangar, PAS, or HAS approved fire suppression system.

5-15.3.2 Separation

2-hour firewall(s) between the rest of the building and/or other bays; Operations alternative in existing building evacuate building of all personnel not part of the fuel servicing operation and stop all other aircraft maintenance activities.

[C] 5-15.3.2 If separation in accordance with 1.2.2 is not provided all persons not directly associated with the specific fuel servicing must evacuate the entire building (T.O. 00-25-172)

5-15.3.3 Drainage

Listed ignitable liquid drainage floor system or other previously approved aircraft hangar, PAS, or HAS drainage system. Drainage collection – approved double wall tank(s) capable of containing the largest single aircraft fuel tank capacity.

5-15.3.4 Electrical

Class I Division 2 (CID2) to height of highest door. Operations alternative in existing building provide a shunt trip to de-energize all electrical not required for the fuel servicing operation.

5-15.3.5 Fueling System

Type V fuel system preferred; in absence of Type V, pantographs inside the hangar supplied by aircraft refueler vehicles outside the hangar or other SSEA approved fueling means previously approved for the specific structure.

[C] 5-15.3.5 Authorization to use fuel supply methods other than the requirements in 3-15.4.5 is outside this installed facility criteria and is a separate post construction operational safety approval process.

5-15.3.6 Wall Surfaces

Wall surfaces in direct line with aircraft fuel vents must have an impervious surface that is unaffected by aircraft fuels and fuel sprays. Concrete, CMU, and metal surfaces painted or unpainted meet this requirements, sheetrock including type X and other moisture resistant types painted or unpainted do not meet this requirement. Other materials must be submitted for individual approval.

5-15.3.7 General Fuel Servicing Area Ventilation

Provide ventilation in accordance with this UFC, UFC 3-410-01, and UFC 3-410-04N. The ability to vary the amount of outside air needs to be in the design. Locate outside air intakes in areas free from contamination. Provide a system capable of ventilating the bay at not less than 1.7 cfm/ft2 during fuel servicing and for a period of time not less than 1 hour following fuel servicing. Ventilate the hangar bay space at all other times at a minimum ventilation rate of 0.05 cfm/ft2. Control the ventilation system by monitoring the concentration of vapors in the space. The use of photoionization detectors (PID) is the preferred method. The level should be maintained below 100 milligram per meter cubed milligram per meter cubed (mg/m3) (14.4 parts per million (ppm)) for JP-8 per the National Institute of Occupational Safety & Health (NIOSH) recommended exposure limit. During maintenance periods, operate the system to maintain fuel vapor concentrations below 14.4 ppm. A minimum of three monitoring points should be used, unless the size of the hangar is such that the use of two sensors will adequately protect the space.

5-15.3.8 Emergency Ventilation

A separate emergency ventilation system will be used to ventilate the hangar bay in the event of high fuel vapor concentrations in the hangar. The emergency ventilation system will energize to maintain the space at or below 14.4 ppm. The ventilation rate should be based on providing a minimum of 20 air changes per hour (ACH) at up to 2 ft. (610 mm) above the finished floor. In hangar bays with lifts, landing gear pits and recessed inspection areas, locate an additional detector in each below-floor area, and

increase the emergency ventilation rate to 30 ACH to ensure proper ventilation and removal of the vapors.

5-15.3.9 Positive Pressure Ventilation

Provide office space, break room, and support equipment/tool room with positive pressure ventilation to prevent vapors and gases from migrating from the aircraft fuel servicing area.

5-15.3.10 Negative/Neutral Pressure Ventilation

When appropriate, provide negative pressure ventilation in restrooms and locker rooms. When these spaces are located next to, and thus will pull air from, areas with fuel/toxic vapors, provide sufficient supply air to allow this space to be at a neutral pressure (to prevent fuel/toxic vapor infiltration.)

5-15.4 Minimum Facility Requirements For Aircraft Fueling Servicing Under New And Existing Weather Shelters

Weather shelters are generally considered organizational equipment (not facilities), however, certain utility features as such electrical features are considered real property or are maintained as real property similar equipment. Weather shelters with 2 or fewer sides (including doors) are allowed to be considered open ramp. Structures with more than 2 sides (including doors) are classified for protection purposes hangars, regardless of identifying nomenclature and must meet the requirements of this UFC for hangars.

[C] 5-15.4 Weather shelters in compliance with 2 or fewer sides and the following sub-paragraphs may conduct fuel servicing operations in accordance with service specific operations guidance: AF T.O. 00-25-172 as open ramp location without additional approvals.

5-15.4.1 Electrical Equipment

Below the surface of the parking ramp must be Class I Div 1 (Zone 1). Above the surface of the parking ramp and within the fuel safety servicing zone (FSSZ) area up to within 12 inches of the roof of the weather shelter electrical equipment and devices must be Class I Division 2 (Zone 2).

[C] 5-15.4.1 Operational alternative in existing weather shelters allows a shunt trip to de-energize all electrical not required for the fuel servicing operation. New construction would have to comply with 5-15.4.2.1.

5-15.4.2 Wall Surfaces

Wall surfaces in direct line with aircraft fuel vents must have an impervious surface that is unaffected by aircraft fuels and fuel sprays.

5-16 PROTECTIVE AND HARDENED/SEMI-HARDENED AIRCRAFT SHELTERS (PAS AND HAS)

Protective and hardened/semi-hardened aircraft shelters are sited and constructed in accordance UFC 3-340-01 and UFC 3-340-02.

[C] 5-16 These shelters are combat assets intended to be fully operational under combat conditions with no installation utility support capable of launch and recovery of aircraft for multiple missions.

5-16.1 Hazardous (Classified) Locations

Classify the entire HAS/PAS and personnel shelters, offices, or other structures located within the HAS/PAS as Class I, Division 2. Where approved in overseas areas, electrical equipment may be installed in accordance with local codes with equivalent electrical hazardous location requirements. Example: Directive 94/9/EC – ATEX95; EU Zone 2, UK Zone 2, JP Zone 2.

[C] 5-16.1 These shelters have been evaluated through the SSEA process for most aircraft types to permit in-shelter fuel servicing when these electrical requirements are present. Failure to provide these electrical features would compromise a significant operational mission capability. See T.O. 00-25-172 for additional information.

5-16.2 Fire Protection Technology

Provide one of the following fire control technology options:

Option 1:

Provide a manual fixed low-level foam fire suppression system providing a 4-minute low expansion foam application to the floor area at a rate of not less than 0.1 gpm/sqft. Activation stations must be provided at any doors into the shelter and at a location on the opposite side of the shelter separated by 180 degrees from the entrance door. Primary power will be from the installation power distribution and secondary power will be the shelter generator.

Option 2:

Provide a listed ignitable liquid drainage floor system. System must be gravity operated. Flushing water will be from the installation water distribution; no secondary flushing will be required; on loss of water distribution the system will rely on gravity alone to flush capture liquids from the shelter. Effluent control outside the shelter must comply with appropriate environmental controls and agreements, however, it must be designed to function without any installation utility support.

[C] 5-16.2 Technology and legislative requirements are rapidly evolving; therefore; prior to programming or commencing work in these shelters consult with AFCEC/COSM for the most current technical direction.

5-16.3 Fire Controls and Notification

Fire controls for the manual fixed low-level fire suppression system must be a listed releasing panel. No detection or manual pull stations are required. The controls will supervise the low level system and the manual start stations (see Figure 3-11). Notification will be visual and audible (NFPA temporal pulse) using high noise area speakers.

Fire controls for the ignitable liquid drainage floor must be a listed fire alarm panel. No detection or manual pull stations are required. The controls will supervise the ignitable liquid floor drainage system controls. Notification will be visual and audible (NFPA temporal pulse) using high noise area speakers.

5-16.4 Egress Marking

Photo luminescent marking will be used. The door leaf will be outlined with a 1-inch wide band and the door frame will be outlined in a 1-inch side band on the sides and top. A running man not less than 6-inch x 6-inch (15mmx15mm) will be mounted at the floor level centered on the door just above the 1-inch band. A second running man will be mounted either top center on the door or just above the door depending on which provided the best general visibility through-out the shelter. The installation may add additional egress marking, if desired.

The secondary means of escape is normally out the exhaust opening; locations of the photo-luminescent marking will be locally determined. Pathway marking to either the door or the secondary means of escape is not required.

5-17 MODERNIZATION OF EXISTING FIRE PROTECTION SYSTEMS

This section provides criteria for the modernization and life-cycle sustainment requirements of existing aircraft hangar fire protection Apply this section to existing hangar bay fire protection systems that are wholly or partially designed to criteria other than contained in this UFC.

Lifecycle obsolesce should be evaluated on several factors frequency of repair, component condition, availability of parts or new component availability. Age, generally is not a factor in lifecycle obsolesce.

[C] 5-17 The target minimum lifecycle for installed hangar fire suppression systems is 50 years with ITM in accordance with UFC 3-601-02 and periodic modernization. AF/A4 has directed all out-of-service hangar fire suppression systems must be operational not later than the end of FY26 or may no longer be used for aircraft storage, maintenance and repair.

5-17.1 Existing Unprotected Hangars

Program unprotected hangars to comply with the requirements of this UFC.

[C] 5-17.1 AF/A4 has not currently established a target date for the elimination of unprotected hangars.

5-17.2 Existing Water Only Deluge Systems

For a hangar bay protected with an existing overhead water only deluge system, at the end of its life cycle or during a major hangar renovation project, replace the fire suppression and releasing system with a new foam fire suppression and releasing system per Chapter 3. Provide an overhead hangar bay sprinkler system and supplemental Hi-Ex foam system in accordance with this UFC. This includes but is not limited to the fire water and foam/water distribution, foam proportioning, and fire water supply system. Provide a releasing system in accordance with this UFC including but not limited to manual foam releasing stations, manual foam stop stations, and optical flame detection. Horns with NFPA temporal audible notification may be used where voice evacuation capability does not currently exist in the building.

5-17.3 Existing High-Expansion Foam/Water Systems

Existing Hi-Ex foam water system must be modernized to meet the radiant energy (optical) detection requirements in 3-6.19.11Optical Flame Detection and the manual releasing requirements in 3-6.19.8 Manual Foam and Low Level Water Releasing Stations. Modify the existing low level Hi-Ex foam suppression system to only activate the foam/water system from either:

Option 1:

Activation signal/input a manual foam releasing station complying with 3-6.19.8 Manual Foam and Low Level Water Releasing Stations and 3-6.19.10 Manual Foam and Low Level Water Releasing and Stop Station Signage.

Option 2:

Activation signal/input from two or more enabled radiant energy (optical) flame detectors and controls complying with 3-6.19.11Optical Flame Detection, 5-6.3 Releasing Service Fire Alarm Control Unit (RSFACU), and 5-6.4 Radiant Energy (Optical) Flame Detection.

No other activation signals/inputs are permitted to activate discharge of any low level or open discharge foam fire suppression system. For hangars constructed before 2015, evaluate the individual hangar evaluation report and program Evaluate the feasibility to provide a foam/water proportioning system in compliance with Chapter 3 General Hangar Requirements. Where this change cannot be made without extensive modifications to the fire water supply that is outside the original scope of the project, such as upgrades to the fire water infrastructure distribution, addition of a fire water storage tank, or addition of a fire pump house, repairs will be made to restore the existing system without altering its original design. The addition of an inline fire water booster pump on the foam/water riser only is often considered a feasible solution.

[C] 5-17.3 AF/A4 has directed these modernization must be completed by the end of FY26.

5-17.4 Existing Low Level AFFF and Overhead AFFF Systems

(Left blank intentionally pending DoD phase-out/life cycle extension guidance.)

5-17.5 Existing Fire Protection Water Supply

Where upgrades are made to the fire water supply per this section such as adding a fire water booster pump, provide a foam/water flow control valve and manual foam stop stations in accordance with this UFC. Where manual foam water stop stations are provided, surge arrestors are required accordance with this UFC. Reconfigure the bladder pressurization piping so the bladder is not under constant pressure, which may include relocating the pressurization piping downstream of the deluge or flow control valve. /3/

CHAPTER 6 ARMY SPECIFIC CRITERIA

6-1 INTRODUCTION

\2\ This UFC is organized with general requirements and Service-specific requirements. Apply Chapters 1, 2, 3, 4 and Appendices to all Services. Additionally apply Chapters 5, 6 and 7 to Air Force, Army, and Navy, respectively, for Service-specific requirements./2/

6-1.1 US Army Aircraft Maintenance Strategy

Current US Army aircraft maintenance strategy is designed to Service-specific needs of the aviation mission and specific aircraft type (Rotary Wing (RW), Fixed Wing (FW) or Unmanned Aircraft Systems (UAS); refer to the *Army Standard for Aircraft Maintenance Hangar (HGR) Complex* for additional details. The Army performs the majority of all repair maintenance in the shops or on the hangar floor. The Army also co-locates unit operations for aviation missions/operations within the hangar facility to coordinate aviation mission requirements/operations and aircraft maintenance requirements. The Army has developed a high level of aircraft maintenance facilities standardization including common spaces, functions, typical floor plans and room data sheets for a variety of hangar types. The US Army Corps of Engineers, Aviation - Center of Standardization (AVN-COS), Mobile District has developed and maintains standard plans and criteria for RW and UAS hangar facilities. The AVN-COS hangar standard design documents and points of contact are maintained on the USACE Center of Standardization website (https://mrsi.erdc.dren.mil/cos/). \2\ The current Army Standard for Aircraft Maintenance Hangar Complex (HGR) along with this document is to govern the planning and design of Army Fixed Wing hangars. /2/

6-1.2 Army Standard for Aircraft Maintenance Hangar (HGR) Complex

The *Army Standard for the Aircraft Maintenance Hangar (HGR) Complex* applies to the planning, design, and construction of all active Army Tables of Organization and Equipment (TOE) aircraft maintenance and repair requirements worldwide. The Army Standard applies equally to Tables of Distribution and Allowance (TDA) hangars. While the Army Standard is based on the Combat Aviation Brigade (CAB), the criteria are applicable to all aircraft maintenance and repair facilities. The current version of the Army Standard is maintained on the MILCON Requirements and Standardization Integration (MRSI) website https://mrsi.erdc.dren.mil.

\3\

6-1.3 Applicability

Additionally, this UFC applies to all new Army rotary wing, fixed wing, and UAS hangars regardless of organization (i.e. MTOE, TDA) or mission type (i.e. operational, training, etc.). Design non-standard hangars to accommodate minimum safety clearances shown in Table 2-1: Minimum Aircraft Maintenance Bay Clearances for the design airframe(s). Comply with all safety and life-safety related criteria when renovating or re-purposing

existing hangar(s) including, but not limited to: Fire Protection, Occupant Loads and Egress, Aircraft minimum safety clearances. Follow all other criteria of this UFC and standard designs to the maximum extent practical for the renovation. The intent of meeting all criteria is to provide for future hangar flexibility to maintain alternate and emerging aviation platforms. If meeting those additional criteria is not technically or financially feasible for a renovation project addressing a specific aircraft platform, then it is only necessary to meet the mission requirements for that specific platform and all safety and life-safety criteria as stated above. Planning documents are to specify the scope and intent of the renovation on the 1391 planning document including listing specific criteria and design aircraft. /3/

6-2 CIVIL

6-2.1 Airfield Pavement Markings

Design and layout Airfield Pavement Markings for Army Hangars in accordance with ETL 1110-3-512.

6-2.2 Containment of Fire Suppression Effluent

Route the wet pipe, dry pipe, preaction or foam/water system runoff from the hangar bay to automatically discharge to an underground containment tank, unless required otherwise by the local environmental regulations.

6-2.2.1 Environmental Regulations

Consider the local environmental regulations to determine the control, treatment and/or remediation measures for the discharge of fire suppression effluent from the hangar bay. Discharge effluent from the containment system as directed by the department overseeing environmental policy for the installation. Base the conditions for disposal upon the capability and location of the facility that would treat the effluent from the containment system. Verify fire suppression effluent containment discharge requirements with the appropriate installation environmental engineer, including local and state environmental requirements.

6-2.2.2 Capacity

Provide capacity to contain 15 minutes of the hydraulically calculated demand from the overhead sprinkler system in the hangar bay, plus the hose stream demand. Do not include the Hi-Ex foam system fire flow in the containment capacity. Design the containment system to accommodate the entire calculated fire suppression effluent discharge volume for the duration noted. Do not use the trenches or piping of the containment system to contain any of the required volume.

6-2.2.3 Containment System Monitoring

Provide the containment system with a remote capacity monitoring panel. Provide monitoring panel with audible and visual (yellow strobe or beacon) alarms. Automatically activate audible and visual alarms when the capacity level exceeds 5%. Provide a silence switch for the audible alarm. Constantly illuminate visual alarms at the panel until the level condition is returned to normal. Locate containment system monitoring panel in the hangar bay. Provide an alarm to the FACU and Energy Management Control System when the capacity level exceeds 5%.

6-2.2.4 Sump Pump

Empty tank in accordance with environmental regulations. Install the sump pump inside the tank and operate the pump manually. Discharge the fire suppression effluent from the sump pump in accordance with environmental regulations. Locate controls for the sump pump near the inspection port to the containment tank.

6-2.2.5 Diverter Valve/System

Provide a system that automatically diverts the floor trench drainage flow to a foam/water containment system upon system activation. Where a containment system uses a diverter valve, provide actuation and monitoring of the valve as indicated in this paragraph. Automatically actuate the valve upon release of the fire suppression system in the hangar bay. Provide indication of the diverter valve position at the monitoring panel through the use of limit switches. Provide indication of when the valve is fully open or closed. Provide the valve with remote manual reset capability through a "Valve Position Restore" button. Provide the panel with a visual alarm (yellow strobe or beacon) that automatically illuminates when the valve position is "off normal" or "closed", and remains illuminated until valve is restored to the full normal "open" position. Locate diverter valve panel in the hangar bay adjacent to the containment system monitoring panel. Provide an alarm to the FACU and Energy Management Control System when the diverter valve is in the off normal position. Install the diverter valve motorized operator above grade or list it for a submersible environment.

6-2.2.6 Monitoring System Construction

The containment system monitoring panel and diverter valve panel (when provided) may be combined. At a minimum, provide NEMA 250 Type 4 panel(s).

Rate any devices, conduits, or electrical enclosures installed below grade or within the containment tank for prolonged submersion, minimum NEMA 250 Type 6P.

6-3 ARCHITECTURAL

6-3.1 Aircraft Maintenance Module Size

The Army Standard has established standard aircraft maintenance module sizes for rotary wing aircraft and UAS aircraft. Refer to the USACE Centers of Standardization website (https://mrsi.erdc.dren.mil/cos/) or via links on the National Institute of Building

Sciences (NIBS) Whole Building Design Guide (WBDG) site (http://www.wbdg.org/references/pa_dod.php).

6-3.1.1 Rotary Wing Aircraft

The Army Standard established two maintenance module sizes for rotary wing (RW) aircraft. The module sizes are as follows:

- 84 Feet Long by 64 Feet Wide (25.6 m Long by 19.5 m Wide) - Utility, Attack, and Reconnaissance (UAR) Aircraft Maintenance Module. Typical RW aircraft serviced include the UH-60, AH-64, and OH-58.
- 110 Feet Long by 70 Feet Wide (33.5 m Long by 21.3 m Wide) - Cargo Aircraft Maintenance Module. Typical RW aircraft serviced include the CH-47.

6-3.1.2 UAS Aircraft

\2\ The Army Standard established a maintenance module size for Group 3 and Group 4 UAS aircraft as follows:

- Group 3: 26 Feet Long by 17 Feet Wide (7.92 m Long by 5.2 m Wide). Typical UAS aircraft serviced is the V2 Shadow RQ-7B-1E.
- Group 4: 40 Feet Long by 68.34 Feet Wide (12.2 m Long by 20.84 m Wide. Typical UAS aircraft serviced is the MQ-1C Gray Eagle Extended Range. /2/

6-3.2 Coordinate Interior Systems

Coordinate Interior Systems with the APPROVED Army Standard Design for Aircraft Maintenance Hangar Complexes.

6-3.3 Aircraft Maintenance Bay and Heavy Maintenance Shop Floor Finishes

Provide one of the following floor finishes for the Aircraft Maintenance Bay and Heavy Maintenance Shops consistent with the user requirements, facility purpose, and the intended design life cycle of the facility:

- Smooth Trowelled Finish with a Sealer
- Fuel Resistive Resinous Floor Coating system, commonly referred to as a 3 Coat System in UFGS Section 09 67 23.15
- Fuel Resistive Resinous Floor Coating system, commonly referred to as a 5 Coat System in UFGS Section 09 67 23.16

If the Project Delivery Team (PDT) selects the 5 Coat System, provide a life cycle cost analysis in the Design Analysis confirming the life cycle cost effectiveness of this floor coating selection for the project.

6-3.4 Aircraft Maintenance Bay Pavement Marking

Design and layout all Aircraft Maintenance Bay pavement markings in accordance with ETL 1110-3-512 and Figure 6-2: Maintenance Bay Pavement Markings. All paint for pavement markings to be in compliance with FS TT-P-1952, Paint, Traffic and Airfield Marking, Waterborne.

Figure 6-1: Typical Maintenance Bay Configuration

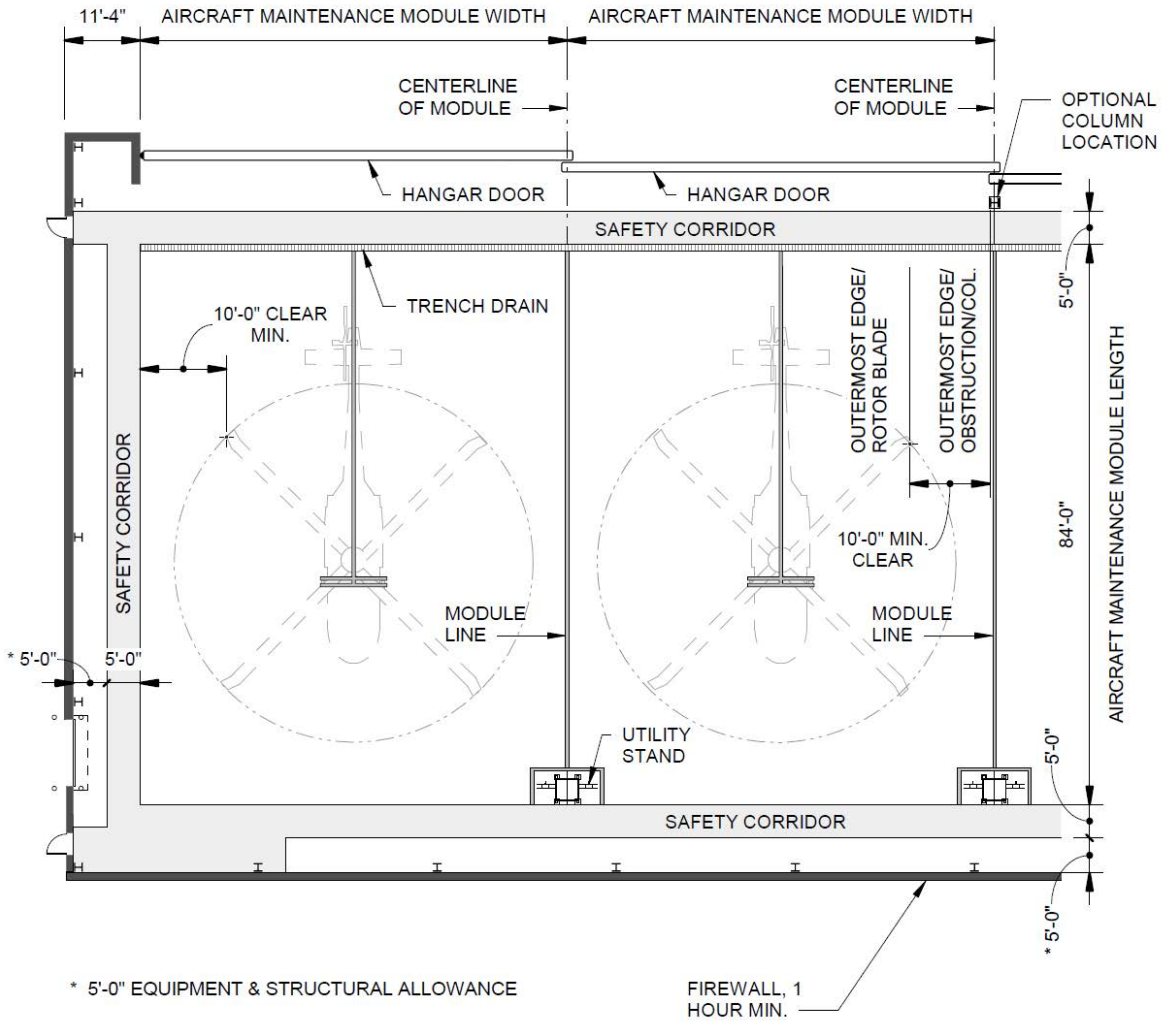
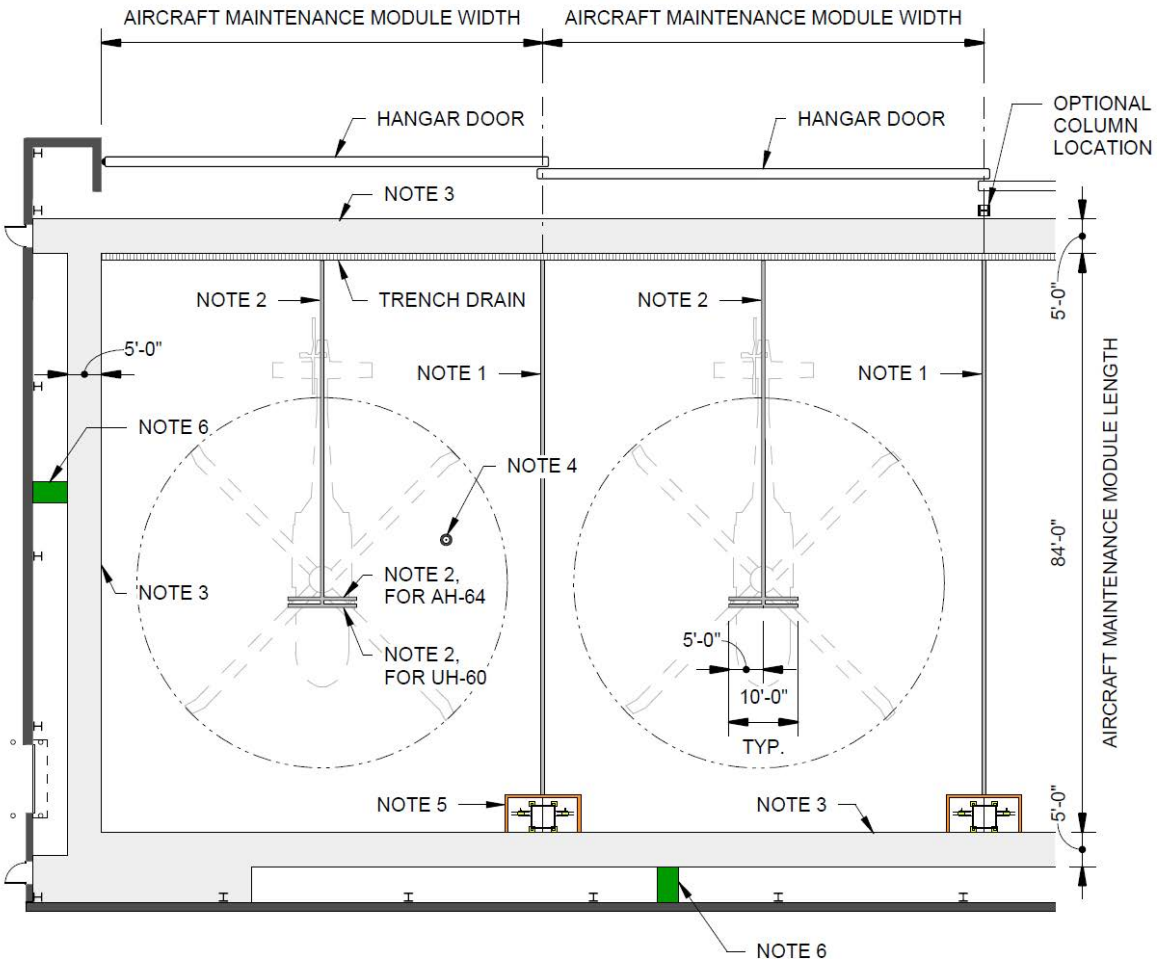


Figure 6-2: Maintenance Bay Pavement Markings



Floor Marking Notes:

1. Maintenance module boundary; 6 in. (152 mm) wide stripe; color - dark grey.
2. Maintenance module centerline & nose gear stop; 6 in. (152 mm) wide stripe; color - dark grey.
3. Safety corridor; 5 ft. (1.5 m) wide; color - yellow.
4. Grounding receptacle; paint per UFC 3-575-01, figure 2-3.
5. Utility stand; 6 in. (152 mm) wide stripe; color - orange. Provide 2'-0" clearance from utility stand equipment.
6. Safety eyewash/shower; color - green; provide 2 ft. (610 mm) clearance from safety equipment.
7. Provide markings for required clear area on floor around electrical and life safety features.

6-4 STRUCTURAL

6-4.1 Aircraft Maintenance Bay - Slab on Ground Loading

Design Army Aircraft Maintenance Bay slabs on ground in accordance with the minimum following traffic requirements. Add project specific additional vehicles to the mix as required. Make no reductions to these traffic mixes without the approval of the USACE Transportation Systems Center (TSC).

6-4.1.1 \2\ UAS Hangars – Group 3 and Group 4 /2/

Use Type B traffic area with the following minimum traffic mix:

- UH-60 Aircraft (16,300 pounds (lbs.)) - 20,000 passes
- ATLAS forklift (6,000 lbs. - loaded carriage)- 25,000 passes
- P-15 Crash/Fire Truck (130,860 lbs.) - 1,200 passes
- Transport Truck M1088 and M871A3 Trailer (80,000 lbs.) - 1,000 passes

6-4.1.2 Rotary Wing Hangars

Use Type B traffic area with the following minimum traffic mix:

- CH-47 Aircraft (37,500 lbs.) - 40,000 passes
- ATLAS forklift (10,000 lbs. - loaded carriage)- 10,000 passes
- P-15 Crash/Fire Truck (130,860 lbs.) - 1,200 passes
- Transport Truck M1088 and M871A3 Trailer (80,000 lbs.) - 1,000 passes

6-4.1.3 Fixed Wing Hangars

Use Type C traffic area with the following minimum traffic mix:

- Design Aircraft - Most critical aircraft expected to use the maintenance hangar bay - 40,000 passes
- P-15 Crash/Fire Truck (130,860 lbs.) - 1,200 passes
- Transport Truck M1088 and M871A3 Trailer (80,000 lbs.) - 1,000 passes
- 10K forklift - 10,000 passes

6-5 MECHANICAL

6-5.1 Heating

Low or high-intensity infrared heaters may be installed as suspended or elevated heaters in hangar bays in accordance with NFPA 409 in hangar bays. Evaluate overhead radiant heat systems as one of the alternatives when determining the most life-cycle cost effective way of heating the hangar bay(s). **\2** Where it is determined that

infrared radiant heat is not effective, evaluate radiant floor heat in the life-cycle cost analysis. **/2/**

6-5.2 Ventilation and Exhaust

Provide general hangar exhaust in accordance with Chapter 3. In addition, consider local ventilation where contaminants are generated. Provide calculations that identify and quantify the contaminant of concern in accordance with OSHA standards. Ventilate under floor pits, duct, and tunnels per NFPA 409 even if the JP-8 (kerosene based fuel) is below its flash point temperature.

Ventilation may be used in economizer cycles for increased thermal comfort where climatic conditions are appropriate. One example would be where diurnal temperature variation allows night time cooling. Natural air movement through locating louvers and dampers near the ceiling and floor should be evaluated for life cycle cost effectiveness versus a fan powered economizer cycle. Evaporative cooling is not allowed in Army hangar maintenance bays.

6-5.3 Plumbing

\2\ Mount hose bibbs and compressed air connections on all utility pedestals located inside the perimeter access aisle. /2/

6-6 FIRE PROTECTION AND LIFE SAFETY

6-6.1 General

Classify hangars as Group I, II, III, or IV in accordance with NFPA 409.

6-6.2 Fire Pumps

\2\ In addition to pressure drop, start fire pumps automatically upon receiving a fire pump start signal from the FACU. /2/

6-6.3 Foam/Water Concentrate Proportioning Systems

Proportioning foam concentrate through the use of a ratio flow controller and bladder tank, or a foam inductor is not permitted. Provide a foam concentrate pumping system, with an atmospheric foam concentrate storage tank. Provide a foam concentrate pumping system in compliance with NFPA 11, NFPA 20, and NFPA 409, except as modified by UFC 3-600-01 and this UFC. Refer to

Figure 6-3: Army Foam Pump Detail.

6-6.3.1 Foam Concentrate Pumps

Provide positive displacement concentrate pumps with electric motor drivers, supplied by a reliable power source. Use UFC 3-600-01 for reliable power requirements. Where reliable power is not available, provide diesel driven concentrate pumps.

Provide a reserve foam concentrate pump of equal capacity. Automatically operate the reserve pump upon failure of the primary pump. Arrange concentrate supply piping to meet the foam concentrate demand from either the primary or reserve foam pump. \3\ Floor drains in fire pump enclosures required by NFPA 20 shall not be required for enclosures for fire pumps dedicated to the delivery of fire suppression foam concentrate. /3/

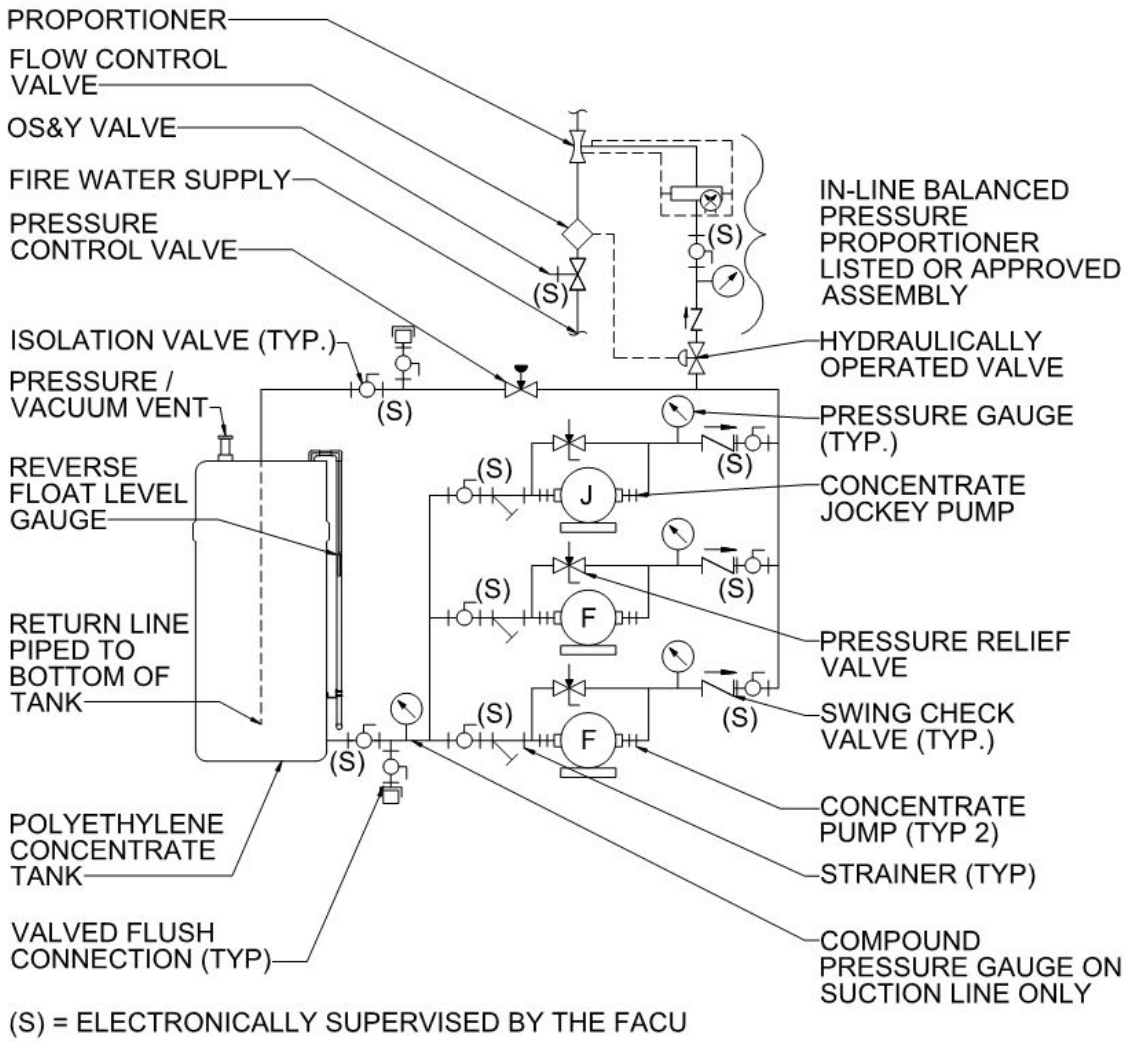
6-6.3.2 Foam Concentrate Jockey Pump

When the foam concentrate line to the proportioner exceeds a linear distance of 50 ft. (15.2 m), provide a positive displacement foam concentrate jockey pump to maintain pressure in the foam concentrate piping.

6-6.3.3 Foam Concentrate Pump and Jockey Pump Control

Upon activation of the foam/water system, remote start the foam concentrate pump from the RSFACU. Do not start the foam concentrate pump upon a drop in pressure. Upon depressing the manual foam stop station, stop the foam concentrate pump and the foam concentrate jockey pump (where provided) to prevent excessive concentrate from being pumped into the foam solution piping. Remote stopping of these pumps from the RSFACU is approved. Releasing the manual foam stop station will restart the foam concentrate jockey pump (where provided). As long as the foam/water system is in alarm, releasing the manual foam stop station will restart the foam concentrate pump.

Figure 6-3: Army Foam Pump Detail



6-6.3.4 In-line Balanced Pressure Proportioners (ILBP)

Provide ILBP proportioners that are listed or approved by a NRTL and are factory assembled and tested by the manufacturer. Disassembly, reassembly, or modification of the ILBP by the installing contractor is prohibited. Install ILBP proportioners downstream of the flow control valve.

6-6.3.5 Concentrate Storage Tank

The concentrate storage tank is permitted to have a tap on the side of the tank for the foam concentrate suction line. Additional taps into the side of the tank are not permitted.

6-6.3.6 Foam/Water Concentrate Proportioning Performance

Increase the capacity of the foam concentrate tanks and pumps, to compensate for proportioner tolerance and the maximum anticipated fire water pressure. Calculate this increase to enable the foam concentrate system to deliver foam for the required discharge duration.

6-6.4 Releasing Service Fire Alarm Control Unit (RSFACU)

Provide waterflow detection devices to monitor the overhead wet pipe, dry pipe, or preaction sprinkler systems in the hangar bay.

Only release the Hi-Ex foam system from a manual foam releasing station, or two simultaneous votes from non-latching initiating devices in the releasing zone. These initiating devices are required to be an optical flame detector in simultaneous operation with either another optical flame detector or waterflow detection device within the same releasing zone. Refer to Table 6-1: \3\ Sample Army RSFACU Functional Matrix for additional functional requirements.

6-6.5 Manual Foam Stop Stations

In addition to stations required by 3-6.19.9: Manual Foam and Low Level Water Stop Stations, provide a manual foam stop station in the corridor of each required exit from the hangar bay through the support space. Locate the station on the support side of the door, such that it is within 5 ft. (1.5 m) of the door and not obstructed when the door is fully open. Provide a 100 sq. in. (0.065 sq. m) fire rated door vision panel in these doors, such that an occupant can view into the hangar bay while operating the manual foam stop station.

6-6.6 Optical Flame Detection Supervised Disconnect

Provide a key operated supervised disconnect switch to disable all optical flame detectors in the hangar bay through programming at the RSFACU. Provide a switch that disables the releasing and notification functions of the optical flame detectors, while leaving all other functions of the RSFACU operational. Operation of the switch will not create a trouble signal. Monitor the disconnect at the RSFACU. Provide a supervisory signal to the receiving station upon operation of the disconnect. While the switch is in the disable mode, the optical flame detectors will not retain any history of alarm conditions such that when the switch is placed in the enable mode the RSFACU will not immediately go into alarm.

Locate the disconnect switch in the hangar bay, in a readily accessible location near a manual foam stop station. Provide a NEMA 250 Type 4 switch and backbox or house the components in a NEMA 250 Type 4 enclosure. Provide a non-flashing or rotating red indicating light not less than 400 cd (208/120VAC) powered from a dedicated \3\ fire protection features \3\ panel provided in accordance with UFC 3-520-01. Control light initiation through the RSFACU. A backup power supply or supervision of the power supply to the light is not required when supplied from the dedicated \3\ fire protection features /3/ panel. Mount the light above the disconnect switch. \3\ Provide a sign, near

the disconnect switch, with a white background and a minimum 1/2 inch wide blue border, with "OPTICAL FLAME DETECTION DISABLED WHEN ILLUMINATED" in red lettering not less than 1 inch (25.4 mm) high. /3/ Provide engraved labels on the disconnect switch indicating when the optical flame detectors are "ENABLED" or "DISABLED". Do not install backboxes or route conduit in front of sign in a manner that obstructs any lettering.

6-6.7 Notification Devices

Provide blue rotating beacons not less than 400 cd (208/120VAC) powered from a dedicated \3\ fire protection features /3/ panel provided in accordance with UFC 3-520-01. Control beacon initiation through the RSFACU. A backup power supply or supervision of the power supply supplying the beacons is not required when supplied from the dedicated \3\ fire protection features /3/ panel. Mount beacons 20 - 30 ft. (6.1 - 9.1 m) above the floor of the hangar bay. Provide a sign next to each blue beacon with a yellow or lime-yellow background matching the manual foam releasing station signage, with "FOAM RELEASE WHEN ILLUMINATED" in red lettering not less than 3 inches (76 millimeters) high. Blue beacons are in addition to any general fire alarm notification such as the fire alarm strobes.

- For single door hangars, provide one beacon approximately centered on each of the three walls.
- For drive through hangars, provide one beacon 10-25 ft. (3.0 -7.6 m) from each corner of the hangar bay.
- Provide additional beacons where at least one beacon is not viewable from normally occupied areas of the hangar bay. Locate beacons to take into account building construction, aircraft configuration and positioning in the hangar bay.

6-6.8 Supervision Devices

Provide a supervisory level alarm monitoring for foam concentrate. Indicate when the foam concentrate in the storage tank is below the amount required to meet the performance criteria.

Table 6-1: \3\ Sample Army RSFACU Functional Matrix

NOTE: This sample table is intended to be specifically tailored/edited for each project./3/

		ANNUNCIATION AT LOCAL PANEL			NOTIFICATION								AUXILARY FUNCTIONS								
		AUDIO-VISUAL ALARM INDCATION	AUDIO-VISUAL TROUBLE INDICATION	AUDIO-VISUAL SUPERVISORY INDICATION	GENERAL FIRE ALARM SIGNAL TO FACU AND RECEIVING STATION	FOAM/WATER RELEASE SIGNAL TO FACU AND RECEIVING STATION	COMMON FOAM/WATER TROUBLE SIGNAL TO FACU AND RECEIVING STATION	COMMON FIRE ALARM SUPERVIORY SIGNAL TO FACU AND RECEIVING STATION	COMMON FOAM/WATER SUPERVISORY SIGNAL TO FACU AND RECEIVING STATION	OPTICAL FLAME DETECTION INHIBITED SUPERVISORY SIGNAL TO FACU AND RECEIVING STATION	OPTICAL FLAME DETECTION DISCONNECT SUPERVISORY SIGNAL TO FACU AND RECEIVING STATION	ENABLE BLUE BEACONS IN HANGAR BAY	OPEN FLOW CONTROL VALVE FOR FOAM/WATER SYSTEM	FOAM CONCENTRATE PUMP START SIGNAL	CLOSE FLOW CONTROL VALVE FOR FOAM/WATER SYSTEM	DISABLE JOCKEY PUMP, AND FOAM CONCENTRATE PUMP STOP SIGNAL **	RE-OPEN FLOW CONTROL VALVE FOR FOAM/WATER SYSTEM IF STILL IN ALARM	RE-ENABLE JOCKEY PUMP, AND FOAM CONCENTRATE PUMP START SIGNAL IF STILL IN ALARM	DEACTIVATE GENERAL POWER IN HANGAR BAY VIA SHUNT TRIP	RELEASE PRE-ACTION SPRINKLER SYSTEM (IF PROVIDED)	DISABLE ALL OPTICAL FLAME DETECTORS IN HANGAR BAY, AND TURN ON RED INDICATING LIGHT	DISABLE ONLY THE RELEASING FUNCTION OF THE OPTICAL FLAME DETECTION
ALARM CONDITIONS	MANUAL FOAM RELEASING STATION	X				X						X	X	X					X			
	FIRST INITIATING DEVICE WITHIN THE RELEASING ZONE (FLOW SWITCH OR FIRST OPTICAL FLAME DETECTOR)	X			X							X										
	TWO SIMULTANEOUS OPTICAL FLAME DETECTORS WITHIN THE RELEASING ZONE	X				X						X	X	X					X			
	ONE OPTICAL FLAME DETECTOR SIMULTANEOUS WITH ONE FLOW SWITCH WITHIN THE RELEASING ZONE	X				X						X	X	X					X			
	PRESSURE SWITCH ON FOAM/WATER RISER *	X				X						X										
	HEAT DETECTION IN THE HANGAR BAY (IF PROVIDED)	X			X															X		
TROUBLE CONDITIONS	COMMON TROUBLE		X				X															
	CONCENTRATE PUMP TROUBLE SIGNALS		X				X															
SUPERVISORY CONDITIONS	COMMON SUPERVISORY			X					X													
	DEPRESS FOAM STOP STATION BUTTON			X					X						X	X						
	RELEASE FOAM STOP STATION BUTTON																X	X				
	CONCENTRATE PUMP RUN SIGNAL			X					X													
	CONCENTRATE PUMP SUPERVISORY SIGNALS			X					X													
	FOAM/WATER SUPERVISED SOLENOID DISCONNECT			X					X													
	PREACTION SUPERVISED SOLENOID DISCONNECT (IF PROVIDED)			X				X														
	OPTICAL FLAME DETECTION INHIBIT SWITCH			X						X												X
	OPTICAL FLAME DETECTION SUPERVISED DISCONNECT			X							X										X	

* DO NOT RELEASE THE FLOW CONTROL VALVE FROM THE PRESSURE SWITCH.
** REMOTE STOPPING OF THE CONCENTRATE PUMP AND CONCENTRATE JOCKEY PUMP IS APPROVED.

6-7 ELECTRICAL

6-7.1 Special Power

Use Table 6-2: Aviation Platform Ground Service Baseline Requirements for Service Baseline Requirements.

Table 6-2: Aviation Platform Ground Service Baseline Requirements

GROUND SERVICE	AVIATION PLATFORM GROUND SERVICE BASELINE REQUIREMENTS							
	AHH-64A	AH-64D	UH-60A/L	UH/MH-60M, X	CH-47D	DH/MH-47E, F, G	OH-58D	ARH
400 Hz 200/115V	28kW (35kVA)	34.4kVA 93kVA (270A) FOR 0.0	45KVA	45kVA	20kVA	40kVA	10kVA	?
28VDC START	NONE	NONE	NONE	NONE	NONE	NONE	500-750A START	500-800A START
28VDC SERVICING	NONE	NONE	NONE	NONE	300A SERVICING	300A SERVICING	200A SERVICING	200A SERVICING

Integrate the system with the building power system and complete with all cables and connectors required to interface with the aircraft. No ground power units (carts) are allowed. Design system to provide access to each aircraft parking space without any cables or equipment passing thru the five foot clear zone around the hangar bay floor.

6-7.1.1 Permanently-Mounted Pedestal

Provide permanently-mounted pedestals. Coordinate the connection point in the hangar floor space with the location of the aircraft. Permanently mount the pedestal to the hangar floor. Locate pedestals to avoid aircraft movements. Coordinate the location of pedestals with the clearance requirements listed in 2-3: Minimum Aircraft Maintenance Bay Clearances. Pedestal may have multiple mechanical, electrical, and communication services including power, compressed air, network connections, and water. Coordinate types of all service utilities to be provided on pedestal with activity. Route utility connections under the hangar floor from the wall to the pedestal. Mount all electrical utilities a minimum of 18 inches (0.46 m) AFF. Seal all electrical penetrations from the floor, per NFPA 70.

6-7.2 Grounding and Bonding

Provide ordnance grounding in accordance with Department of the Army Pamphlet (DA PAM) 385-64.

6-7.3 Electrical Equipment

All electrical equipment in the hangar bay is required to be in a NEMA 250 Type 3R or weather proof enclosure.

6-8 COMMUNICATIONS

6-8.1 CATV Systems

Refer to the Army Hangar Center of Standardization for required CATV locations.

6-9 OVERHEAD BRIDGE CRANES

Provide in accordance with 3-9: Overhead Bridge Cranes and the Army Standard for Aircraft Maintenance Hangar Complex.

6-10 HANGAR DOORS

Provide in accordance with 3-10: Hangar Doors.

6-11 FLOORS AND TRENCH DRAINS

6-11.1 Trench Drains

Provide trench drains in the hangar bay to comply with NFPA 409 *Floor Drainage Requirements* for the removal of hazardous fuels and fire suppression system discharges.

6-11.1.1 Trench Design

Size trench drains to account for the simultaneous flow of the hydraulically calculated demand of the overhead sprinkler system in the hangar bay and the exterior hose stream demand.

6-11.1.2 Location and Spacing

\2\ Provide trench drain parallel to hangar door track located per

Figure 6-1: Typical Maintenance Bay Configuration. Slope the floor from the back wall to the trench drain. /2/

6-11.2 Trench Covers

Provide ductile iron or galvanized steel trench covers, manufactured to withstand a minimum proof-load of 50,000 pounds from a tire with a 250 psi pressure or the most critical of the aircraft wheel loads listed in this UFC, whichever is greater.

6-12 FUEL CELL MAINTENANCE

Fuel cell maintenance is performed in Army helicopter maintenance hangars in accordance with approved maintenance procedures. Mobile helicopter fuel tank ventilating equipment is used to remove local fuel vapors.

6-13 WASH BAY

Provide in accordance with 3-13: Wash Bay.

CHAPTER 7 NAVY SPECIFIC CRITERIA

7-1 INTRODUCTION

This UFC is organized with general requirements and Service-specific requirements. Apply Chapters 1, 2, 3, 4 and Appendices to all Services. Additionally apply Chapters 5, 6 and 7 to Air Force, Army, and Navy respectively for Service-specific requirements. This UFC and Chapter 7 also applies to United States Marine Corps (USMC).

7-1.1 US Navy Aircraft Hangar Overview

7-1.1.1 Applicability

Refer to 1-4: Scope of Facility. Additionally, this UFC applies to all new Navy or USMC hangars including the defined Navy standard hangar Types I, II, III, and IV, variations of the hangar Types, as well as any non-standard hangars. All new Navy and USMC standard hangars must meet all hangar Type I-IV requirements for the respective standard. In any case, design all hangars to accommodate the minimum safety clearances shown in Table 2-1: Minimum Aircraft Maintenance Bay Clearances for the design airframe(s). Clearances for non-standard hangars should be conservatively selected by comparing the design airframe size to those found in the various standard hangar Types.

Selective portions of this UFC apply only when renovating or re-purposing an existing hangar. As a minimum, renovation projects must comply with all safety and life-safety related criteria. This includes, but is not limited to, fire protection, egress, and aircraft minimum clearances. Follow all other criteria of this UFC, including all standard hangar Type requirements (Table 7-1: \3\ Standard Hangar Bay Module Dimensions and Crane Capacities*), to the maximum extent practical for the renovation. The intent of meeting all criteria in this UFC is to provide for future hangar flexibility to maintain alternate aviation platforms. If meeting those additional standard hangar Type requirements is not feasible or possible for a renovation project addressing a specific aircraft platform, then it is only necessary to meet the mission requirements for that specific platform and all safety and life-safety criteria as stated above. This is not an option for new hangars which must meet this entire UFC including Table 7-1. It is important for the planner to clarify the intent of the renovation scope on the 1391 planning document.

7-1.1.2 Hangar Design Philosophy

Since the 1990s, the Navy has chosen to maintain several standard hangar types primarily with regard to hangar bay size. The fundamental planning concept is to group similar Navy aircraft by size and function and to establish a common hangar bay envelope size (length, width, height), that efficiently suits that aircraft grouping with established aircraft quantity and layout of each airframe. This approach allows for some flexibility should there be a change in mission, aircraft layout, or introduction of new airframes during the lifespan of the hangar. The expectation is that if the hangar bay has been designed with adequate flexibility in size, then other renovations to the hangar can be reasonably accommodated for the change in mission. It is understood that there

will always be substantial renovation costs to accommodate a new airframe. Hangars also often provide shelter for many different transient aircraft or short duration missions and deployments.

With these concepts in mind, flexibility of the hangar bay is critical and has been incorporated into these criteria where reasonable. Specific areas of consideration include hangar bay sizes, minimum slab design loading, maximization of door sizes, bridge crane capacities, and elimination of fixed obstructions or other features on the hangar bay floor that would impact revised aircraft layouts. The theory is that although hangars are being designed and optimized for an initial airframe and layout, the Navy and USMC are building multi-purpose hangars with reasonable flexibility that can be utilized through their lifespan. Custom, non-standard, single purpose hangars should be avoided when possible and special caution should be given where frequent airframe changes are expected.

7-1.1.3 US Navy Aircraft Maintenance Strategy

US Navy operational guidelines allow aircraft maintenance to be performed ashore similarly to how it is performed shipboard. The strategy includes reducing the total movement of the aircraft once it has entered the maintenance cycle by performing most levels of maintenance on the aircraft in the same hangar assigned to the aircraft custodian. The majority of the shops within the maintenance hangar facility are used as maintenance work shops, maintenance management offices, and tool and equipment storage. Repairs on parts removed from aircraft and extensive depot-level maintenance are typically performed in centralized shops remote from the hangar.

This UFC is geared towards accommodating Organizational “O” level aircraft maintenance, although some limited Intermediate “I” level and more limited Depot “D” level maintenance can be performed if approved and compatible with the facility design. "O" level maintenance is the day-to-day work that a unit performs in support of its own operations to maintain its aircraft and equipment in a full mission capable status. "O"-level maintenance includes aircraft inspections, servicing, handling, removal and replacement of defective parts and components and limited aircraft service changes and modifications. Extensive D-Level inspection, service changes and modifications are performed in separate facilities located on or off site of the aircraft custodian’s assigned base. Refer to "COMNAVAIRFORINST 4790.2B CH-1 15 Jun 2013, Chapter 3" for more discussion on aircraft maintenance levels.

7-2 CIVIL

7-2.1 Hangar Safety Clearance

Orient hangar such that it is in compliance with all runway safety zones and imaginary surface criteria of UFC 2-000-05N, UFC 3-260-01, and 3-2.1.2: Airfield Clearance Criteria.

7-2.2 Airfield Pavements

Design and Layout all airfield pavements, including hangar access aprons, in accordance UFC 2-000-05N, UFC 3-260-01, and 3-2.3: Airfield Pavements.

7-2.3 Airfield Pavement Markings

Design airfield pavement markings for Navy and Marine Corps facilities in accordance with Naval Air Systems Command (NAVAIR) 51-50AAA-2.

7-2.4 \2\ Low Level System Containment

Route the foam system runoff from the hangar bay to automatically discharge to an underground containment system, unless required otherwise by local environmental regulations.

7-2.4.1 Environmental Regulations

Follow all the local environmental regulations to determine the control, treatment and/or remediation measures for the discharge of foam. Discharge effluent from the containment system as directed by the department overseeing environmental policy for the installation. Conditions for disposal will depend upon the capability and location of the facility that would treat the effluent from the containment system. Verify foam containment discharge requirements with the appropriate installation environmental engineer, including local and state environmental requirements.

7-2.4.2 Capacity

Provide capacity to contain 15 minutes of the hydraulically calculated demand from the foam system. Design the containment system to accommodate the entire calculated foam system effluent discharge volume for the duration noted. Do not use the trenches or piping of the containment system to contain any of the required volume. No allowance is required for the water only sprinkler systems or hose streams. /2/

7-2.4.3 Containment System Monitoring

Provide the containment system with a remote capacity monitoring panel. Provide monitoring panel with audible and visual (yellow strobe or beacon) alarms. Automatically activate audible and visual alarms when the capacity level exceeds 5%. Provide a silence switch for the audible alarm. Constantly illuminate visual alarms at the panel until the level condition is returned to normal. Locate containment system monitoring panel in the hangar bay. Provide an alarm to the FACU and Energy Management Control System when the capacity level exceeds 5%.

7-2.4.4 Diverter Valve/System

Provide a system that automatically diverts the floor trench drainage flow to a foam/water containment system upon system activation. Where a containment system uses a diverter valve, provide actuation and monitoring of the valve as indicated in this paragraph. Automatically actuate the valve upon release of the fire suppression system

in the hangar bay. Provide indication of the diverter valve position at the monitoring panel through the use of limit switches. Provide indication of when the valve is fully open or closed. Provide the valve with remote manual reset capability through a "Valve Position Restore" button. Provide the panel with a visual alarm (yellow strobe or beacon) that automatically illuminates when the valve position is "off normal" or "closed", and remains illuminated until valve is restored to full the normal "open" position. Locate diverter valve panel in the hangar bay adjacent to the containment system monitoring panel. Provide an alarm to the FACU and Energy Management Control System when the diverter valve is in the off normal position. Install the diverter valve motorized operator above grade or list it for a submersible environment.

7-2.4.5 Monitoring System Construction

The containment system monitoring panel and diverter valve panel (when provided) may be combined. At a minimum NEMA 250 Type 4 panel(s).

Rate any devices, conduits, or electrical enclosures installed below grade or within the containment tank for prolonged submersion, minimum NEMA 250 Type 6P.

7-3 ARCHITECTURAL

7-3.1 Types of Hangars

7-3.1.1 General

Refer to 7-1.1.2: Hangar Design Philosophy for additional discussion on the Navy Hangar Type concept. The Navy has established four (4) standard maintenance hangar bays including Type I, Type II, Type III and Type IV to efficiently meet the needs of its current aircraft inventory. Each Type is designed to accommodate commonly grouped aircraft which are categorized by size and function and are further defined in paragraphs below and in Table 7-1: \3\ Standard Hangar Bay Module Dimensions and Crane Capacities*. These hangar Types are based on the controlling aircraft size, controlling aircraft layout, additional maintenance clearance required (if any), and minimum required aircraft clearances shown in Table 2-1: Minimum Aircraft Maintenance Bay Clearances. Do not reduce the minimum clearances for standard hangar Types below the thresholds indicated. If necessary, increase the selected standard Hangar Type dimensions to accommodate the specific design airframe(s) layout with adequate clearances (Table 2-1: Minimum Aircraft Maintenance Bay Clearances) and any additional maintenance clearance per the manufacturer's Facilities Requirements Document (FRD). The intent is to prevent a situation where a new airframe or larger variant is introduced prior to an update of Hangar Type standard definitions. Refer to UFC 2-000-05N for hangar planning requirements, modular sizing, and square footage guidance.

7-3.1.1.1 Organization

Navy aircraft hangars are comprised of three distinct areas; the hangar bay Organizational Hangar (OH) space, the Shop and Maintenance Administration (O1 level); and the Operations, Training and Administration (O2 level). The levels are

designations from shipboard levels and are not specific to the hangar design. The hangar bay provides sheltered space to primarily perform Organizational "O" level maintenance to aircraft and limited additional levels as previously discussed in

7-1.1.3: US Navy Aircraft Maintenance Strategy. Layout of this space is determined by the planning documents for the module configuration identified. The net area of the hangar bay is defined in the module layout and is considered a fixed area.

7-3.1.1.2 Standard Configurations

Hangar configurations, including heights, are provided to allow for maximum flexibility in accommodating all of the existing and proposed aircraft in the Naval Aviation Fleet. Do not modify the size of any hangar bay module without approval from Naval Facilities Engineering Command Atlantic, Capital Improvements Criteria and Programs Office (CIENG), Naval Air Systems Command (NAVAIR) and Commander, Navy Installations Command (CNIC). Additionally, Marine Corps hangar bay configurations may be modified by Headquarters, Logistics Facilities (USMC) (LF).

7-3.1.2 Type I Hangar

The Type I maintenance hangar is primarily designed for carrier aircraft, but is adaptable to meet requirements for rotary wing and various types of smaller aircraft, including Navy and Marine Corps variants of the F-35. The O1 and O2 level spaces in this type of hangar are configured for a typical strike fighter squadron, two carrier airborne early warning squadrons, or one H-60 helicopter squadron.

Provide one bridge crane per modules for all Type I hangars. When a single large hangar includes more than one module, additional cranes are required.

7-3.1.3 Type II Hangar

\3\ The Type II hangar is primarily provided for US Marine Corps Aviation. The hangar is designed to accommodate CH-53 Helicopters, MV-22 Tilt-Rotor and C-130 Refueler/Transport Aircraft. This type of hangar may also accommodate Navy versions of the C-130, MV-22 and CH-53 aircraft. Provide one bridge crane per modules for all Type II hangars. When a single large hangar includes more than one module, additional cranes are required. /3/

7-3.1.4 Type III Hangar

The Type III maintenance hangar is principally designed for land based patrol aircraft such as the P-8A Poseidon and large transport aircraft. Type III hangars are not authorized to have a bridge crane.

7-3.1.5 Type IV Hangar

The Type IV Navy Hangar is intended for the largest Unmanned Aircraft Systems (UAS). At this time, only the MQ-4C Triton is targeted for the Type IV hangar. The MQ-4C Triton is an (UAS) and will be a forward deployed, land-based, autonomously operated system that provides a persistent maritime intelligence, surveillance and

reconnaissance capability using a multi-sensor mission payload. The MQ-4C Triton air vehicle is a Navy variant based upon the USAF RQ-4B Global Hawk. The Type IV hangar will be periodically updated to accommodate other similarly sized aircraft should they be acquired by the Navy. \3\ Provide one bridge crane per modules for all Type IV hangars. When a single large hangar includes more than one module, additional cranes are required. /3/ For UAS other than Triton, planners may consider non-standard hangars or other facility types as appropriate to meet the mission.

7-3.1.6 Hangar Bay Column-Free Layout and Module Concept

Table 7-1: \3\ Standard Hangar Bay Module Dimensions and Crane Capacities* contains dimensions for a single hangar module as defined by UFC 2-000-05N. A single module is intended to be the minimum size hangar for the intended aircraft and can be combined with additional fractional or whole modules per UFC 2-000-05N to produce a larger hangar bay. Provide a framing system with a completely column-free hangar bay and flight line regardless of the number of hangar modules. This allows for maximum bay utilization and aircraft layout flexibility. If future hangars are planned adjacent to a new hangar, the framing system should be adaptable so as to allow for future expansion and combined column-free hangar bay. Refer to Appendix C-4: STRUCTURAL for more discussion on cantilever hangar bay framing systems.

Table 7-1: \3\ Standard Hangar Bay Module Dimensions and Crane Capacities*

\3\ /3/	HANGAR TYPE					
	TYPE I		TYPE II	TYPE III	TYPE IV	SEE NOTES
	NAVY	USMC				
WIDTH	212' 64.62 M	270' 82.30 M	325' 99.1 M	165' 50.3 M	161' 49.07 M	1, 2, 3
DEPTH	95' 28.96 M		119' 36.3 M	165' 50.3 M	141' 42.98 M	1, 2, 3
CLEAR HEIGHT	32.5' 9.91 M		44' 13.41 M	50' 15.24 M	32.5' 9.91 M	2, 4
BRIDGE CRANE CAPACITY	5-TON 4.5 METRIC TON		7 TON 6.5 METRIC TON	NONE	5-TON 4.5 METRIC TON	6
HOOK HEIGHT	29.5' 8.99 M		39' 11.9 M		29.5' 8.99 M	5, 6
DOOR WIDTH (MIN)	209' 63.7 M	267' 81.38 M	322' 98.15 M	162' 49.38 M	158' 48.16 M	7
DOOR HEIGHT	25' 7.62 M		44' 13.41 M	50' 15.24 M	25' 7.62 M	2
*DIMENSIONS ARE FOR A SINGLE HANGAR BAY MODULE BASED ON TABLE 2-1 CLEARANCES. SEE UFC 2-000-05N FOR WIDER INCREMENTS						

/3/

Table 7-1 Notes:

1. The Width and Depth of the hangar are defined as the respective net clear horizontal dimension between the nearest fixed obstructions. Horizontal fixed obstructions along back walls and side walls include, but are not limited to the inside face of the wall, a structural column or bracing, bollard, liner panel, an open door extending into the Aircraft Maintenance Bay, mechanical equipment or ductwork, plumbing equipment, valves and pipes, electrical equipment (such as power transformers), or other fixed items. Fixed obstructions do not include furniture, tables, desks, benches, cabinets, tools, parts, carts or other movable objects. The depth at the hangar door is to the interior face of the innermost panel of a rolling steel door, or to the interior face of a vertical lift fabric door.

2. Dimensions for width, depth, and height are considered to be "standard." Variations in hangar bay sizes are not permitted without authorization of the NAVFAC HQ Chief Engineer. Additionally, Marine Corps hangar bay configurations may be modified by Headquarters, USMC (LF).

3. Table includes required NET clear hangar dimensions that are also to be used for square foot planning calculations. See UFC 2-000-05N for guidance and requirements on Net to Gross planning calculations. See also paragraph 2-4: Net to Gross Area in Aircraft Maintenance Hangars.

4. The clear height is the lowest obstruction including but not limited to, an overhead structure, and MEP equipment such as lighting, fans, heaters, ductwork, and sprinklers.

5. Hook height is to the saddle of the hook. Hook heights are minimum requirements. Increase height where possible to maximize for available structure height. Refer to crane requirements in 0:

6.

7. General Hangar Requirements and 7-9: Overhead Bridge Cranes.

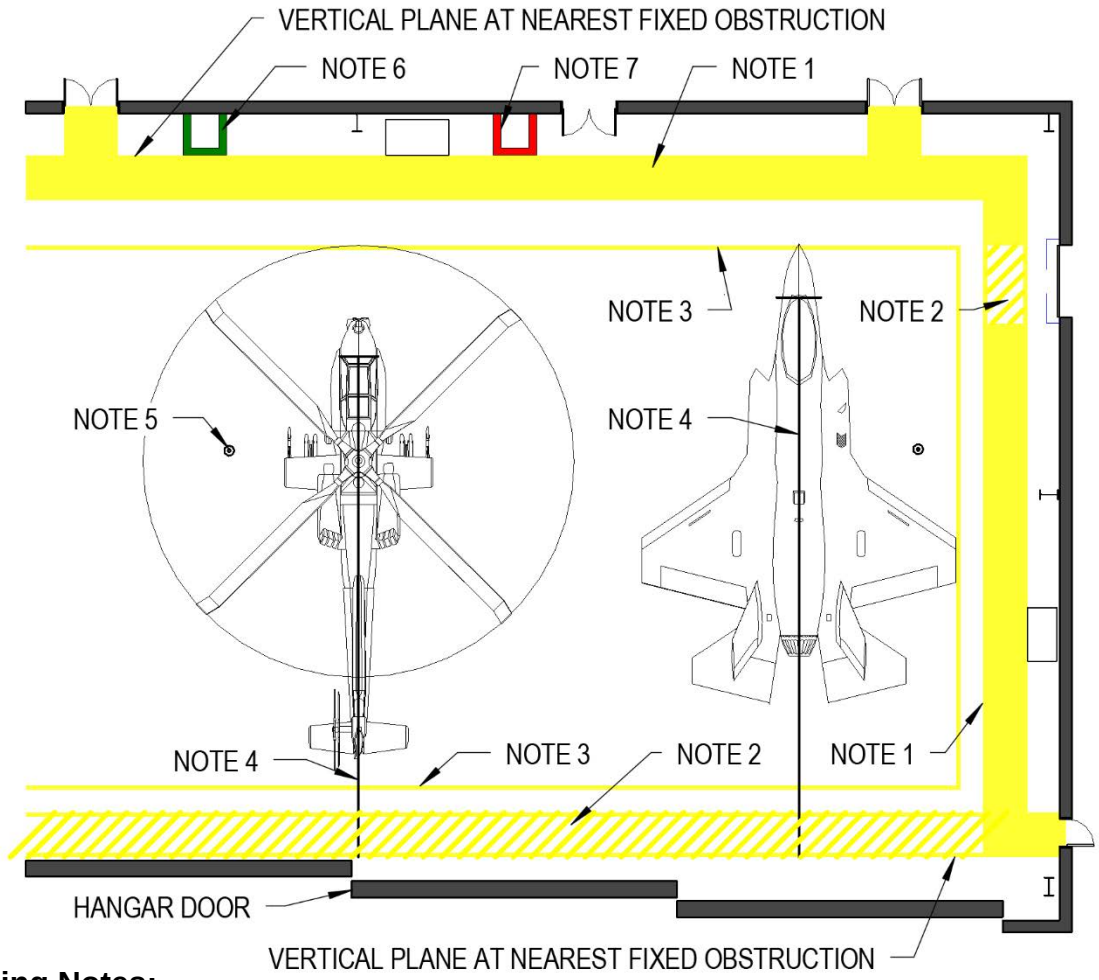
8. Refer to Figure 7-11: Section through Type II Hangar Crane Configuration and Vertical Clearances to clarify minimum hangar crane coverage area for Type II hangars. The bridge crane coverage must be designed to account for the possibility of servicing a C-130 aircraft. Coordinate crane coverage with the user.

9. The elements at the edge of the hangar door opening determine the width of the opening. Provide an opening not less than 3 ft. (1 m) less than the width of the aircraft maintenance bay.

7-3.2 Aircraft Maintenance Bay Striping Requirements

Provide striping in the aircraft maintenance bay per paragraph 3-3.4.3: Protective Coatings and Figure 7-1: Aircraft Maintenance Bay Striping Requirements.

Figure 7-1: Aircraft Maintenance Bay Striping Requirements



Striping Notes:

1. Safety Lane; 5 ft. (1.5 m) wide stripe; color - yellow.
2. Safety Lane; 5 ft. (1.5 m) with 6 in. (152 mm) boundaries and 6 in. (152 mm) diagonal stripes at locations where there is risk of being hit by vehicles; hangar door and rolling service doors, e.g.; color - yellow.
3. Six inches wide solid white aircraft safety perimeter line following clearances per Table 2-1: Minimum Aircraft Maintenance Bay Clearances.
4. **\2** Aircraft position centerline & nose gear stop; 6" wide stripe; color – yellow or white to match marking from outside the hangar to inside the hangar. May not be required at multi-aircraft position hangars. Coordinate with users. ***/2/***
5. Grounding receptacle; paint per UFC 3-575-01, Figure 2-3.
6. Safety eyewash/shower; color - green; provide 2 ft. (610 mm) clearance from safety equipment. Slope to drain, if provided.
7. Fire Extinguishers (if provided); color - red. Provide 2 ft. (610 mm) clearance from extinguishers.

7-4 STRUCTURAL

7-4.1 Aircraft Maintenance Bay - Slab on Ground Loading

Design Navy/USMC Aircraft Maintenance Bay slabs on ground in accordance with the minimum following traffic requirements. Add project specific additional vehicles to the mix as required. The mixes represent a 50-year traffic loading. These slab loadings have been developed to maximize Aircraft Maintenance Bay use and flexibility. Make no reductions to these traffic mixes or loadings without the approval of NAVFAC HQ Chief Engineer.

\1\ For Navy and USMC standard hangar Types I, II, III, and IV or similar variations, provide a slab on ground of uniform design and thickness throughout the hangar bay. Do not reduce the slab thickness in areas not subject to the design aircraft loads. For single aircraft non-standard hangar types, slab optimization is permitted by section 3-4.2.3.1 Aircraft Maintenance Bay - Slab on Ground Design where applicable. /1/

7-4.1.1 Type I Hangar

Use Type B traffic area with the following minimum traffic mix:

- F-35C Aircraft (70,400 lbs.) - 40,000 passes
- ATLAS forklift (10,000 lbs. - loaded carriage)- 10,000 passes
- P-15 Crash/Fire Truck (130,860 lbs.) - 1,200 passes
- Transport Truck M1088 and M871A3 Trailer (80,000 lbs.) - 1,000 passes

7-4.1.2 Type II Hangar- Type B traffic area with the following minimum traffic mix:

Use Type B traffic area with the following minimum traffic mix:

- C-130J (155,000 lbs.) - 40,000 passes
- P-15 Crash/Fire Truck (130,860 lbs.) - 1,200 passes
- Transport Truck M1088 and M871A3 Trailer (80,000 lbs.) - 1,000 passes
- 10K forklift - 10,000 passes

7-4.1.3 Type III Hangar

Use Type B traffic area with the following minimum traffic mix:

- P-8A (155,000 lbs.) - 40,000 passes
- P-15 Crash/Fire Truck (130,860 lbs.) - 1,200 passes
- Transport Truck M1088 and M871A3 Trailer (80,000 lbs.) - 1,000 passes
- 10K forklift - 10,000 passes

7-4.1.4 Type IV Hangar

Use Type B traffic area with the following minimum traffic mix:

- F-35C Aircraft (70,400 lbs.) - 40,000 passes
- ATLAS forklift (6,000 lbs. - loaded carriage)- 25,000 passes
- P-15 Crash/Fire Truck (130,860 lbs.) - 1,200 passes
- Transport Truck M1088 and M871A3 Trailer (80,000 lbs.) - 1,000 passes

7-5 MECHANICAL

Provide in accordance with 3-5: Mechanical.

7-5.1 Plumbing

Install hose bibbs on all interior walls of the hangar bays.

7-5.2 HVAC

Provide dedicated units for the Communications Room and Secure Office. Provide heating only with a unit heater for the stairs when the climate makes it necessary.

7-6 FIRE PROTECTION AND LIFE SAFETY

7-6.1 General

Classify all hangars as Group I in accordance with NFPA 409.

7-6.2 Tension Fabric Hangars

7-6.2.1 Protection of OH Space

Protect the OH space in accordance with this UFC, except the overhead sprinkler system is not required.

7-6.2.2 Protection of O1/O2 Levels

Unless otherwise noted, protect the O1/O2 Levels in accordance with this UFC and UFC 3-600-01 including sprinkler and fire alarm systems. Provide passive protection of the O1/O2 levels based on their location outside or within the tension fabric structural frame.

7-6.2.2.1 O1/O2 Levels outside the Tension Fabric Structural Frame

Provide a minimum 1-hour fire barrier between the O1/O2 levels and the OH space, or provide fire separation between the tension fabric structure and other structures in accordance with UFC 3-600-01 for tensioned-membrane hangars.

7-6.2.2.2 O1/O2 Levels within the Tension Fabric Structural Frame

Provide a minimum 1-hour fire barrier between the O1/O2 levels and the OH space, inclusive of all sides exposed to the OH space such as side, top, and bottom.

7-6.2.3 Egress from O1/O2 Levels

Do not discharge required exits or exit access from the O1/O2 levels into or through the OH space. When a 1-hour fire barrier is provided between the O1/O2 levels and OH space, convenience openings are permitted where minimum 3/4-hour rated opening protection is provided.

7-6.3 Concentrate Piping

The use of brass piping with brazed or flanged joints is permitted. Provide flanges in the brass piping for equipment and valve removal. The use of threaded connections is not permitted, except at the connection to the inductor or concentrate storage tank.

7-6.4 Releasing Service Fire Alarm Control Unit (RSFACU)

Provide X3301 Multispectrum IR Flame Detectors manufactured by DetTronics. Provide Detectors with Hangar Mode as the factory default. Control and monitor optical flame detectors from a factory assembled Eagle Quantum Premier fire detection/releasing control unit manufactured by Det-Tronics.

\2\ Only release the low level trench nozzle system from a manual releasing station, or two simultaneous votes from non-latching optical flame detectors in the releasing zone. Refer to Table 7-2: \3\ Sample Navy RSFACU Functional Matrix for additional functional requirements. /2/

Table 7-2: \3\ Sample Navy RSFACU Functional Matrix

NOTE: This sample table is intended to be specifically tailored/edited for each project. /3/

	ANNUNCIATION AT LOCAL PANEL			NOTIFICATION						AUXILARY FUNCTIONS				
ALARM CONDITIONS	AUDIO-VISUAL ALARM INDCATION	AUDIO-VISUAL TROUBLE INDICATION	AUDIO-VISUAL SUPERVISORY INDICATION	GENERAL FIRE ALARM SIGNAL TO FACU AND RECEIVING STATION	FOAM/WATER RELEASE SIGNAL TO FACU AND RECEIVING STATION	COMMON FOAM/WATER TROUBLE SIGNAL TO FACU AND RECEIVING STATION	COMMON FIRE ALARM SUPERVIORY SIGNAL TO FACU AND RECEIVING STATION	COMMON FOAM/WATER SUPERVISORY SIGNAL TO FACU AND RECEIVING STATION	OPTICAL FLAME DETECTION INHIBITED SUPERVISORY SIGNAL TO FACU AND RECEIVING STATION	OPEN FLOW CONTROL VALVE FOR FOAM/WATER SYSTEM	CLOSE FLOW CONTROL VALVE FOR FOAM/WATER SYSTEM	RE-OPEN FLOW CONTROL VALVE FOR FOAM/WATER SYSTEM IF STILL IN ALARM	RELEASE PRE-ACTION SPRINKLER SYSTEM (IF PROVIDED)	DISABLE ONLY THE RELEASING FUNCTION OF THE OPTICAL FLAME DETECTION
MANUAL FOAM RELEASING STATION	X				X					X				
ONE OPTICAL FLAME DETECTOR WITHIN THE PROTECTED ZONE	X			X										
TWO SIMULTANEOUS OPTICAL FLAME DETECTORS WITHIN THE PROTECTED ZONE	X				X					X				
PRESSURE SWITCH ON FOAM/WATER RISER *	X				X									
HEAT DETECTION IN THE HANGAR BAY (IF PROVIDED)	X			X									X	
TROUBLE CONDITIONS														
COMMON TROUBLE		X				X								
SUPERVISORY CONDITIONS														
COMMON SUPERVISORY			X					X						
DEPRESS FOAM STOP STATION BUTTON			X					X			X			
RELEASE FOAM STOP STATION BUTTON												X		
FOAM/WATER SUPERVISED SOLENOID DISCONNECT			X					X						
PREACTION SUPERVISED SOLENOID DISCONNECT (IF PROVIDED)			X				X							
OPTICAL FLAME DETECTION INHIBIT SWITCH			X						X					X

* DO NOT RELEASE THE FLOW CONTROL VALVE FROM THE PRESSURE SWITCH.

7-7 ELECTRICAL

7-7.1 Hazardous Classification

\3\ Design all hangar bays electrically as hazardous areas for maintaining fueled aircraft regardless if the aircraft contain fuel or not. Assume all aircraft in hangar bay will enter fueled. /3/

7-7.2 Special Power Systems

7-7.2.1 Aircraft 270VDC Service

Aircraft 270VDC ground power units, cables and connector are RPIE equipment.

7-7.3 Power Service Points

Coordinate all requirements with users and aircraft manufacturer and dedicate adequate wall space for all equipment. The power service points may include:

- Coordinate required outlet amperage and type requirements with the users. Three-phase, 480V, 4-wire, 60 Hz, receptacles for government

furnished support equipment (SE.). These receptacles are built by very few manufacturers and are identified by part number.

- Single-phase, 120V, 60 Hz, ground fault interrupt duplex utility outlets.
- **\2** For Triton Type IV hangars, as a minimum, provide at each aircraft parking space (minimum four per hangar bay), one - 480 VAC, 100 ampere, three-phase, four-wire, 60 Hz, MIL-C-22992, Class L, Connector Size 44, Insert Arrangement per MS14055 Figure 5, receptacle for Navy Ground Support Equipment (GSE). **/2/**

7-7.4 O1/O2 Level Spaces

Serve shop spaces by distinct panels dedicated to shop and equipment loads only. Do not supply office spaces from shop circuits or panels. Supply loads located in the O1 space from panel boards located in the O1 space; supply loads located in the O2 space from panel boards located in the O2 space.

7-7.5 Grounding and Bonding

Provide ordnance grounding in accordance with NAVSEA OP-5.

7-7.6 Obstruction Lighting

Provide obstruction lighting in accordance with 3-7.10.2: Aviation Obstruction and NAVAIR 51-50AAA-2. Provide LED obstruction lights where the users and airfield manager can verify that night vision goggles (NVG) or vision enhancement systems are not used. \3\ Use of LED lighting must be carefully coordinated with the user on case by case basis due to NVG wavelength issue and compatibility with LED lights. See UFC 3-535-01 Visual Air Navigation Facilities for further guidance. /3/

7-8 COMMUNICATIONS

7-8.1 Communication Systems Infrastructure

Provide additional communications outlets as required by mission. Additional required communications systems may include:

- Naval Aviation Logistics Command Management Information System (NALCOMIS)
- Triton Communication Systems

7-8.2 CATV Systems

Refer to the Navy functional data sheets for locations where CATV is required.

7-8.3 3M Communications (Maintenance and Material Management)

Coordinate with users and determine if 3M system is required. If required, provide an inter-communications system, integral to the telephone system, to allow two-way

communications between different spaces. Provide an independent, stand-alone, Type 1, Direct Connected Keyed, intercommunications system, for use by aircraft maintenance and material operations only. Provide a two-way communication from Line Shacks to, and between, all rooms in the O1 level space except passages, locker and toilet rooms, and mechanical equipment rooms.

7-8.4 Intercommunication System

Coordinate with users and determine if an intercom system is required. If required, provide the necessary infrastructure with provisions for interconnection with other buildings including the following.

- Rooms in the O1 and O2 level space, except corridors, locker and toilet rooms, and storage rooms.
- Department heads and the Commanding Officer and Executive Officers of the squadron.
- Officers' ready room and maintenance control.
- Administration office and maintenance administration.

7-8.5 ALIS Communication System

The ALIS is required for all F-35 hangars. A SAPF area is required for the ALIS. Refer to 2-2.3 - Secure Spaces for standards that apply to the construction of secure spaces.

7-9 OVERHEAD BRIDGE CRANES

\3\

Provide all cranes in accordance with Navy Crane Instruction 11450.2 Design of Navy Shore Weight Handling Equipment and with UFGS 41 22 13.55 Bridge Cranes, Under Running, Aircrat Hangar. For bridge crane capacities and additional crane requirements refer to Table 7-1: \3\ Standard Hangar Bay Module Dimensions and Crane Capacities*.

All overhead bridge cranes to be under running girder electric cranes with under running trolley hoist. Provide either single or double girder type, whichever minimizes the lowest overall crane depth for the configuration. Support all bridge cranes from patented track systems designed by the crane manufacturer.

[C] Per the current Navy Crane Instruction 11450.2 Design of Navy Shore Weight Handling Equipment, Navy/USMC hangar bridge cranes are considered operating in hazardous environments due to fueled aircraft and due to bridge crane span. Contact the Navy Crane center for design review involvement. A procurement waiver may also be required. For bridge crane electrical and anti-spark requirements, all hangars are to be designed for fueled aircraft regardless if the aircraft contain fuel or not.

/3/

7-9.1 Hook Height

The minimum hook clearance height, (measured from the finished floor elevation to the saddle of the hook at full elevation) is as tabulated in Table 7-1: \3\ Standard Hangar Bay Module Dimensions and Crane Capacities*. Increase crane hook height where possible to take advantage of the available structure height.

7-9.2 Hook Coverage

Design bridge crane layout to provide loaded hook coverage to within 12 ft. (3.7 m) of the inside face of all walls and to within 15 ft. (4.6 m) of the inside face of the hangar doors, except for Type II hangars. Refer to Figure 7-11: Section through Type II Hangar Crane Configuration and Vertical Clearances for Type II crane requirements. Where multiple cranes are provided, fully loaded hooks must be capable of being located within 15 ft. (4.6 m) of each other.

\3\

7-9.3 Hazardous Classification

For crane and other electrical hazardous classification requirements, the aircraft hangar bay shall be design as required for maintaining fueled aircraft per NFPA 70 and Section 513 regardless if aircraft contain fuel or not. Per Navy Crane Instruction 11450.2, incorporate “minimum anti-spark” requirements. This includes special requirements for the pendant, hook, hoist, wire rope and other elements per UFGS 41 22 13.55 Bridge Cranes, Under Running, Aircrat Hangar which also contains additional guidance. /3/

7-10 HANGAR DOORS

Hangar door widths to be determined by the elements at the edge of the door opening. Design the width of the opening to be not be less than 3ft. less than the width of the aircraft maintenance bay. Provide individually operated panels if the project includes sliding steel hangar doors.

7-11 FLOORS AND TRENCH DRAINS

At a minimum, provide trenches and nozzles around the perimeter of the hangar bay to enclose the aircraft silhouette and service area. For the purpose of the trench and nozzle locations, the aircraft service area is defined by Table 2-1: Minimum Aircraft Maintenance Bay Clearances. For example, in a Navy Type I Hangar, the aircraft service area starts at 7'-6" from the inside face of the hangar bay door.

7-11.1 Trench Drains

\2\ Provide trench drains in the hangar bay to remove hazardous fuels, fire suppression system discharge, and convey fire suppression system piping to the low level system discharge devices. Trench drains may also be used to convey compressed air and water service lines to support other operational functions of the maintenance hangar.

7-11.1.1 Trench Sizing

Size trench drains to account for the flow of the sprinkler system, low level system discharge, and hose stream allowance. To allow for sufficient space for maintenance in the trench, consider the volume of piping within the trenches and turning radius of the fittings in the design. /2/

7-11.1.2 Trench Covers

At a minimum, provide ductile iron or steel trench covers manufactured to withstand a minimum proof-load of 100,000 lbs. (45,359 kg) from a tire with a 250 psi (1.72 Megapascal (MPa)) pressure. Use nozzles and assembles that are not subjected to damage resulting from forces and torque imposed by a tow cart. Install nozzles, integral trench grate assembly, and supporting framework in accordance with manufacturer's recommendations. Design the top of the nozzle and grate assembly to be flush or level with floor it is protecting.

7-11.1.3 Trench Location

Provide trench drains in a grid pattern, as shown in Figure 7-2: Drive-Through Hangar and Figure 7-3: Pull-In Hangar.

7-11.1.4 Trench Nozzles

Use nozzles that develop a spray pattern from its installation position, with no moving parts. Do not exceed a nozzle spray pattern height of 12 in. (305 mm) above the hangar bay floor. Do not provide nozzles with characteristics that result in foam/water solution being discharged on an aircraft fuselage or wing components through direct impingement or misting. Do not provide nozzles that require high pressure fittings and system components. Provide nozzles compatible with the inductor proportioning system in this UFC.

Provide nozzles that have been tested for obstruction to discharge such as aircraft tires, 55 gal. (208 L) barrels, 3/4 in. (19 mm) rubber hoses, construction materials, with little effect on time of floor coverage. Design the system so the total nozzle obstructions do not negatively impact the hydraulics of the distribution system or the foam induction capabilities.

7-11.1.5 Nozzle Location

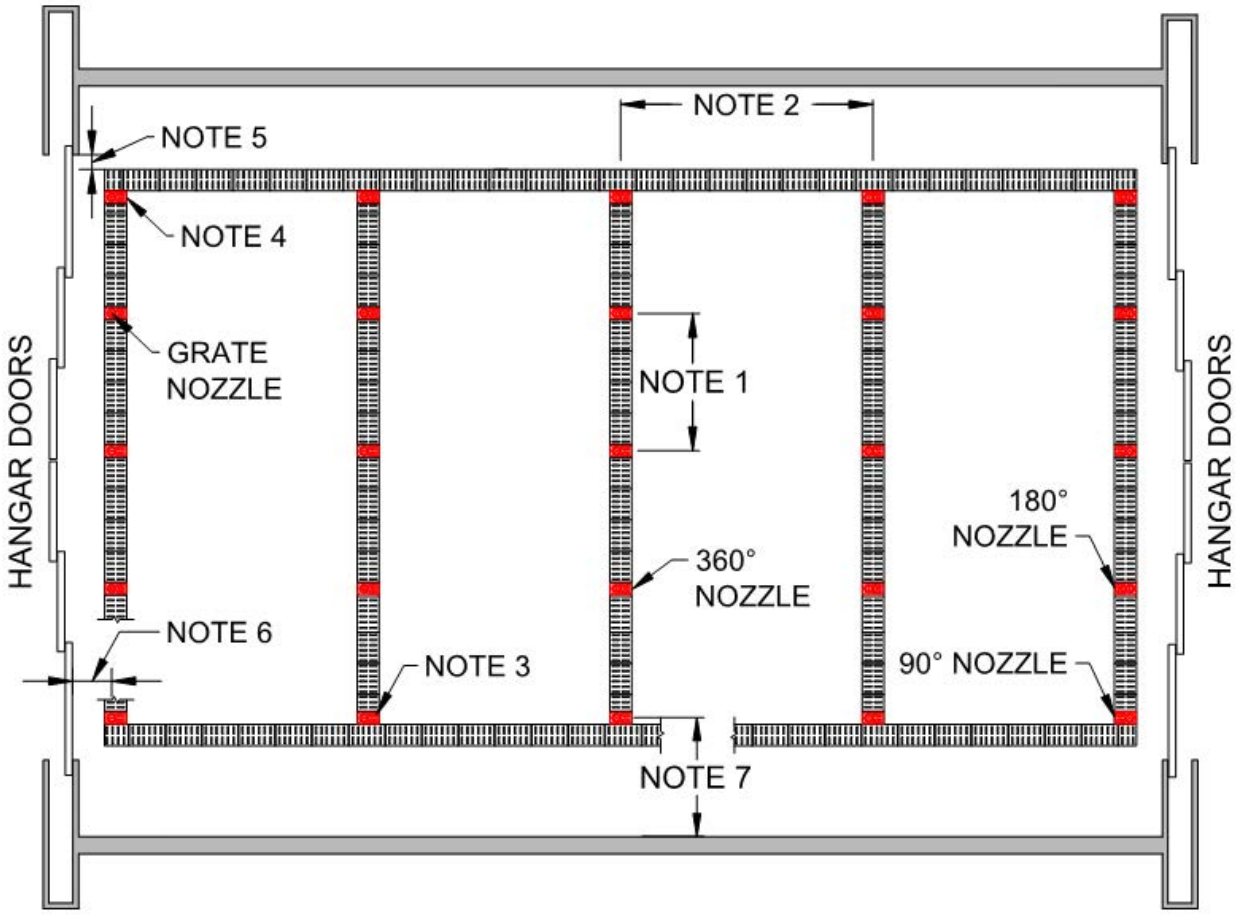
Use nozzles that discharge foam/water solution in a 360-degree, 180-degree, and 90-degree patterns. Use only 90-degree or 180-degree pattern nozzles around the perimeter such that foam/water solution is directed onto the aircraft servicing area. Provide uniform discharge of foam/water solution over the aircraft servicing area with a maximum spacing between trenches of 50 ft. (15.2 m) and a minimum and maximum spacing of nozzles within trenches of 22.5 ft. (6.86 m) and 27.5 ft. (8.38 m.), respectively. Do not discharge foam/water solution beyond the perimeter trenching of the hangar bay.

7-11.1.6 \2\ Low Level Discharge Devices

Use Viking Grate Nozzle™, Models GN 200/360, 200/180, or 200/090 or equal for the low level system. Use nozzles that are UL listed (GFUT) or FM approved. In order to use a nozzle other than specifically listed; provide performance capabilities of the alternative nozzle to the Navy for approval.

Install the low level trench nozzle system in a similar arrangement and with the limitations indicated in Figure 7-2: Drive-Through Hangar and Figure 7-3: Pull-In Hangar. /2/

Figure 7-2: Drive-Through Hangar



Nozzle Placement Notes:

1. Center to center nozzle spacing is approved for no less than 22.5 ft. (6.8 m.) and no greater than 27.5 ft. (8.4 m.)

2. The maximum distance between the centerline of distribution trenches is 50 ft. (15.2 m).

3. Provide 180 degree nozzles around the perimeter of the aircraft servicing area.

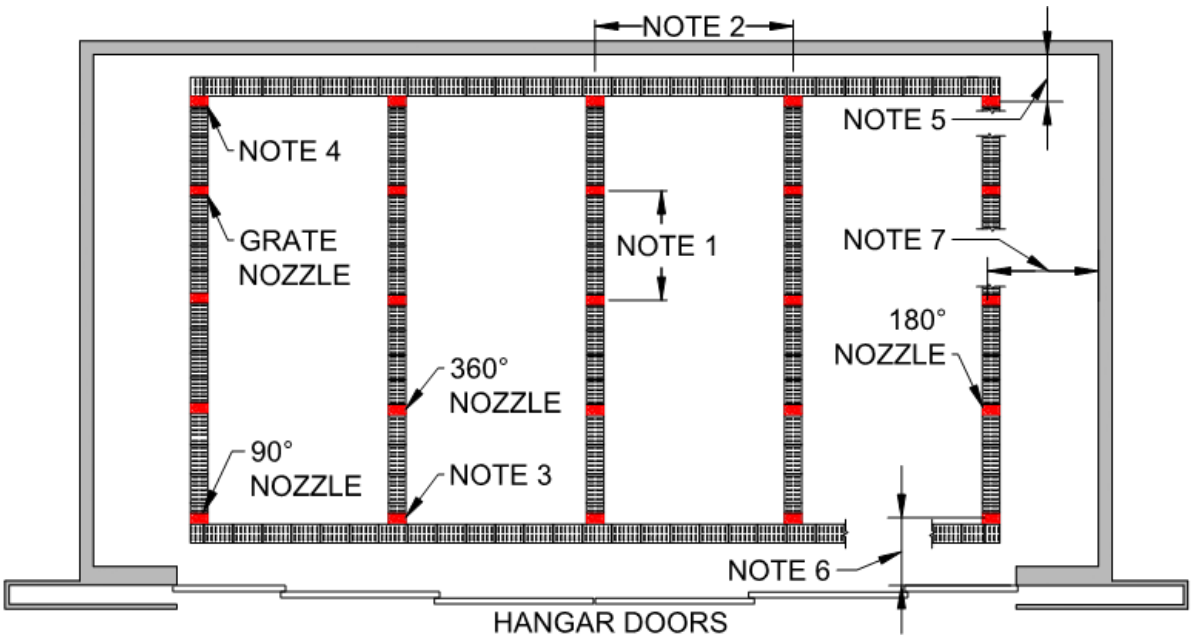
4. Provide 90 degree nozzles in the corners of the aircraft servicing area.

5. Do not exceed a distance of 3 ft. (1 m) into the hangar bay from the face of the hangar bay door jamb to the nearest parallel edge of the trench.

6. Do not exceed the tabular value in Table 2-1: Minimum Aircraft Maintenance Bay Clearances for the perpendicular distance from the centerline of the nozzles to the inside face of the nearest hangar bay door.

7. Do not exceed the tabular value in Table 2-1: Minimum Aircraft Maintenance Bay Clearances for the perpendicular distance from the centerline of the nozzles to the nearest fixed obstruction along the side wall.

Figure 7-3: Pull-In Hangar



Nozzle Placement Notes:

1. Center to center nozzle spacing is approved for no less than 22.5 ft. (6.8 m.) and no greater than 27.5 ft. (8.4 m.)

2. The maximum distance between the centerline of distribution trenches is 50 ft. (15.2 m).

3. Provide 180 degree nozzles around the perimeter of the aircraft servicing area.

4. Provide 90 degree nozzles in the corners of the aircraft servicing area.

5. Do not exceed the tabular value in Table 2-1: Minimum Aircraft Maintenance Bay Clearances for the perpendicular distance from the centerline of the nozzles to the nearest fixed obstruction along the back wall.

6. Do not exceed the tabular value in in Table 2-1: Minimum Aircraft Maintenance Bay Clearances for the perpendicular distance from the centerline of the nozzles to the inside face of the nearest hangar bay door.

7. Do not exceed the tabular value in in Table 2-1: Minimum Aircraft Maintenance Bay Clearances for the perpendicular distance from the centerline of the nozzles to the nearest fixed obstruction along the side wall.

7-12 FUEL CELL MAINTENANCE

For Navy, fuel cell maintenance is performed in aircraft maintenance hangars in accordance with NAVAIR 01-1A-35 vs. in dedicated fuel cell maintenance hangars. Refer to NAVAIR 01-1A-35 dated 1 July 2009, Aircraft Fuel Cells and Tanks for policy, requirements and procedures. Refer to paragraph 3-5.8.1: Compressed Air for compressed air requirements.

7-13 WASH BAY

Provide in accordance with 3-13: Wash Bay.

7-14 NAVY FUNCTIONAL DATA SHEETS (FDS) AND SPACE TYPES

The Functional Data Sheets (FDS) and Space Types identify the functional spaces and specific design needs for individual spaces within hangars. They are presented as a guide for the designer, planner, or Request for Proposal (RFP) preparer. It is intended that the information in the FDS are the minimum requirements for the respective rooms and spaces. These minimum requirements apply in addition to all other requirements of this UFC and other referenced documents. In the event of a mutually exclusive conflict or where both requirements cannot be satisfied, the FDS take precedence. However, if in the best judgment of the designer, a more restrictive requirement is appropriate, the more restrictive requirement may be applied after consulting with the user. It should not be assumed that these data sheets or space types reflect full requirements of the user or the full requirements of any specific aircraft type. Refer to 7-14.1: FDS Format for blank space references and additional minimum requirements.

7-14.1 FDS Format

Building design criteria are provided in a standard FDS table format that generally follows the Uniformat II/Work Breakdown Structure (WBS). Note that blank spaces found in the FDS indicate building components or systems should follow standard guidance per UFC 1-200-01, as a minimum. The Built-In Equipment/Casework category includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window shades or blinds, heavy-duty pallet racks, and recessed projection screens. The Furnishings, Fixtures &Equipment (FF&E) category includes loose or moveable items such as desks, chairs, and shelving. Items such as computers, printers, copiers, and flat screen monitors are "user-provided" equipment and are not considered FF&E. Coordinate FF&E and user-provided equipment with the building systems.

7-14.2 Applicability

All of the spaces listed in the following tables may not be applicable to all hangar types. For example, Aviation Ordnance will not generally be provided in a hangar where the aircraft do not have weapons or ejection seats. However, consider future flexibility and future hangar use in the design of functional spaces. Additionally, not all required spaces are listed in these tables, as there are too many variations and unique requirements when considering the range of aircraft inventory. Many aircraft FRD may

further define more specific requirements for these functional areas as well as define other required hangar spaces. Building support spaces such as mechanical, pump rooms, and electrical rooms must be provided as required and all spaces may not be listed. Some data sheets and space types apply only to specific airframes as noted.

7-14.3 Coordination with User and Airframe

Each squadron occupying a hangar has different requirements based on the size of the squadron, the type of aircraft, the type of hangar (see below), the type of squadron (e.g., training, reserve) and various other factors. The functional areas required are dependent on operational requirements and the functions required are determined by the user during the planning/DD 1391 development phase. Designer or RFP preparer must develop and coordinate project specific requirements with the user squadron, based on this UFC, the specific design aircraft(s), respective FRD or equivalent documents, and existing maintenance capabilities at each base.

7-14.4 Hangar Levels and Space Types

7-14.4.1 Hangar Levels

As discussed earlier in this chapter, Aircraft hangars are comprised of 3 distinct areas; the hangar bay (OH space), the Shop and Maintenance Administration area (O1 level); and the Operations, Training and Administration area (O2 level). Hangar spaces are grouped as O1 and O2 for planning purposes, and may be located on 1st or 2nd floors as required for appropriate adjacencies (refer to 7-15: NAVY ADJACENCY DRAWINGS). Additionally, spaces are categorized as to their general function such as the Hangar Bay, a Shop, Admin, Ops or Support (building). These space groupings and categories are reflected in 7-14.4.2: Hangar Space Types.

7-14.4.2 Hangar Space Types

Table 7-3: Hangar Space Table includes a list of spaces and functions that are commonly found in Navy hangars. General (Airframe) spaces indicate those found in every hangar. Airframe specific (i.e. F-35) spaces indicate special spaces for the respective aircraft. Additional FDS are presented for some spaces. Actual user, airframe, or FRD terms may vary from those used in Table 7-3: Hangar Space Table. The US Marine Corps has different designations for similar activities.

Table 7-3: Hangar Space Table

Airframe	Space Category	Space Grouping	Space Name	Space Description	Refer to Functional Data Sheet (Reference Table Number)
General	OH	OH	Hangar Bay (OH)	Maintenance Hangar area	Refer to Table 7-4: Hangar Bay
General	Shop	O1	Air Frames (Shop)	Maintains Air Frames.	Refer to Table 7-5: Air Frames
General	Shop	O1	Aviation Ordnance (Shop)	Maintains aircraft weapons systems including weapons cleaning and storage.	Refer to Table 7-6: Aviation Ordnance

Airframe	Space Category	Space Grouping	Space Name	Space Description	Refer to Functional Data Sheet (Reference Table Number)
General	Shop	O1	Avionics Space (Shop)	Maintains Aircraft electrical systems. This shop also provides storage for specialized communication equipment and may require special secure storage areas. Consider providing a vault within the shop as opposed to making the entire shop a secure space. A separate Avionics shop may be required due to different ratings of work or required security level.	Refer to Table 7-7: Avionics
General	Shop	O1	Corrosion Control/Coating (Shop)	Provides maintenance shop for corrosion control. Includes Low Observability (LO) Maintenance for F-35.	Refer to Table 7-8: Corrosion Control/Coating Shop
General	Shop	O1	Detachment (Shop)	Standard shop for Squadrons employing deployed aircraft. This is generally a workspace without any specific requirements. Coordinate requirements with a squadron configured for detachment components.	Refer to Table 7-9: Detachment
General	Shop	O1	Flight Gear/Paraloft (Shop)	This space is used to repair flight gear. It also provides the storage area for flight gear. Also may be part of AME shop or Flight Equipment	Refer to Table 7-10: Flight Gear/Paraloft
General	Shop	O1	Flight Line Office	Office for flight line shop	None
General	Shop	O1	Hangar Storage (Shop)	Storage area adjacent to hangar bay.	None
General	Shop	O1	Line Shack (Shop)	Flightline personnel waiting area and storage area	None
General	Shop	O1	Night Vision Goggles (NVG) Storage (Shop)	This space provides for storage of night vision gear.	Refer to Table 7-12: Night Vision Goggles (NVG) Storage
General	Shop	O1	Phase Crew (Shop)	Provides planned maintenance on aircraft parts.	Refer to Table 7-13: Phase Crew
General	Shop	O1	Power Plant (Shop)	Maintains Aircraft Engines.	Refer to Table 7-14: Power Plant
General	Shop	O1	Seat Shop (Shop)	Shop and storage area for seats and other components that are part of reconfigurable aircraft.	Refer to Table 7-15: Seat Shop
General	Shop	O1	Secured Classified Storage (Shop)	Secure storage of aircraft weapon system components with roll up door to hangar bay access	None
General	Shop	O1	Tool Room (Shop)	Tool Storage and Issue	Refer to Table 7-16: Tool Room
General	Admin	O1	1st Lieutenant	This space provides for the storage of building maintenance supplies and office space for the 1st Lieutenant.	None
General	Admin	O1	Bunk Room	Sleeping Quarters for Duty Officer	None

Airframe	Space Category	Space Grouping	Space Name	Space Description	Refer to Functional Data Sheet (Reference Table Number)
General	Admin	O1	Chief's Mess	Provides meeting space for Chief Petty Officers (CPO). Coordinate requirement with squadron.	None
General	Admin	O1	Division Office	This space provides office space for the squadron division officers.	Refer to Table 7-17: Division Office
General	Admin	O1	Lobby	This space is located at the main personnel entrance to the hangar. The space may include the quarterdeck. Verify requirement for quarterdeck as not all squadrons have personnel available for manning.	None
General	Admin	O1	Maintenance Administration	This space provides for administration of maintenance activities. This space is a general office area.	None
General	Admin	O1	Maintenance Administration - Private Offices	Provides for separate or combined office for the Maintenance Officer (MO) and the Assistant Maintenance Officer (AMO).	None
General	Admin	O1	Maintenance Control	This space provides for administration of squadron maintenance. The space also provides flight crews to access the maintenance records and flight data. This space may also be used for briefing of maintenance personnel prior to beginning of work day. Includes consolidated printer location and admin supply storage.	Refer to Table 7-18: Maintenance Control
General	Admin	O1	Maintenance Control Private Office	Provides private office for the Maintenance Control Officer in Charge (OIC).	None
General	Admin	O1	Material Control	This space provides for maintenance record storage. This area also provides for receipt and documentation of deliveries.	None
General	Admin	O1	Quality Assurance	This space provides office space and study space for quality assurance activities. This space also provides for storage of aircraft manuals. Manuals may be provided on Compact Disk (CD).	None
General	Admin	O1	Quarterdeck/Duty/Security Office	This space is located at the main personnel entrance to the hangar. The space may be separate from the lobby or open to the lobby as determined. Generally, this space is occupied by one person. Provides a controlled entry to the building.	None
General	Admin	O2	CO/XO Toilet	Private Toilet for CO/XO	None

Airframe	Space Category	Space Grouping	Space Name	Space Description	Refer to Functional Data Sheet (Reference Table Number)
General	Admin	O2	Exam Room	Provides exam space for medical officer	None
General	Admin	O2	General Office (open)	General open office space used for squadron administration.	None
General	Admin	O2	Personnel Office	General open office space used for squadron administration.	None
General	Admin	O2	Private Office - Commanding Officer, Executive Officer	Executive level private offices are generally adjacent to each other and are often interconnected either by direct access or by a vestibule. They may share a toilet with shower if requested. Generally, the spaces are associated with a waiting area and/or clerk's office. They may be a part of a "command suite" that includes the Command Master Chief. Command Suites may have secure environments.	None
General	Admin	O2	Private Office - General	This type of office is provided for various administrative functions on the O2 level. Offices may include: Drug and Alcohol Program Advisor (DAPA), Command Master Chief, Admin Officer, CPO, OIC, CCD, Combat Control Officer (CCO), SAFTO, NATO, Legal, and Contractor.	None
General	Ops	O2	Briefing Room	This space provides for operational briefings associated with flight operations	None
General	Ops	O2	Chart Room	Provides space for flight planning operations and storage of charts.	None
General	Ops	O2	Conference Room	Provides space for meetings and conferences. May be a secure space and may include Video Teleconference Capabilities (VTC).	None
General	Ops	O2	Operations Offices	Office serves as the operations center for all squadron flight operations. This may include other offices such as Intel or Tactics	None
General	Ops	O2	Secure Communications Office	Provides head-in space for SIPRNet	None
General	Ops	O2	Training Room/Classroom	This space provides for training of personnel. May require training storage space for table/chairs. May include operable partitions to create separate spaces.	None
General	Ops	O2	Ward Room (Ready Room)	Ready room for pilots and flight crew.	None

Airframe	Space Category	Space Grouping	Space Name	Space Description	Refer to Functional Data Sheet (Reference Table Number)
General	Support	O1/O2	Men's Toilet	Toilet facilities, locker and shower rooms.	None
General	Support	O1/O2	Break Room/Vending	Provides space for vending machines and snack bar operations. Coordinate specific requirements with the squadron. Multiple break rooms may be required.	None
General	Support	O1/O2	Building Systems Spaces	Provides space for building systems including, but not limited to: Mechanical, Fire Protection, Fire Pump, Electrical, and Elevator Equipment.	None
General	Support	O1/O2	Communications Room	Provides space for telecommunications and Navy Marine Corp Intranet (NMCI) head-in equipment	None
General	Support	O1/O2	Corridors	Provides for horizontal circulation	None
General	Support	O1/O2	Elevator	Elevator cab and shaft space	None
General	Support	O1/O2	Janitor Closet	Provides for cleaning supply storage.	None
General	Support	O1/O2	Stairs	Provides for vertical circulation	None
General	Support	O1/O2	Women's Toilet	Toilet facilities, locker and shower rooms.	None
F-35	OH	OH	Hangar Bay (OH) (F-35 Only)	Maintenance Hangar area	Refer to Table 7-19: Hangar Bay (OH) (F-35 Only)
F-35	Shop	O1	Seat and Canopy Maintenance/AME (Shop) (F-35 Only)	Maintains ejection seats and canopies. Includes arming and de-arming with storage of explosives. Includes storage and maintenance of other Alternate Mission Equipment (AME).	Refer to Table 7-20: Seat and Canopy Maintenance/AME Maintenance (Shop) (F-35 Only)
F-35	Ops	O1/O2	SAPF ALIS Administration (F-35 Only)	Office	None
F-35	Ops	O1/O2	SAPF ALIS Maintenance (F-35 Only)	Office	None
F-35	Ops	O1/O2	SAPF ALIS OMS Operations (F-35 Only)	Office	None
F-35	Ops	O1/O2	SAPF Assistant Intel (F-35 Only)	Office	None
F-35	Ops	O1/O2	SAPF Assistant Security Office (F-35 Only)	Office	None
F-35	Ops	O1/O2	SAPF Avionics Shop Subset (F-35 Only)	Office	None
F-35	Ops	O1/O2	SAPF Intel (F-35 Only)	Office	None
F-35	Ops	O1/O2	SAPF Large Pilot Briefing (2) (F-35 Only)	Briefing - Separate by operable partition	None

Airframe	Space Category	Space Grouping	Space Name	Space Description	Refer to Functional Data Sheet (Reference Table Number)
F-35	Ops	O1/O2	SAPF Mission Planning (F-35 Only)	Office	None
F-35	Ops	O1/O2	SAPF Pilot Briefing (6) (F-35 Only)	Briefing	None
F-35	Ops	O1/O2	SAPF Security Office (F-35 Only)	Office	None
F-35	Ops	O1/O2	SAPF Security Work Space (F-35 Only)	Office	None
F-35	Ops	O1/O2	SAPF SOU Communications (F-35 Only)	Office	None
F-35	Ops	O1/O2	Collateral/SAR Storage	Multiple options are available to meet storage requirements based on type and condition of parts/equipment.	None
F-35	Support	O1/O2	SAPF Toilets (F-35 Only)	Toilet	None
F-35	Support	O1/O2	SAPF Break Room (F-35 Only)	Support	None
F-35	Support	O1/O2	SAPF SIPRNet Communications (F-35 Only)	Support	None
F-35	Support	O1/O2	SAPF Storage (F-35 Only)	Storage	None
MV-22	Shop	O1	Airframe Hydraulic Clean Room (Shop) (MV-22 Only)	This work center performs inspections and proper procedures on flight control systems, hydraulic power systems and associated subsystems, and Blade Fold Wing Stow (BFWS) systems	Refer to MV-22 Functional Data Sheets Table 7-21: Airframe Hydraulic Clean Room (Shop) (MV-22 Only)

7-14.5 Functional Data Sheets

Table 7-4: Hangar Bay (OH)

Description / Usage		Maintenance area for airframes
Minimum Ceiling Height		Refer to mandatory height requirements based on hangar type.
Finishes	Walls	Painted walls between O1/O2 and hangar bay.
	Floors	Fuel Resistive Resinous Flooring, 5-Coat System. Incorporate floor markings if required.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Incorporate an approved Avian Intrusion Prevention System in the hangar bay.
Furniture, Fixtures & Equipment (FF&E)		Storage cabinets
Plumbing		Emergency Shower and Eyewash stations per Chapter 3. Compressed air drops on walls - Compressed air source of 125 psi with a constant flow rate of 20 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack. Coordinate with users on number of compressed air drops required and requirements for hose reels for water or air. **\2** Provide high-volume compressed air drops, 150 scfm minimum, for every two hangar bays, minimum 1-1/4" pipe size. **2/**
HVAC		Provide per Chapter 3. Specialized exhaust system(s) required. Exhaust directly outdoors through roof. Thermostatic control switch activated by hangar door to shutoff heating if OA temp is above 40ºF. May require air conditioned hangar bay for certain aircraft in warmer climates. May require overhead radiant heating. May require hangar door track heating system in colder climates.
Fire Protection		Provide per Chapter 3 and Chapter 7.
Power		Provide per Chapter 3 and Chapter 7.
Lighting		
Communication		Provide per Chapter 3 and Chapter 7.
Intercommunications Systems		Provide per Chapter 3. Microphone and Auxiliary Jacks, Paging Speaker System (Neoplanar Emitters), GPS Repeater Systems
Electrical Special Systems and Devices		Provide per Chapter 3 and Chapter 7. 400 Hz Frequency Converters, Ground Power Equipment Connections. Security - CCTV Cameras, Access Control (if required by Government)
Special Requirements		Provide Hangar Doors per Chapter 3 and Chapter 7. Provide catwalks and ladders to provide service for Vertical Lift Fabric Doors. Provide bridge crane(s) when required.
Acoustics		Provide acoustical seals including automatic door bottoms and perimeter seals on any doors provided between the O2 level and the hangar bay.

Table 7-5: Air Frames (Shop)

Description / Usage		Maintains air frames.
Minimum Ceiling Height		
Finishes	Walls	Painted with resilient base.
	Floors	Fuel Resistive Resinous Flooring, 5-Coat System. Incorporate floor markings if required.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Marker Boards.
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, bookcases, file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets.
Plumbing		Service Sink. Compressed air drop at workbench. Compressed air source of 125 psi with a constant flow rate of 40 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack. Coordinate with users on number of compressed air drops and requirements for hose reels.
HVAC		Requires special industrial exhaust system that goes directly to the outside through roof.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		Dedicated Equipment Connections.
Lighting		
Communication		CATV Outlet
Intercommunications Systems		Call-In and Volume Control Station.
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, provide a minimum of a pair of 3'0" x 7'-0" personnel doors opening onto the hangar bay. If a 4 ft. (1220 mm) wide opening is adequate, provide a single 4 ft. (1220 mm) wide personnel door in lieu of double doors.
Acoustics		

Table 7-6: Aviation Ordnance (Shop)

Description / Usage		Maintains aircraft weapons systems including weapons cleaning and storage.
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Fuel Resistive Resinous Flooring, 3-Coat System. Incorporate floor markings if required.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Marker Boards.
Furniture, Fixtures & Equipment (FF&E)		Desks and Chairs, bookcases, file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets.
Plumbing		Service Sink. Compressed air drop at workbench. Compressed air source of 125 psi with a constant flow rate of 20 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack. Coordinate with users on number of compressed air drops and requirements for hose reels.
HVAC		Specialized exhaust system(s) required. Exhaust directly outdoors through roof. Thermostat/humidistat. Separately controlled zones. Humidifier/Dehumidifier may be required due to the presence of ordnance. Explosion-proof fan motors may be required.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Grounding Systems		Provide Ground Bus Bar per UFC 3-575-01
Electrical Special Systems and Devices		400 Hz Panelboard, 400 Hz Bench Connection, Test Bench Connections
Lighting		
Communication		CATV Outlet.
Intercommunications Systems		Call-In and Volume Control Station.
Special Requirements		Provide direct access to the exterior for the Aviation Ordnance Shop. Provide panic devices on all doors from the shop. May require a vault. Coordinate with the squadron. Special solvents may be used for cleaning - provide special exhaust if required. Coordinate explosive classification requirements with the users.
Acoustics		

Table 7-7: Avionics Space (Shop)

Description / Usage		Maintains aircraft electrical systems. This shop also provides storage for specialized communication equipment and may require special secure storage areas. Consider providing a vault within the shop as opposed to making the entire shop a secure space.
Minimum Ceiling Height		
Finishes	Walls	Paint resilient base.
	Floors	Static Dissipative resilient flooring.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Marker Boards.
Furnishings		Desks and chairs, bookcases, file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets, secure file cabinet if required.
Plumbing		Service Sink. Compressed air drop at workbench. Compressed air source of 125 psi with a constant flow rate of 20 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack. Coordinate with users on number of compressed air drops and requirements for hose reels. Emergency Eyewash per Chapter 3.
HVAC		Specialized exhaust system(s) required per Chapter 3. Exhaust directly outdoors through roof.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Grounding Systems		Provide Ground Bus Bar per UFC 3-575-01
Electrical Special Systems and Devices		400 Hz Frequency Converter, 400 Hz Panelboard, Convenience Outlets, Dedicated Equipment Connections, 400 Hz Bench Connections, Test Bench Connections.
Lighting		
Communication		CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations.
Special Requirements		Sometimes this space may require a vault or secure file cabinets. Coordinate requirement with squadron.
Acoustics		

Table 7-8: Corrosion Control/Coating Shop

Description / Usage		Maintenance shop for corrosion control. Includes Low Observability (LO) Maintenance for F-35.
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Sealed concrete.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Marker Boards.
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, bookcases, file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets, hazmat lockers, and corrosive battery lockers.
Plumbing		Service Sink. Compressed air drop at workbench. Compressed air source of 125 psi with a constant flow rate of 20 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack. Coordinate with users on number of compressed air drops and requirements for hose reels.
HVAC		Specialized exhaust system(s) required. Exhaust directly outdoors through roof.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Lighting		
Communication		CATV Outlet.
Intercommunications Systems		Call-In and Volume Control Station.
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, provide a minimum of a pair of 3'-0" x 7'-0" personnel doors opening onto the hangar bay. If a 4 ft. (1220 mm) wide opening is adequate, provide a single 4 ft. (1220 mm) wide personnel door in lieu of double doors.
Acoustics		

Table 7-9: Detachment (Shop)

Description / Usage		Standard shop for Squadrons using deployed aircraft. Coordinate requirements with a squadron configured for detachment components.
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Fuel Resistive Resinous Flooring, 3-Coat System. Incorporate floor markings if required.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Marker Boards
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, bookcases, file cabinets, work benches.
Plumbing		
HVAC		Specialized exhaust system(s) may be required. Exhaust directly outdoors through roof.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Lighting		
Communication		CATV Outlet.
Intercommunications Systems		Call-In and Volume Control Stations.
Special Requirements		
Acoustics		

Table 7-10: Flight Gear/Paraloft (Shop)

Description / Usage		This space is used to repair and store flight gear.
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Resilient flooring or Fuel Resistive Resinous Flooring, 3-Coat System. May require static dissipative flooring.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Marker Boards. Flight Gear Lockers - coordinate requirements with squadron. Generally, lockers are open style with mesh sides. Due to the storage of combustible materials (flares), doors are not desirable on the locker fronts. Size lockers to accommodate helmets and the particular gear associated with the aircraft type. Work table - provide large worktable to provide workspace for working on flight gear. Consider Rolling Storage units in lieu of fixed lockers to save space. Coordinate with structural slab for possible rail installation.
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, bookcases, file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets, commercial washer and dryer, sewing machine.
Plumbing		Washer hook up.
HVAC		Dryer vent required. Specialized exhaust system(s) required. Exhaust directly outdoors through roof. Explosion-proof fan motors may be required.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		Dryer hookup.
Lighting		
Communication		CATV Outlet.
Intercommunications Systems		Call-In and Volume Control Stations.
Special Requirements		Two (2) exits are required from this space. Swing door outward and provide panic hardware. Verify quantity of Class C/D1.4G explosive material within the space. Provide protective construction if the allowable quantities of explosive material are exceeded. Space may need to be classified as a "Hazardous Occupancy" based on types and quantity of pyrotechnical devices stored in the space. Verify quantity (pounds) of material prior to establishing a special occupancy separation.
Acoustics		

Table 7-11: Flight Line (Shop)

Description / Usage		Flight line personnel shop
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Sealed concrete is the minimum. Resilient flooring or Fuel Resistive Resinous Flooring, 3-Coat System if requested by the squadron.
	Ceiling	Exposed construction. Paint exposed items such as structure, ductwork, conduit, piping, devices.
Interior Construction / Built-in Equipment		
Furniture, Fixtures & Equipment (FF&E)		Desks, desk chairs, tool storage cabinets, workbenches, stools, file cabinets, as required.
Plumbing		Service sink Emergency eyewash per Chapter 3
HVAC		
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Lighting		
Communication		CATV Outlet
Intercommunications Systems		Call-In and Volume Control Stations
Special Requirements		Due to the potentially large pieces of equipment brought into this space, provide a minimum of a pair of 3'-0" x 7'-0" personnel doors opening onto the hangar bay. Provide a minimum 8 ft. (2.4 m) high motorized rolling service door to the exterior.
Acoustics		No special requirements

Table 7-12: Night Vision Goggles (NVG) Storage (Shop)

Description / Usage		This space serves as storage room of night vision gear.
Minimum Ceiling Height		
Finishes	Walls	Painted CMU with resilient base.
	Floors	Resilient flooring.
	Ceiling	Suspended Acoustical Ceiling.
Interior Construction / Built-in Equipment		Shelving.
Furniture, Fixtures & Equipment (FF&E)		
Plumbing		Not required.
HVAC		
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Lighting		
Communication		
Special Requirements		Provide metal door with a combination lock and deadbolt.
Acoustics		

Table 7-13: Phase Crew (Shop)

Description / Usage		Shop for planned maintenance on aircraft parts.
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Fuel Resistive Resinous Flooring, 5-Coat System. Incorporate floor markings if required.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Marker Boards.
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, bookcases, file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets.
Plumbing		Service Sink. Compressed air drop at workbench. Compressed air source of 125 psi with a constant flow rate of 20 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack. Coordinate with users on number of compressed air drops and requirements for hose reels.
HVAC		Specialized exhaust system(s) may be required. Exhaust directly outdoors through roof.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Lighting		
Communication		CATV Outlet.
Intercommunications Systems		Call-In and Volume Control Station.
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, provide a minimum of a pair of 3'-0" x 7'-0" personnel doors opening onto the hangar bay. If a 4 ft. (1220 m) wide opening is adequate, provide a single 4 ft. (1220 mm) wide personnel door in lieu of double doors.
Acoustics		

Table 7-14: Power Plant (Shop)

Description / Usage		Maintains aircraft engines.
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Fuel Resistive Resinous Flooring, 5-Coat System. Incorporate required floor markings
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Marker Boards.
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, bookcases, file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets.
Plumbing		Service Sink. Compressed air drop at workbench. Compressed air source of 125 psi with a constant flow rate of 20 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack. Coordinate with users on number of compressed air drops and requirements for hose reels.
HVAC		Specialized exhaust system(s) required. Exhaust directly outdoors through roof.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		Dedicated Equipment Connections.
Lighting		
Communication		CATV Outlet.
Intercommunications Systems		Call-In and Volume Control Station. Connect all shops, maintenance control, tool room and material control via intercommunication system.
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, provide a minimum of a pair of 3'-0" x 7'-0" personnel doors opening onto the hangar bay. If a 4 ft. (1220 mm) wide opening is adequate, provide a single 4 ft. (1220 mm) wide personnel door in lieu of double doors.
Acoustics		

Table 7-15: Seat Shop (Shop)

Description / Usage		Shop and storage area for seats and other components that are part of reconfigurable aircraft.
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Resilient flooring or Fuel Resistive Resinous Flooring, 3-Coat System.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Marker Boards. May require heavy industrial shelving for seat storage.
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, bookcases, file cabinets.
Plumbing		
HVAC		Specialized exhaust system(s) may be required. Exhaust directly outdoors through roof. May require explosion-proof fans and motors for MK16E ejection seats.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Grounding Systems		Provide Ground Bus Bar per UFC 3-575-01
Lighting		
Communication		CATV Outlet.
Intercommunications Systems		Call-In and Volume Control Stations.
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, provide a minimum of a pair of 3'-0" x 7'-0" personnel doors opening onto the hangar bay. If direct access to the hangar bay is not provided, provide an exterior double door.
Acoustics		

Table 7-16: Tool Room (Shop)

Description / Usage		Tool storage and issue
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Sealed concrete resilient flooring or Fuel Resistive Resinous Flooring, 3-Coat System.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Stainless steel tool issue counter located within the tool room. Provide a stainless steel service counter with overhead rolling service counter door if requested by the users. Marker Boards and Peg Board
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, bookcases file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets, parts storage bins.
Plumbing		Service Sink Compressed air drop at workbench. Compressed air source of 125 psi with a constant flow rate of 20 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack. Coordinate with users on number of compressed air drops and requirements for hose reels. Emergency eye and face wash per Chapter 3.
HVAC		
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		Dedicated Equipment Connections
Lighting		
Communication		
Intercommunications Systems		Call-In and Volume Control Stations. Connect all shops, maintenance control, tool room and material control via intercommunication system.
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, provide a minimum of a pair of 3'-0" x 7'-0" personnel doors opening onto the hangar bay. If a 4 ft. (1220 mm) wide opening is adequate, provide a single 4 ft. (1220 mm) wide personnel door in lieu of double doors. Consider using modular rolling storage shelving units for large tool rooms. Coordinate with structural slab for possible rail installation.
Acoustics		

Table 7-17: Division Office

Description / Usage		This space provides office space for the squadron division office.
Minimum Ceiling Height		
Finishes	Walls	Paint resilient base. Internal separation partitions may be gypsum board on metal studs.
	Floors	Resilient flooring, minimum. Do not provide carpet.
	Ceiling	Suspended Acoustical Ceiling.
Interior Construction / Built-in Equipment		Marker Board.
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, side chairs, bookcases, file cabinets.
Plumbing		
HVAC		
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Lighting		
Communication		CATV Outlet, Secure (SIPRNet) Outlets.
Intercommunications Systems		Call-In and Volume Control Stations.
Special Requirements		
Acoustics		Provide a minimum STC rating of 39, for partition and door construction.

Table 7-18: Maintenance Control

Description / Usage		Squadron Maintenance Administration: The space also allows flight crews to access the maintenance records and flight data. This space may also be used for briefing of maintenance personnel prior to beginning of work day.
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Resilient flooring, minimum on office side; sealed concrete, epoxy coating on the customer side. Do not provide carpet.
	Ceiling	Suspended Acoustical Ceiling.
Interior Construction / Built-in Equipment		Service Counter to provide for maintenance personnel to receive daily assignments and provide a work space for review of records. Counter for flight crew to enter flight records. Marker Board, TV Bracket.
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, bookcases, lateral files, time zone clock. Flight planning boards, if required.
Plumbing		
HVAC		
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Lighting		
Communication		Provide network and telephone per UFC 3-580-01, CATV Outlet, Conduits to Roof Mounted Antenna Farm Platform, Base Radio Outlet
Intercommunications Systems		Master Control Station. Connect all shops, maintenance control, tool room and material control via intercommunication system.
Special Requirements		User may request that this space be combined with Material Control. Sometimes access to the exterior is provided if it is part of Material control. CCTV monitoring and Pan, Tilt Zoom (PTZ) control of hangar and apron cameras. When this space has direct visual access to the hangar bay, provide fixed with fire rated glass.
Acoustics		

7-14.5.1 F-35 Functional Data Sheets

Table 7-19: Hangar Bay (OH) (F-35 Only)

Description / Usage		Maintenance Hangar area
Minimum Ceiling Height		Refer to mandatory height requirements based on hangar type.
Finishes	Walls	Paint walls between O1/O2 and hangar bay
	Floors	Fuel Resistive Resinous Flooring, 5-Coat System. Incorporate floor markings if required
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Incorporate Avian Intrusion Prevention System in the hangar bay.
Furniture, Fixtures & Equipment (FF&E)		
Plumbing		Emergency Shower and Eyewash stations per Chapter 3. Compressed air drops on walls - Compressed air source of 125 psi with a constant flow rate of 20 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack. Coordinate with users on number of compressed air drops required and requirements for hose reels for water or air. **\2** Provide high-volume compressed air drops, 150 scfm minimum, for every two hangar bays, minimum 1-1/4" pipe size. **/2/**
HVAC		Provide per Chapter 3. Exhaust directly outdoors through roof. Thermostatic control switch required. Activate switch by hangar door to shut off heating per Chapter 3. May require overhead radiant heating. Provide Pre-Conditioned Air System per Chapter 3 and Chapter 4.
		May require hangar door track heating system in colder climates.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		Ground Power Equipment Connection Dedicated Equipment Connections Two 480VAC, 3-phase, 60Hz power connection, at each aircraft parking spot. Electrical Hazardous classified area per Chapter 3.
Grounding Systems		Grounding per UFC 3-575-01.
Electrical Special Systems and Devices		270VDC 72kW power connection. 100-amp minimum ground power connections. 400 Hz Frequency Converters, if required by Legacy aircraft, 270VDC converters.
Lighting		
Communication		SCI Communications Outlets Local Area Network (LAN) connection at each aircraft parking location, and any F-35 wheel and tire maintenance area, GPS Repeater Systems.
Intercommunications Systems		Microphone and Auxiliary Jacks Paging Speaker System (Neoplanar Emitters)
Special Requirements		Security - CCTV Cameras, Access Control (if required by Government)
		Provide Hangar Doors per Chapter 3 and Chapter 7.
		Provide catwalks and ladders to provide service for Vertical Lift Fabric Doors
		Provide Overhead Bridge Crane
Acoustics		Provide doors between the O2 level and the hangar bay with acoustical seals including automatic door bottoms and perimeter seals

Table 7-20: Seat and Canopy Maintenance/AME Maintenance (Shop) (F-35 Only)

Description / Usage		Maintains ejection seats and canopies. Includes arming and de-arming with storage of explosives. Includes storage and maintenance of other Alternate Mission Equipment (AME).
Minimum Ceiling Height		
Finishes	Walls	Paint with resilient base.
	Floors	Sealed concrete is the minimum. Resilient flooring or Fuel Resistive Resinous Flooring, 3-Coat System if requested by the squadron.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		Marker Boards
Furniture, Fixtures & Equipment (FF&E)		Desks and chairs, bookcases, file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets.
Plumbing		Compressed air drop: Compressed air source of 125 psi with a constant flow rate of 20 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack. Coordinate with user on quantity and location and requirements for hose reels.
HVAC		Specialized exhaust system(s) required. Exhaust directly outdoors through roof. Thermostat/humidistat. Separately controlled zone Humidifier/Dehumidifier may be required due to the presence of ordnance. Explosion-proof fans and motors may be required for MK16E aircraft ejection seats.
Fire Protection		Provide per Chapter 3 and Chapter 7. Deflagration venting may be required depending upon the type and quantity of explosive stored.
Power		
Grounding Systems		Provide Ground Bus Bar per UFC 3-575-01 and Ordnance Grounding per NAVSEA OP-5.
Electrical Special Systems and Devices		
Lighting		Explosive proof
Communication		CATV Outlet
Intercommunications Systems		Call-In and Volume Control Station
Special Requirements		Due to the potentially large pieces of equipment brought into this shop, provide a minimum of a pair of 3'-0" x 7'-0" personnel doors opening onto the hangar bay. Seat Maintenance Shop should have direct access to the exterior. Provide panic devices on all doors from the shop.
		Accommodate classifications of 1.3c and 1.4c with a Net Explosive Weight (NEW) of 6.31 pounds of explosives (used in each ejection seat within the seat shop). Coordinate requirements for allowable quantities without creating separate occupancy type, if possible.
		Accommodate classifications of 1.4b and 1.4d with a NEW of 0.54 pounds of explosives used in the Canopy Transparency Removal System (TRS) (Canopy NEW = .06 lbs./canopy)
		Criteria for explosive classifications are based on Joint Technical Bulletin 700-2 Department of Defense Ammunition and Explosives Hazard Classification Procedure
		Provide doors wide enough to accommodate the seat dolly. Validate door size adequate to accommodate Rotating Canopy Stand.
Acoustics		

7-14.5.2 MV-22 Functional Data Sheets

Table 7-21: Airframe Hydraulic Clean Room (Shop) (MV-22 Only)

Description / Usage		This work center performs inspections and proper procedures on flight control systems, hydraulic power systems and associated subsystems, and Blade Fold Wing Stow (BFWS) systems
Minimum Ceiling Height		10 ft. (3.0 m)
Finishes	Walls	Paint with resilient base.
	Floors	Fuel Resistive Resinous Flooring, 5-Coat System if requested by the squadron.
	Ceiling	Exposed construction.
Interior Construction / Built-in Equipment		
Furniture, Fixtures & Equipment (FF&E)		
Plumbing		Compressed Air Drops. Compressed air source of 125 psi with a constant flow rate of 20 scfm. Each service point with the following: One (1) 38 mm (1/2 in.) needle valve shutoff, One (1) pneumatic tool filter, One (1) 861.8 kPa (125.0 psi) pressure regulator, One (1) pneumatic tool lubricator, Two (2) pneumatic tool quick-connectors, One (1) wall-mounted hose rack.
HVAC		Provide per Chapter 3 Heating Air Conditioning, 70°F (21°C) with 35%-50% humidity Ventilation 10.0 scfm/person Thermostatic control switch required.
Fire Protection		Provide per Chapter 3 and Chapter 7
Power		
Grounding Systems		
Electrical Special Systems and Devices		
Lighting		
Communication		Category (CAT) 5e Unshielded Twisted Pair (UTP) cable for all connections involving the Portable Electronic Maintenance Aid (PEMA) equipment.
Intercommunications Systems		
Special Requirements		The Hydraulic Particle Analyzer uses a Class 1 Laser, has a rechargeable Nickel-Metal Hydride battery, an Alternating Current (A/C) power cord, a sonic bath with A/C plug, and a compressed air connection (60.0 to 110.0 psi, clean and dry). This unit is portable using Carbon Dioxide (CO2) bottles for compressed air and rechargeable battery for power.
		Provide handling and storage (IAW) local codes and requirements due to HAZMAT.
Acoustics		

7-15 NAVY ADJACENCY DRAWINGS

7-15.1 Drawings

The conceptual adjacency diagrams below illustrate functional relationships and are not intended for use as standard designs.

- Figure 7-4: OH/O1 Level Adjacency Diagram
- Figure 7-5: O2 Level Adjacency Diagram
- Figure 7-6: Type I & II OH/O1 Level Hangar Adjacency Diagram
- Figure 7-7: Type I (F-35) O2 Level Adjacency Diagram
- Figure 7-8: Type III OH/O1 Hangar Adjacency Diagram
- Figure 7-9: Section Showing Header Truss
- Figure 7-10: Section Showing Cantilever Truss
- Figure 7-11: Section through Type II Hangar Crane Configuration and Vertical Clearances

Figure 7-4: OH/O1 Level Adjacency Diagram

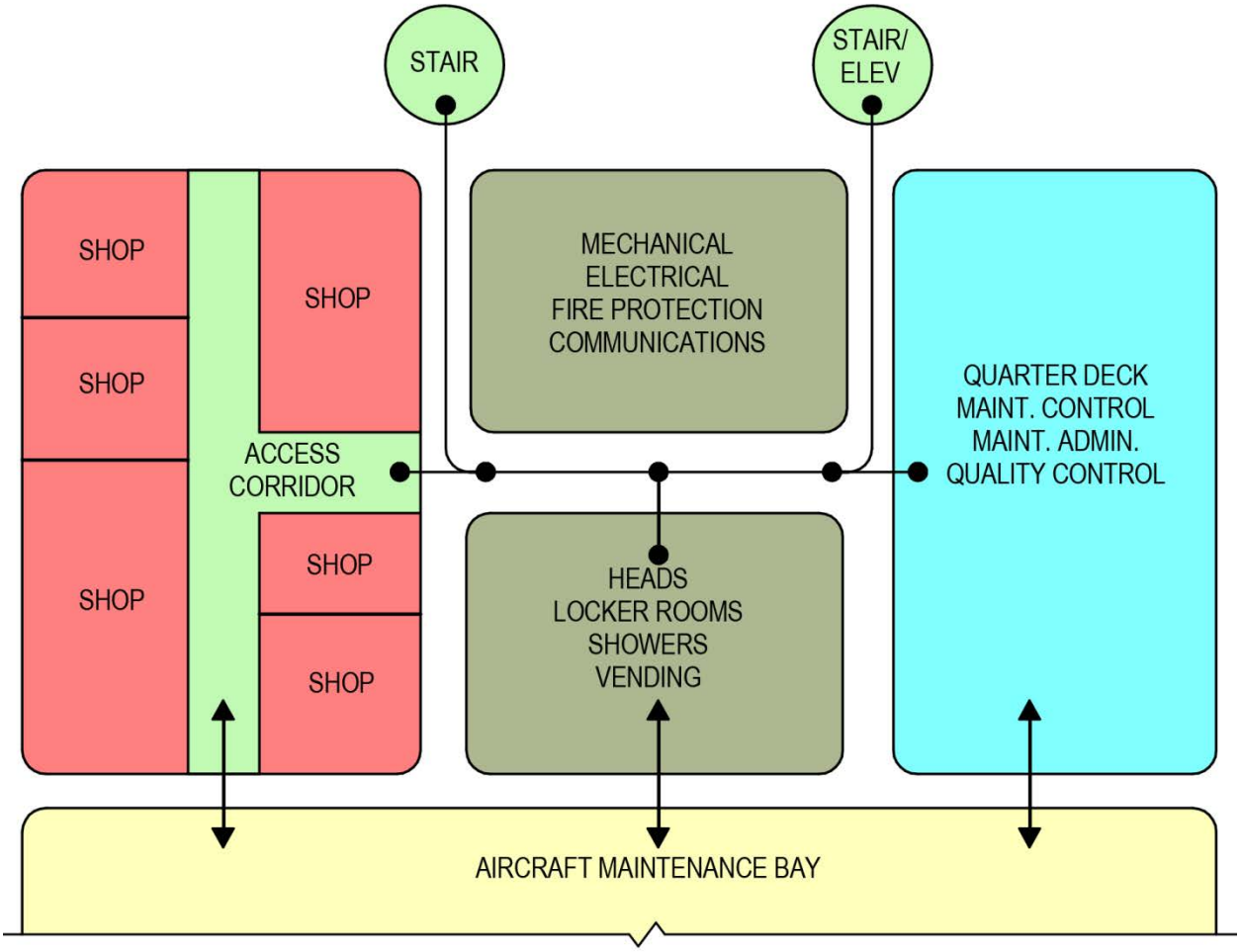


Figure 7-5: O2 Level Adjacency Diagram

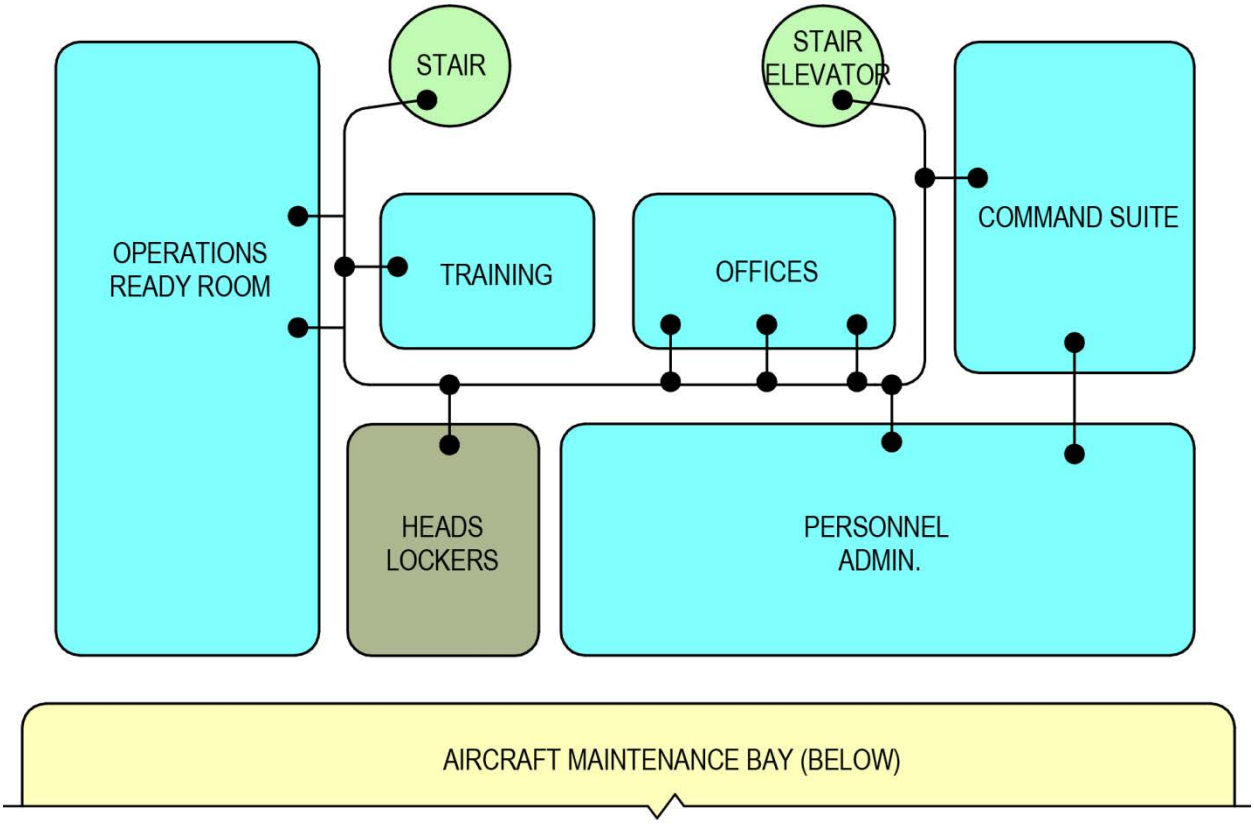


Figure 7-6: Type I & II OH/O1 Level Hangar Adjacency Diagram

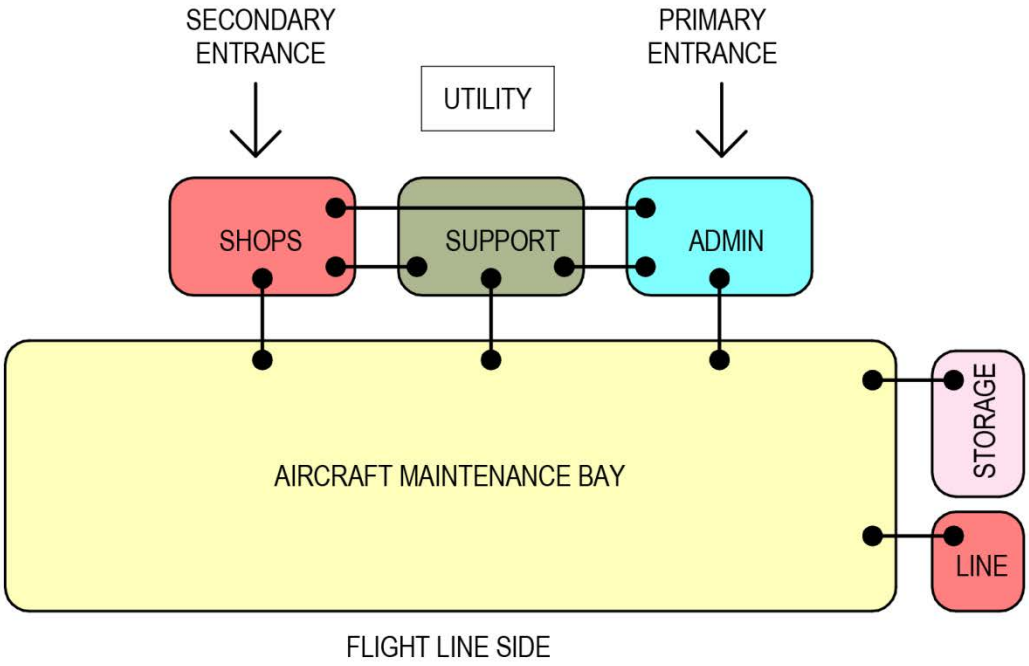


Figure 7-7: Type I (F-35) O2 Level Adjacency Diagram

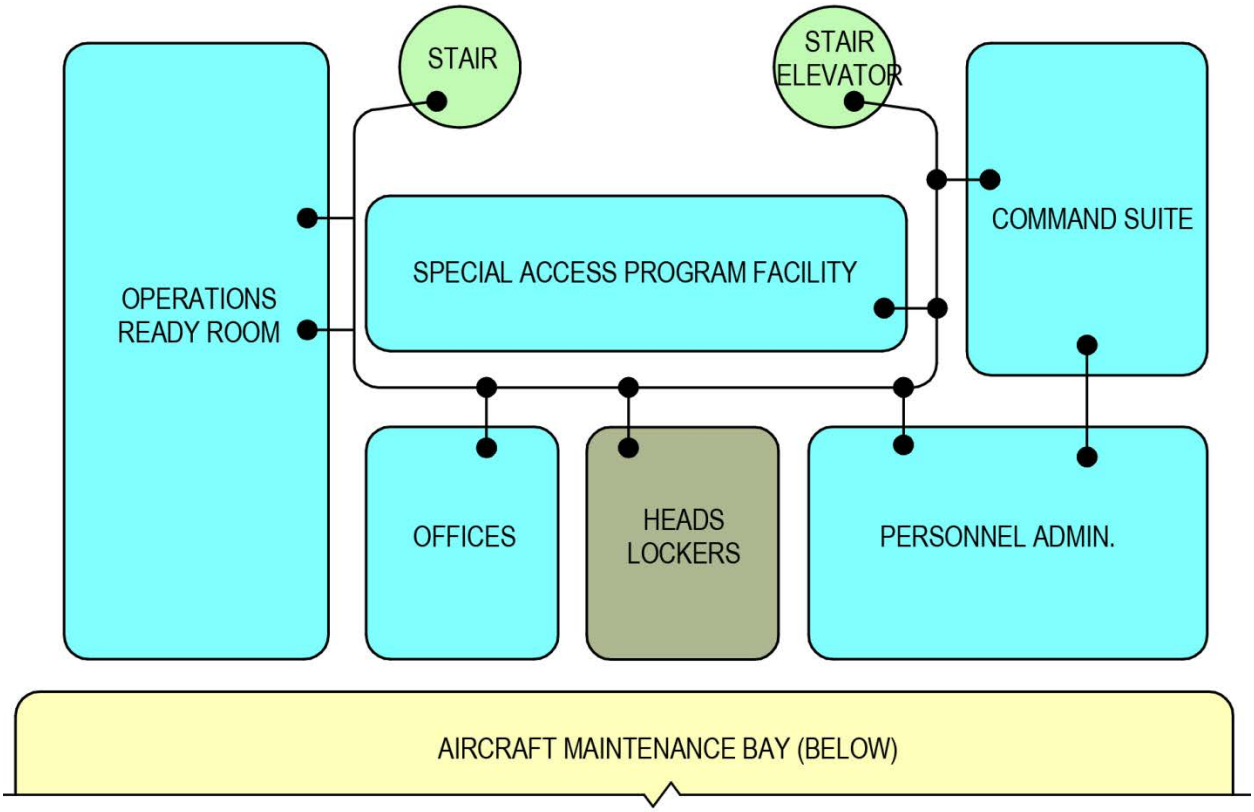


Figure 7-8: Type III OH/O1 Hangar Adjacency Diagram

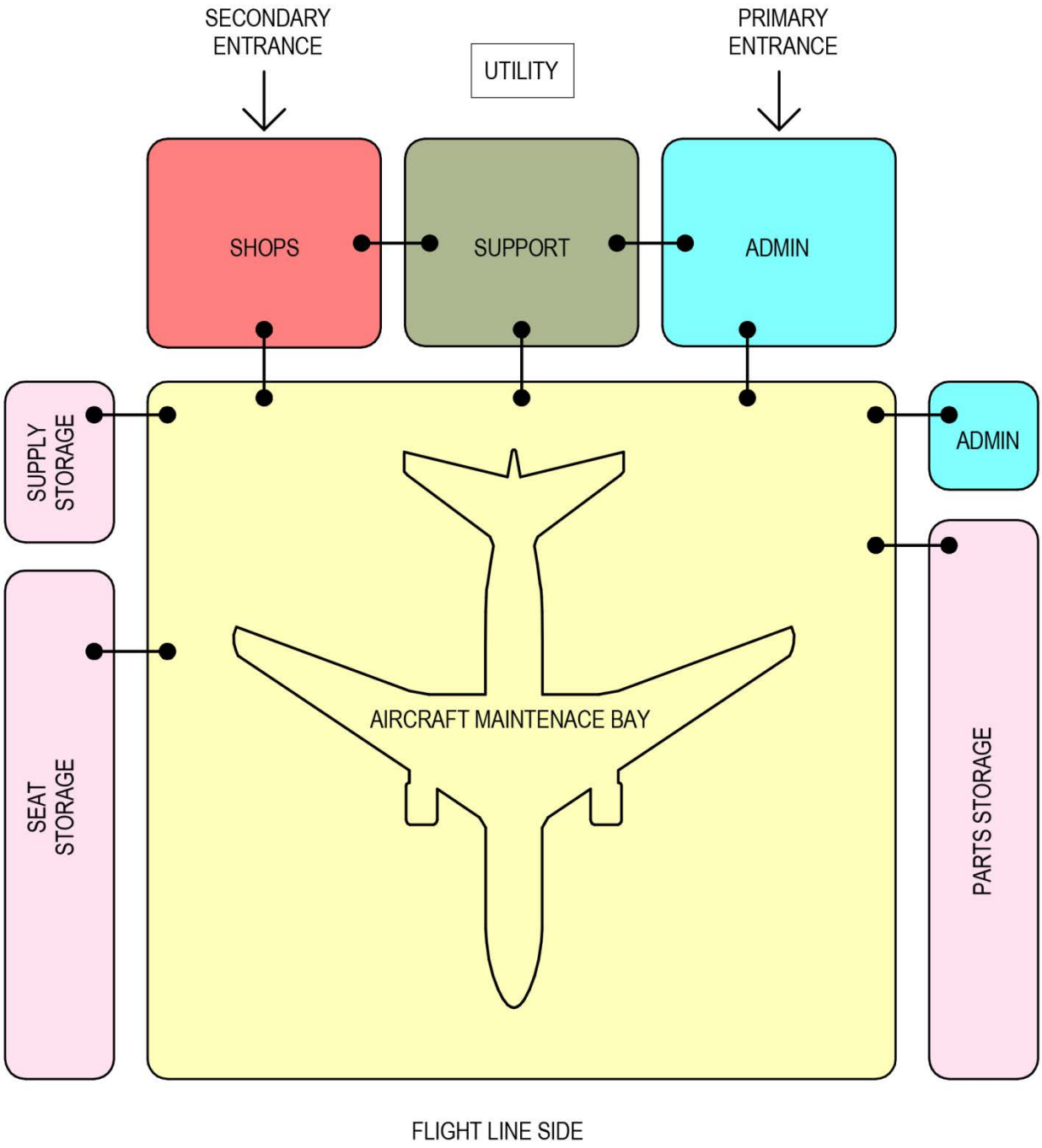


Figure 7-9: Section Showing Header Truss

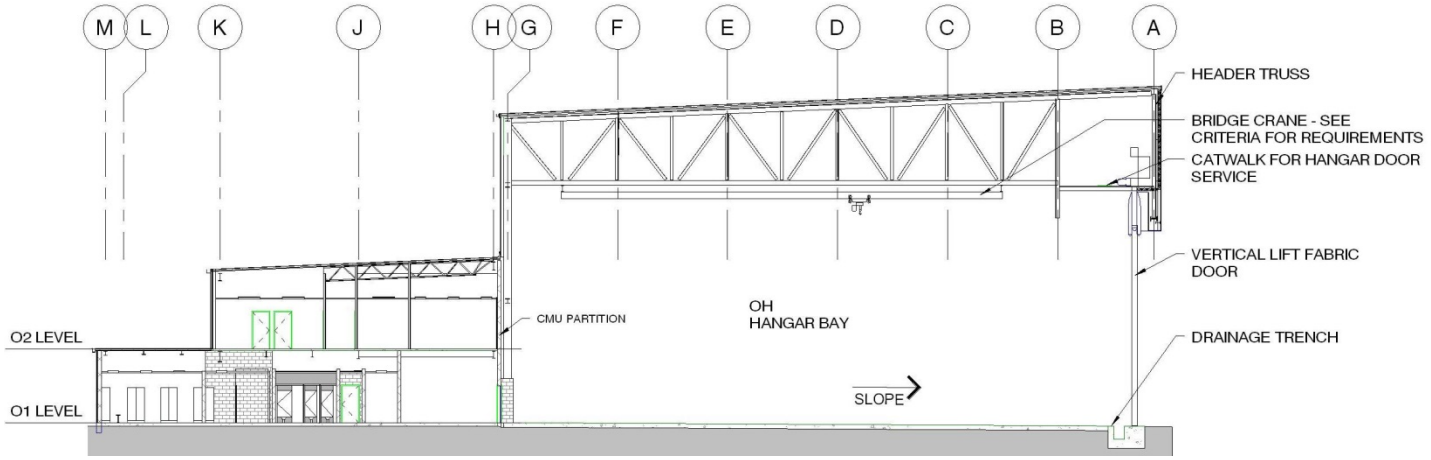


Figure 7-10: Section Showing Cantilever Truss

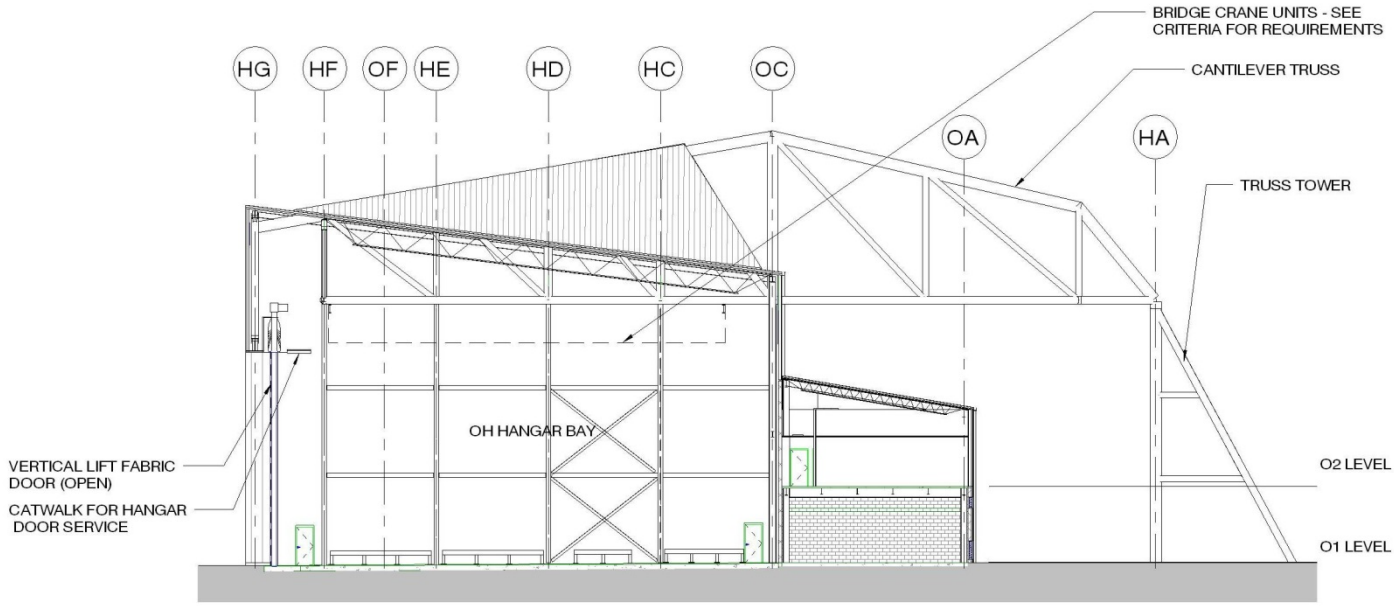
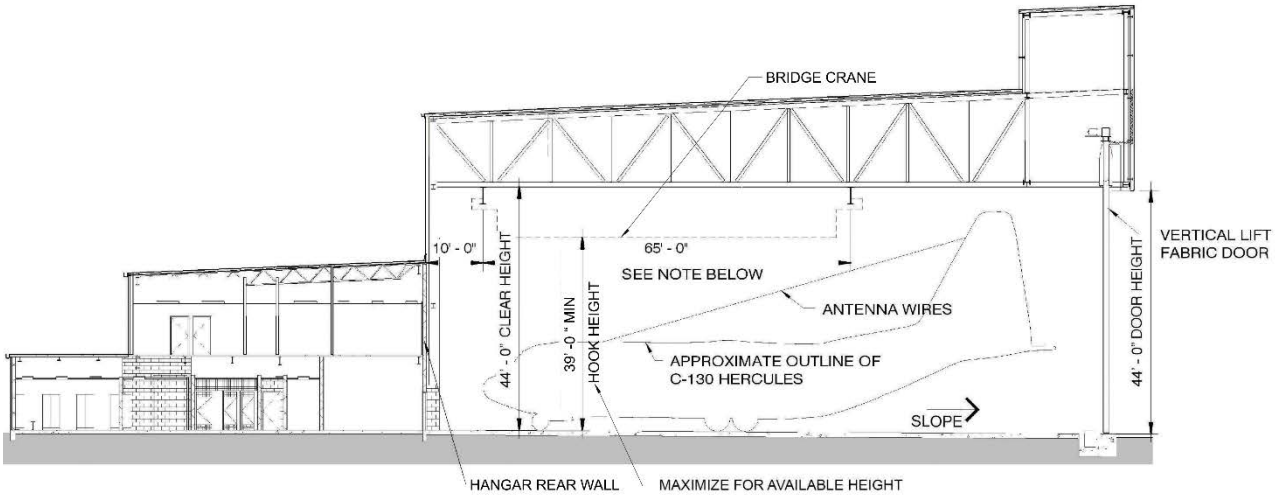


Figure 7-11: Section through Type II Hangar Crane Configuration and Vertical Clearances

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RFP PREPARER / DESIGNER MAY INCREASE SPAN OF BRIDGE CRANE AFTER DETERMINING WITH THE ACTIVITY THAT BRIDGE CRANE DOES NOT INTERFERE WITH COMPONENTS OF SPECIFIC MODEL OF C-130 EXPECTED TO BE MAINTAINED IN THE HANGAR BAY

APPENDIX A: REFERENCES

A-1 REFERENCES:

GOVERNMENT PUBLICATIONS	
1. Department of Defense (DoD)	
Washington Headquarters Service Communications and Directives Directorate http://www.whs.mil/	DoD Instruction 6055.01, *DoD Safety and Occupation Health (SOH) Program, 14 October 2015*
Military Specifications http://quicksearch.dla.mil/qsText.aspx	MIL-F-24385F, *Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater*
Unified Facilities Criteria http://www.wbdg.org	UFC 1-200-01, *DoD Building Code (General Building Requirements)* UFC 1-200-02, *High Performance and Sustainable Building Requirements* UFC 2-000-05N, *(P-80) Facility Planning Criteria for Navy/Marine Corps Shore Installations* UFC 2-100-01, *Installation Master Planning* UFC 3-101-01, *Architecture* UFC 3-110-03, *Roofing* UFC 3-120-01, *Design: Sign Standard* UFC 3-201-01, *Civil Engineering* UFC 3-220-01, *Geotechnical Engineering* UFC 3-250-01 FA, *Pavement Design for Roads, Streets, Walks, and Open Storage Areas*

GOVERNMENT PUBLICATIONS	
	UFC 3-260-01, *Airfield and Heliport Planning and Design*
	UFC 3-260-02, *Pavement Design for Airfields*
	UFC 3-260-04, *(Draft) Standard Airfield Pavement Marking Schemes*
	UFC 3-301-01 *Structural Engineering*
	UFC 3-310-04, *Seismic Design for Buildings*
	UFC 3-400-02, *Design: Engineering Weather Data*
	UFC 3-401-01, *Mechanical Engineering*
	UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*
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APPENDIX B: GLOSSARY

B-1 GLOSSARY

3M	Maintenance and Material Management
A	Amps
A/C	Alternating Current
A/E	Architects and Engineers
A/V	Audio Visual
ABA	Architectural Barriers Act
ACGIH	American Conference of Governmental Industrial Hygienists
ACH	Air Changes per Hour
ACI	American Concrete Institute
ACU	Autonomous Control Unit
AFCEC	Air Force Civil Engineer Center
AFCEC/CO	Air Force Civil Engineer Center, Operations Director
AFF	Above Finished Floor
AFFF	Aqueous film-forming foam
AFI	Air Force Instruction
AFMAN	Air Force Manual
AGE	Aerospace Ground Equipment
AHJ	Authority Having Jurisdiction
AISC	American Institute of Steel Construction
ALIS	Autonomic Logistics Information Systems
ALTHA	Armed Forces Health Longitudinal Technology Application
AMO	Assistant Maintenance Officer
ANSI	American National Standards Institute

AOA	Airport Operations Area
AR	Army Regulation
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AT/FP	Antiterrorism/ Force Protection
AVN-COS	Aviation - Center of Standardization
AWACS	Airborne Warning and Control System
AWG	American Wire Gage
AWI	Architectural Woodwork Institute
BFWS	Blade Fold Wing Stow
BHMA	Builders Hardware Manufacturers Association
BIA	Bilateral Infrastructure Agreements
C	Celsius
CAB	Combat Aviation Brigade
CAD	Cartridge Actuating Devices
CAT	Category
CATV	Cable Television
CENTRIX	Combined Enterprise Intelligence Exchange System
CCO	Combat Control Officer
CCU	Climate Control Unit
CCTV	Closed-Circuit Television
CD	Compact Disc
cd	Candela
CE	Civil Engineering
CEA	Consumer Electronics Association

cfm	Cubic Feet per minute
CFR	Code of Federal Regulations
CIENG	Capital Improvements Criteria and Programs Office
CMAA	Crane Manufacturers Association of America
CMU	Concrete Masonry Unit
cm	centimeter(s)
CNIC	Commander, Navy Installations Command
CO_2	Carbon Dioxide
CPO	Chief Petty Officers
DA	Department of the Army
DAPA	Drug and Alcohol Program Advisor
DAPAM	Department of Army Pamphlet
db	Dry Bulb
dBA	decibels A weighted Scale
DDC	Direct Digital Control
DOAS	Dedicated Outdoor Air System
DoD	Department of Defense
EISA	Energy Independence Security Act
EMCS	Energy Management Control System
ESS	Electronic Security System
ETL	Engineering Technical Letter
F	Fahrenheit
F-35	Joint Strike Fighter
FAA	Federal Aviation Administration
FAA AC	Federal Aviation Administration Advisory Circular
FACU	Fire Alarm Control Unit

fc	Foot Candle
FDS	Functional Data Sheets
FF&E	Furnishing, Fixtures, and Equipment
FM	Factory Mutual
FOD	Foreign Object Damage
FRD	Facilities Requirements Document
ft.	Feet
FW	Fixed Wing
gal	Gallon
GFCI	Government Furnished Contractor Installed
GFGI	Government Furnished Government Installed
gpm	Gallons per minute
GPS	Global Positioning System
HAZMAT	Hazardous Material
HDPE	High Density Polyethylene
HEEDS	Helicopter Emergency Egress Device
HEPA	High-Efficiency Particulate Air
HGR	Hangar
Hi-Ex	High-Expansion
HLL	Horizontal Life line
HNFA	Host Nation Funded Construction
HQ	Headquarters
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HSS	Hollow Structural Sections
HVAC	Heating, Ventilation and Air Conditioning
HVLS	High Volume, Low Speed

Hz	Hertz
IAW	In Accordance With
IBC	International Building Code
ICS	Intelligence Community Standard
IDS	Intrusion Detection System
IDWS	Interim Defensive Weapon System
ILBP	In-Line Balanced Pressure
IMIS	Integrated Maintenance Information System
IMRL	Individual Material Readiness List
in	inches
IR	Infrared
IT	Information Technology
J&A	Justification and Authorization
JWICS	Joint Worldwide Intelligence Communications System
kPA	kiloPascals
kVA	kilovolt-amperes
L	Liters
LAN	Local Area Network
lbs.	Pounds
LED	Light Emitting Diode
LEL	Lower Explosive Limit
LF	Logistics Facilities
LMS	Logistics Maintenance System
L/min	Liters Per minute
MAJCOM	Major Command
MATS	Military Air Transport Service

m	meter(s)
max	maximum
MCS	Mission Control System
MEDEVAC	Medical Evacuation
MEP	Mechanical, Electrical, Plumbing
mg	milligram
MILCON	Military Construction
min	minimum or minute
mm	millimeter(s)
MO	Maintenance Officer
MPa	Megapascal
MRSI	MILCON Requirements and Standardization Integration
NAC	Notification Appliance Circuit
NALCOMIS	Naval Aviation Logistics Command Management Information System
NATO	North Atlantic Treaty Organization
NAVAIR	Naval Air Systems Command
NAVFAC	Naval Facilities Engineering Command
NDI	Non-destructive Inspection
NEMA	National Electrical Manufacturers Association
NEW	Net Explosive Weight
NFPA	National Fire Protection Agency
NIBS	National Institute of Building Sciences
NIOSH	National Institute of Occupational Safety and Health
NMCI	Navy Marine Corp Intranet
NRC	Noise Reduction Coefficient
NRTL	Nationally Recognized Testing Laboratory

NVG	Night Vision Goggles
O&M	Operations and Maintenance
OFD	Optical Flame Detectors
OH	Organizational Hangar
OIC	Officer in Charge
OPSNAVINST	Office of the Chief of Naval Operations Instructions and Notices
OSHA	Occupational Safety and Health Administration
OS&Y	Outside stem & yoke (a type of plumbing gate valve)
PA	Public Address
PCA	Preconditioned Air
PDS	Protective Distribution System
PEMA	Portable Electronic Maintenance Aid
PFAS	Personal Fall Arrest System
PID	Photoionization Detector
ppm	Parts per million
psi/psig	pounds per square inch
PTZ	Pan, Tilt, Zoom
PV	Photovoltaic
PVC	Polyvinyl Chloride
QFPE	Qualified Fire Protection Engineer
QPL	Qualified Products List
RF	Radio Frequency
RFP	Request for Proposal
RGR	Rapid Ground Refueling
RHR	Rigid Horizontal Rail
RMF	Risk Management Framework

RMWS Ramp Mounted Weapon System

RPA Remote Piloted Aircraft

RPIE Real Property Installed Equipment

RSFACU Releasing Service Fire Alarm Control Unit

RSL Ready Service Locker

RW Rotary Wing

SAA Sound Absorption Average

SAP Special Access Program

SAPF Special Access Program Facility

\2\ SCFM Standard cubic feet per minute of air at standard pressure and temperature which is 14.5 psia, 68˚F and 0% relative humidity/2/

SCI Sensitive Compartmented Information

SCIF Sensitive Compartmented Information Facility

SDI Steel Door Institute

SE Service Equipment

sec Second

SF Square Footage

SGHAT Solar Glare Hazard Analysis Tool

SHW Solar Hot Water

SIPRNet Secret Internet Protocol Network

SOFA Status of Forces Agreements

SOH Safety and Occupation Health

SPD Surge Protection Device

sq. Square

SRL Self-Retracting Lanyards

STC Sound Transmission Coefficient

TBD	To Be Determined
TDA	Table of Distribution and Allowance
TM	Technical Manual
TOE	Table of Organization and Equipment
TRS	Transparency Removal System
TSC	Transportation Systems Center
UAR	Utility, Attack and Reconnaissance
UAS	Unmanned Aircraft Systems
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specifications
UL	Underwriters Laboratory
ULLS-A	Unit Level Logistics System - Aviation
UPS	Uninterrupted Power Supply
US	United States
USA	United States of America
USACE	United States Army Corp of Engineers
USAF	United States Air Force
USMC	United States Marine Corp
UTP	Unshielded Twisted Pair
UV	Ultra-Violet
V	Volt
VAC	Volt Alternating Current
VDC	Volts Direct Current
VLFD	Vertical Lift Fabric Door
VTC	Video Teleconference
WAP	Wireless Access Point

WBS	Work Breakdown Structure
WBDG	Whole Building Design Guide (www.wbdg.org)
XO	Executive Officer

APPENDIX C: BEST PRACTICES

C-1 GENERAL

Best practices in Aircraft Maintenance Hangar design are contained in this appendix. Design all Aircraft Maintenance Hangars to meet all applicable requirements found in the following:

- UFC 1-200-01, *DoD Building Code (General Building Requirements)*;
- UFC 4-010-01, *DoD Minimum Antiterrorism Standard for Buildings;*
- UFC 3-600-01, *Fire Protection Engineering for Facilities*, supplemented by Chapter 3 of this UFC. NFPA 101; and NFPA 409.

C-1.1 Antiterrorism/Force Protection (AT/FP)

Incorporate AT/FP issues at the initial phase of the design. Formulate the basis for design on UFC 4-010-01. Coordinate all protection features with the current standards and any additional requirements in place at the time of the design. Ascertain the exact requirements for protection based on a site-specific survey, or lacking one, provide the minimum protection standards outlined in the standards. Coordinate all AT/FP issues with the base that may be a part of another project or impact adjacent facilities such as security fencing, parking.

C-1.2 Sustainable Design

In accordance with UFC 1-200-02, *High Performance and Sustainable Building Requirements*, implement an integrated design process at the initial phase of design to reduce environmental impacts, lower energy and operating costs, optimize performance and conserve water, while increasing occupant satisfaction and productivity through improved health and well-being. While certain design strategies are specifically based on varying climatic, site, mission, program and budget requirements, employ an overall approach with focus on sustainable site development, water savings, energy efficiency, resource selection and indoor environmental quality. The best practices below provide a general example of potential strategies, but are not intended to represent a comprehensive list of sustainable design opportunities.

- Incorporate passive energy conservation measures by evaluating optimal site orientation.
- Shape and size the building footprint within close tolerances of the aircraft; finely tuned to the operation taking place. Smaller buildings and support systems translate to direct first cost savings and reduced operating costs of mechanical, electrical and fire protection systems.
- Hangar roofs generally provide large expanses that can be designed and oriented to maximize the efficiency of renewable energy systems, such as solar collection.

- Highly reflective roof surfaces can reduce the heat island effect and decrease solar heat gain to the building interior.
- Use whole building energy simulation and life cycle cost analysis to evaluate high performance building envelope, mechanical and electrical systems.
- Integrate automated controls with high-bay lighting, such as zoned photometric sensors.
- Reflective (white or light colored) interior finishes help reduce the amount of required lighting while ensuring direction to the work zone, instead of absorption by walls and ceilings.
- Air compressor designs to include water cooled equipment strategically located to provide the rejected heat for space heating, domestic hot water pre-heating and tie into building heating systems.
- Solar air preheat for hangar bay area and combination preheating domestic hot water.

C-2 CIVIL

C-2.1 Appearance

Locate HVAC equipment, meters, poles, transformers, vaults, pressure reducing station piping and valving, and other utility items so that they do not detract from the building's appearance. Design should also reduce the negative visual impact of utility items and communication lines.

C-2.2 Energy Concerns

Consider the effect of local sun angles and wind conditions on the hangar.

C-2.3 Winds

In harsh climates, seacoasts and areas of consistently high or changing winds, design hangar entry points (hangar bay, personnel entrance and windows, intake and exhaust vents) to compensate for these adverse conditions, including snow. Consider prevailing and seasonal wind conditions as well.

C-2.4 Security Fencing

Limit the use of fencing to enclose and separate areas within the vicinity of the hangar to those conditions requiring security or the protection of life, separation of a construction site from operational facilities, isolation of a hazardous area, or as stipulated by the Base Security Department.

C-2.5 Landscape Planting

Make use of low maintenance landscape plants that are indigenous to the area. Existing mature trees and vegetation should be retained whenever practical. Landscape design should avoid planting next to the hangar that would permit concealment in accordance with criteria set forth in the Unified Facilities criteria for AT/FP. As hangars are generally in industrial areas, limit landscaping to entrances and other public areas.

C-2.6 Utilities

Consider utilities that are essential to efficient operation and design of adequate size to serve future requirements in the early planning stages. Specifically address the adequacy of existing utilities support and include any additional needs. Plan utility lines to minimize utility easements, capital investments, and maintenance and repair costs.

C-2.7 Underground Lines

Locate underground utilities to minimize the cost and effort of performing maintenance. Do not locate utility lines of any type under hangars except for those portions serving the hangar. Minimize utility lines running under parking lots, sidewalks, and other paved surfaces to minimize cost for maintenance of the systems. Locate all underground utility lines, mains, and conduits at the minimum depth required in accordance with local code, frost line and water table requirements, and, when possible, in common corridors to allow for ready access and maintenance. Locate utilities to allow for future expansion of the flightline.

C-2.8 Storm Drainage

The building up of undeveloped areas may have a noticeable effect on installation drainage facilities; design alterations or extensions to storm sewers and drainage channels as required because of the location and design of new facilities.

C-3 ARCHITECTURAL

C-3.1 Aircraft Maintenance Bay and Maintenance Shop Floor Finishes

C-3.1.1 Performance Requirements

Military maintenance hangars are active workspaces and can be especially abusive environments. An aircraft maintenance bay floor finish must be evaluated on a number of performance characteristics.

- Proper Installation
- Chemical Resistance
- Impact Resistance
- Abrasion Resistance
- Reflectivity

- Slip Resistance
- Ease of Maintenance
- Replacement Timeline
- Life Cycle Cost

C-3.1.1.1 Proper Installation

Coordinate floor finishes with the concrete design. For example UFGS Section 09 67 23.15 and UFGS Section 09 67 23.16 suggest a number of items for the concrete designer to consider, such as types of admixtures, curing strategies, and below slab vapor barriers to keep an epoxy finish from delaminating due to moisture emissivity levels in the concrete. Refer to Figure 3-4: Typical Aircraft Maintenance Bay Slab on Ground Cross-Section for guidance on location of the vapor barrier in the Aircraft Maintenance Bay. Refer also to C-4.2.1: Floor Coatings and Vapor Retarder/Barrier.

C-3.1.1.2 Chemical Resistance

Protect the floor from deterioration from harsh chemicals and solvents commonly used in aircraft maintenance including jet fuel and Skydrol® fire resistant hydraulic fluids. Concrete is porous and can easily be contaminated by spills. Dry shake floor hardeners and polished floors increase resistance to absorption of chemicals, but true protection requires a barrier. Consider Ultra-Violet (UV) resistance in hot climates that have high levels of UV radiation.

C-3.1.1.3 Impact Resistance

Protect concrete from damage from dropped tools and parts. The urethane topcoats of an epoxy system are less brittle and are more resistant to impact and abrasion wear than hardeners or polishing. 5-coat epoxy is more resistant to chipping.

C-3.1.1.4 Abrasion Resistance

An abrasion resistant floor finish will protect concrete from damage incurred by carts, stands and heavy wheels of aircraft and tugs. Sand and dirt left on the floor can become an abrasive and dull the shine of many finishes.

C-3.1.1.5 Reflectivity

Reflectivity improves lighting conditions for maintenance operations under the fuselage or wings and reduces the amount of lighting fixtures required. Provide translucent windows to diffuse the natural light coming into a space with a reflective floor.

C-3.1.1.6 Slip Resistance

Provide a floor finish with an acceptable coefficient of friction to protect maintenance staff from slip and fall conditions.

C-3.1.1.7 Ease of Maintenance

Provide an easily cleaned floor finish to allow small parts and FOD to be easily discovered. Provide a floor finish requiring low maintenance cost and low maintenance effort for users.

C-3.1.1.8 Replacement Timeline

Provide a floor finish requiring fewer replacements over the life of the building.

C-3.1.1.9 Life Cycle Cost

Provide the finish most appropriate for the users' requirements at the lowest life cycle cost.

C-3.1.2 Floor Finish Options

There are a number of floor finishes commonly used in aircraft maintenance bays. The 3-coat system is most common, but has an ongoing problem with low tolerance to moisture emissivity in the slab. There are two floor finish options if the 3-coat system is considered unacceptable and unreliable. You can use a non-coating system which may cost less but provide significantly less protection than a coating system. The other option is to provide the 5-coat system which has high performance ratings, but high initial costs. However, the 5-coat system outperforms the 3-coat system in life cycle cost analyses due to requiring fewer replacements over the life of the building.

- Sealed concrete
- Polished concrete
- Dry shake-on hardener
- 3-coat epoxy systems
- 5-coat epoxy systems

C-3.1.2.1 Sealed Concrete

Concrete sealers are applied to concrete to protect it from surface damage, corrosion, and staining. They either block the pores in the concrete to reduce absorption of water and salts or form an impermeable layer which prevents such materials from passing. This is basically the lowest initial cost solution but it provides almost no protection for the concrete with regard to chemical and impact resistance. Performance:

- No issues in bonding to concrete as are associated with coatings
- No chemical resistance
- Low impact resistance
- Abrasion resistance of the concrete finish is not changed
- Reflectivity of the concrete finish is not changed
- Slip resistance of concrete finish is not changed

- Cleanability depends on the texture of the concrete
- Low maintenance
- Needs to be resealed every couple of years
- Least expensive initial cost and least expensive life cycle cost

C-3.1.2.2 Polished Concrete

Polished concrete is a high-gloss finish attained by using special floor polishers fitted with diamond-impregnated abrasive disks (similar to sandpaper) to grind down surfaces to the desired degree of shine and smoothness. The resulting surface is relatively low cost and low-maintenance but only provides slightly better performance than the sealed concrete. Performance:

- No issues in bonding to concrete as are associated with coatings
- Relatively low chemical resistance. Any non-neutral PH chemical that is highly acidic or alkaline will deteriorate the finish and concrete.
- Relatively low impact resistance
- Relatively low abrasion resistance
- Shiny, but is typically a mottled dark color
- Available in smooth and slip resistant finishes
- Easily cleaned - sweep regularly and scrub weekly. However, spills will absorb into the concrete and stain the floor.
- Only needs to be refinished once every five to ten years
- Relatively inexpensive initial cost and life cycle cost

C-3.1.2.3 Dry Shake-on Hardener

Mineral and metallic dry shake hardeners are hand spread and power-trowelled into the wet concrete to provide additional abrasion resistance for high wear industrial concrete floors. Performance:

- No issues in bonding to concrete as are associated with coatings. Inconsistent color is typical due to uneven spreading and uneven trowelling.
- Low chemical resistance
- Relatively high impact resistance
- Relatively high abrasion resistance
- Relatively high reflectivity, depending on color of dry shake
- Slip resistance of concrete finish is not changed
- Low maintenance - sweep regularly and scrub weekly

- Relatively inexpensive initial cost and life cycle cost

C-3.1.2.4 Fuel-Resistant Resinous Flooring, 3-coat Systems

Commonly known as a thin-film flooring system, this coating system has had delamination problems in the past due to its intolerance to moisture emissivity in concrete slabs. Current moisture vapor emissivity test requirements by the manufacturers as well as the UFGS spec have minimized the installation of this system on slabs where moisture rates are likely to cause delamination. Most manufacturers can provide a moisture vapor barrier coating to reduce the emissivity to acceptable levels. A 3-coat system typically consists of 2 layers of epoxy with a urethane topcoat. Performance:

- It is difficult to attain a concrete moisture vapor emissivity rate below the maximum 3lbs./1000SF/24-hours required by the UFGS spec, and the manufacturer. Include the manufacturer's moisture vapor barrier coating with a requirement to deduct the associated cost if the concrete moisture tests determine this coating is not necessary.
- High chemical resistance
- Relatively high impact resistance. Finishes may chip and peel and are a costly continuous maintenance concern. Exposed concrete where epoxy coatings have chipped/flaked away absorb fluids deteriorating the concrete and complicating future re-coating
- Abrasion resistance based on level of grit applied
- High reflectivity
- Slip resistance based on level of grit applied. There is a fine line between slippery and hard to clean.
- Low maintenance - sweep regularly and scrub weekly. Higher grit levels make cleaning more difficult.
- Needs to be re-coated every 3-5 years
- Relatively expensive initial cost, especially if moisture vapor barrier is required. Highest life cycle cost due to the requirement to recoat more frequently than the 5-coat system over the life of the building.

C-3.1.2.5 Fuel-Resistant Resinous Flooring, 5-coat Systems

This has an epoxy primer, a 1/4" to 3/8" trowelled on epoxy grout coat followed by 2 layers of epoxy and urethane top coat. Basically, the top 3 coats are the 3-coat system bonded to a thick grout layer. Performance:

- Fewer issues in bonding to concrete than 3-coat system due to epoxy grout layer Specs require a maximum 4.5lbs./1000SF/24-hours moisture vapor emissivity rate which is relatively easier to attain than the 3lb rate of the 3-coat system. However, it is still a good idea to include the

manufacturer's moisture vapor barrier coating with a requirement to deduct the associated cost if the concrete moisture tests determine this coating is not necessary.

- High chemical resistance
- High impact resistance due to epoxy grout layer
- Abrasion resistance based on level of grit applied
- High reflectivity
- Slip resistance based on level of grit applied. There is a fine line between slippery and hard to clean.
- Low maintenance - sweep regularly and scrub weekly. Higher grit levels make cleaning more difficult.
- Needs to be patched and a new top coat applied every 8-10 years
- Most expensive initial cost, but lower life cycle cost than a 3-coat system due to a less frequent re-coating schedule than the 3-coat system over the life of the building.

C-3.1.3 Life Cycle Cost Analysis

Sealed concrete, polished concrete and dry shake-on hardeners are lower in cost than the coating systems, but have significant reduced capabilities to protect the concrete from the harsh environment of a military aircraft maintenance hangar. Life Cycle Cost Analysis (LCCA) of the coating systems show the 3-coat system is less expensive initially, but requires recoating more often than the 5-coat system, and therefore, has a higher life cycle cost. The 5-coat system is tolerant of higher moisture vapor emissivity rates and is less likely to require a moisture vapor barrier coating.

C-3.2 Considerations for Large Aircraft Maintenance Bays

Consider the following issues when designing an Aircraft Maintenance Hangar for large aircraft.

- Hangars designed for smaller aircraft, or hangars requiring large areas of crane coverage have a relatively consistent clear height requirement throughout the Aircraft Maintenance Bay and will usually have very low sloped roofs. Large aircraft with tall tails and limited if any crane coverage area may require significantly less clear vertical height at the nose than at the tail. The roofs often slope down from the tail to the nose reducing exterior envelope surface area and material quantities and structural steel quantities. This also reduces the volume inside the bay, an advantage in areas where the bays are conditioned. This is depicted in Figure 2-4: Vertical Hangar Clearances with Sloped Roofs.
- Large Aircraft Maintenance Bays may have significant space between the wings and the backwall or between the nose of the aircraft and the sidewall. Designers have successfully solved reducing the excess space

in a number of ways. One solution is to shape the building closer to the shape of the clear area requirements of the design aircraft by cutting the outside corners of the Aircraft Maintenance Bay as is allowed by paragraph 2-3: Minimum Aircraft Maintenance Bay Clearances and as depicted by Figure 2-2: Alternate Corner Configuration. This concept is not intended to reduce hangar bay square footage. Total square footage of hangar bay should remain as programmed and redistributed to length or width of bay. This concept is only allowed on end bay of multi-bay hangar. This concept limits hangar expansion options on endwall. This concept may limit "dense packing" options of hangar for additional aircraft if need arises.

- Another common solution involves building the Aircraft Maintenance Bays rectangular but making some other use of the excess area in front of the wings of large aircraft as depicted in Figure C7-1: Considerations for Aircraft Maintenance Bays for Large Aircraft. Obstructions are allowed in front of the wings by Figure 2-2: Alternate Corner Configuration. Confirm all operational clearances in the area before introducing obstructions. Clearance may be required in front of the engine to maneuver a portable crane to remove engines. Allow for alternate aircraft layouts that could be used in the future such as tail-in parking. If future flexibility is a guiding concern, consider less permanent construction in this area. Avoid locating elevators, utility rooms, restrooms or showers in the high bay area. Storage and offices may be more appropriate.
- Figure C-2: Considerations for Aircraft Maintenance Bays for Large Aircraft presents a solution to reduce the depth of the expensive high bay portion of the Aircraft Maintenance Bay and let the nose of the fuselage extend into lower cost conventionally framed nose docks. Again, as with any solution that introduces obstructions in the area in front of the wings, operational clearance requirements are likely to govern over the clearances required in this UFC.
- Allow a path for the tug to get back to the air-side of the hangar. Large hangars often require a rolling service door for the tug to exit the hangar as it pulls an aircraft into a nose-in configuration. In this case do not block the area in front of the aircraft with the lean-to.
- Consider minimizing the Aircraft Maintenance Bay height by providing a taller hangar door in the center of the building to allow the tail in and out of the bay but lower doors over the wings.
- Consider adding rolling service doors on the sidewalls to allow deliveries in front of the aircraft wings and behind the aircraft wings without opening the hangar door.

Figure C-12: Considerations for Aircraft Maintenance Bays for Large Aircraftces

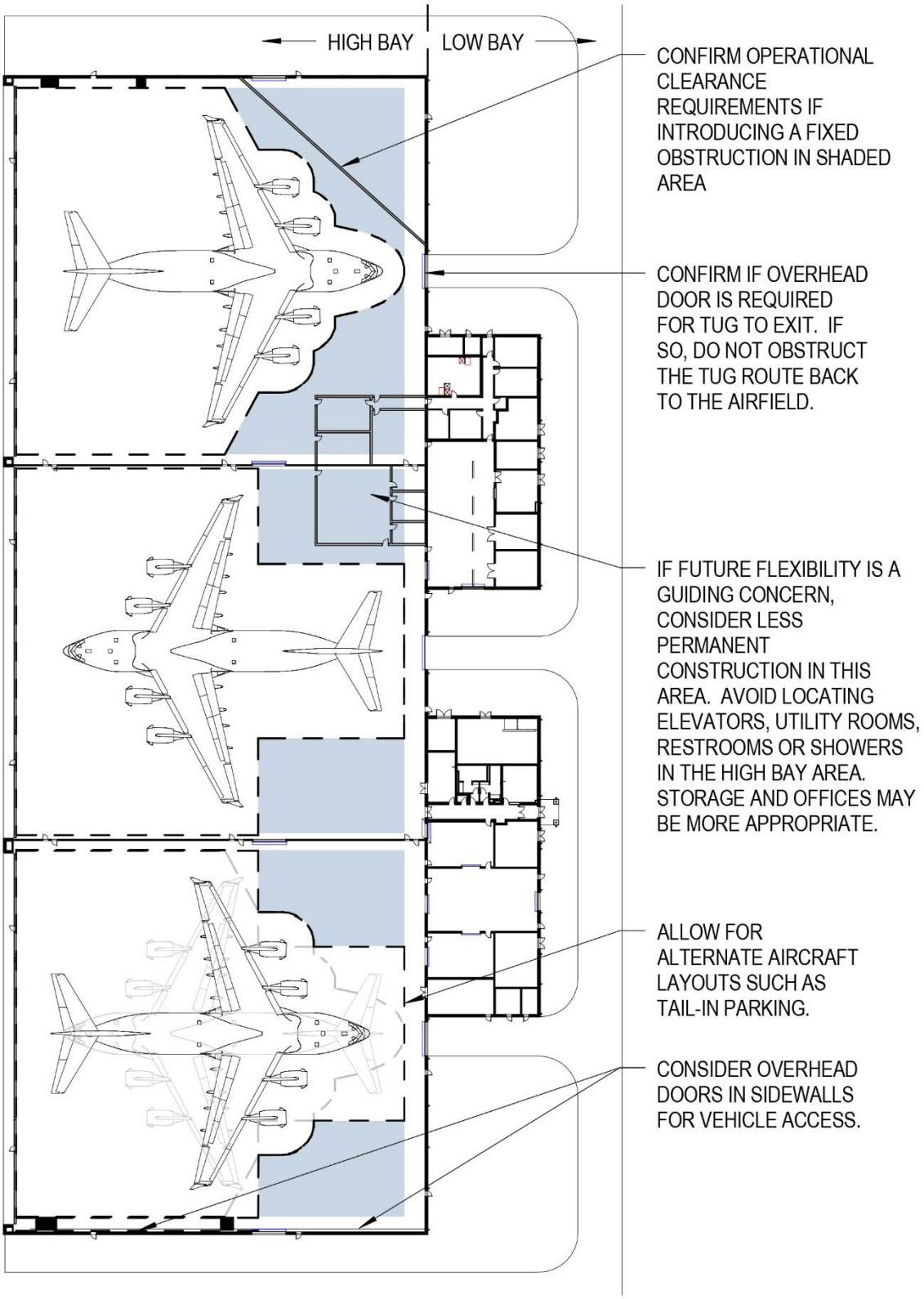
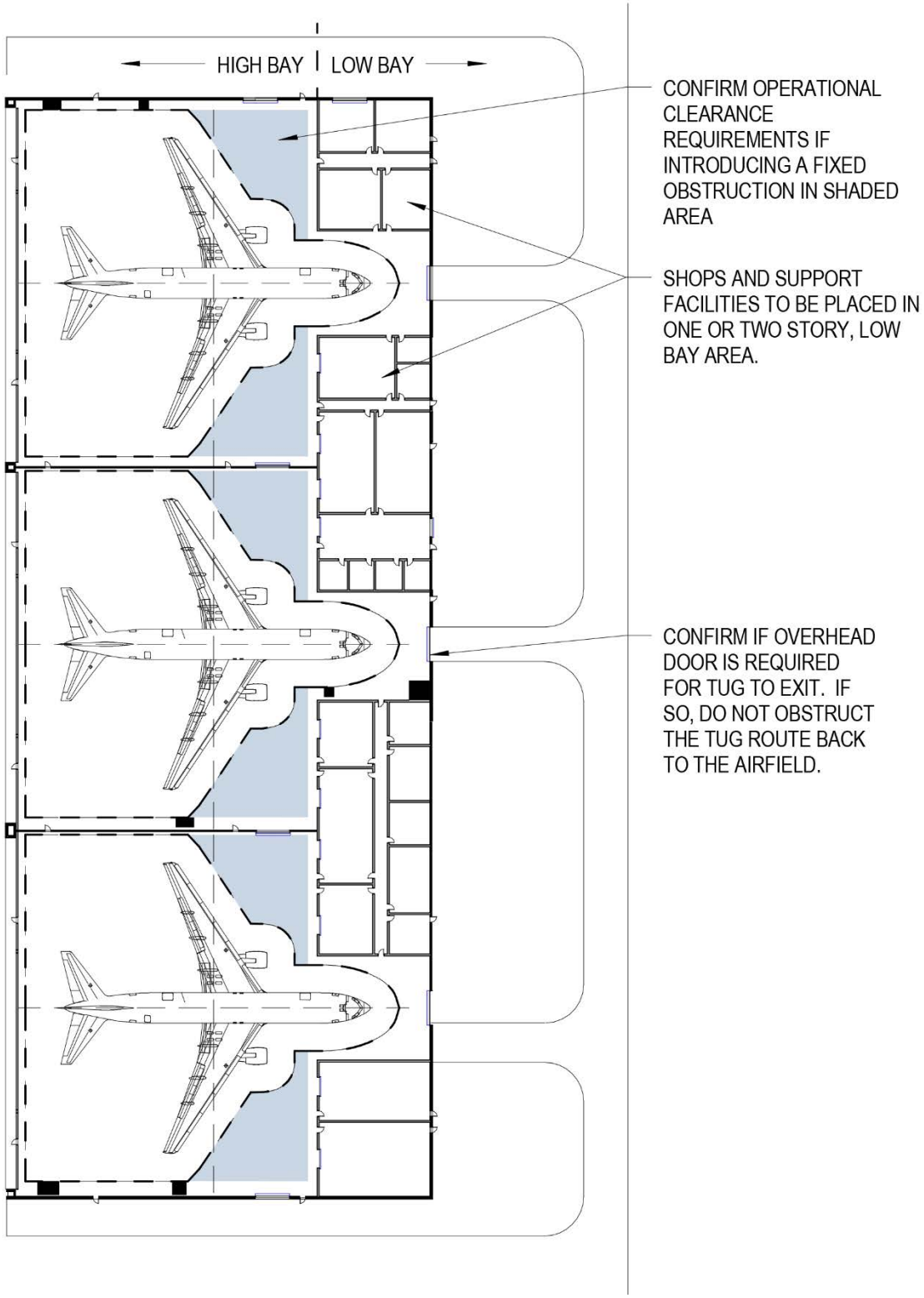


Figure C-12: Considerations for Aircraft Maintenance Bays for Large Aircraft



C-3.3 Interior Design - Furniture and Equipment

Furniture, Fixtures and Equipment (FF&E) should be "heavy duty" for shop spaces. Verify FF&E to be furnished by user (not MILCON funded)." In addition, shops must be easily reconfigurable by the users, so avoid the use of systems/panel furniture. Utilize a freestanding desking systems for ease of configuration.

Office equipment such as printers, copiers, and fax machines are typically user-provided equipment. However, these items should be located on furnishings plans and coordination of supporting building systems such as power, data, and comm should be included. Provide flush recessed floor power/data outlets as required by furnishings layouts. Avoid or limit the use of power poles.

C-3.4 Acoustics

C-3.4.1 Exterior Envelope

Acoustics around operational airfields pose significant questions about what to provide in the way of acoustical enhancements on a hangar. The type of aircraft and the projects proximity to the runways play a significant role in what might be expected on the envelope of the project. At jet bases or other locations employing aircraft with extremely high noise levels, it is important to consult with an acoustical consultant to determine proper noise reduction requirements within various areas of the hangar. The designer should carefully investigate the implications of providing specific acoustical requirements for the envelope of the facility. In Design Build projects it is the responsibility of the RFP preparer to determine the requirements and provide adequate data to allow the Design-Build Contractor to adequately determine the cost for any acoustical requirements.

C-3.4.2 Interior

Interior acoustical requirements should be limited to what is specifically needed by the functional requirements. Do not specify special acoustical requirements if there is not an operational or functional reason to do so. Most shop spaces do not have high noise level equipment so it is not necessary to provide ratings in excess of what will be provided by the standard partition recommended in the UFC. Office and other similar type of administrative spaces should comply with commercial standards for similar type of spaces.

Some military projects specify Noise Reduction Coefficient (NRC) to provide requirements for sound absorption/reflectance in rooms such as tele video conference rooms. NRC is being replaced by the Sound Absorption Average (SAA), which is described in the current ASTM C423-09a.

C-3.5 Bird Intrusion Prevention

Birds entering various openings within aircraft maintenance bay, roost in the available flat areas of the superstructure. Accumulation of droppings, feathers, and other matter pose a big problem. Bird droppings, accumulating on the aluminum skin of airplanes,

can corrode the metal and eventually weaken the structure itself. Another concern is that if droppings, feathers, and other matter get into the engines, clean critically important parts as they could stall an engine during flight. Another concern is the constant maintenance of the hangar floor and other surfaces due to bird inhabitants.

Bird-proofing methods vary from scaring devices, repellents such as screening mists and sonic systems and full netting systems.

C-3.5.1 Scaring Devices

An inexpensive way to try and bird proof facilities is through the use of visual deterrents. Iridescent reflective foil or flash tape can be easily strung around the superstructure and turned into pennants. Inflatable balloons and stuffed bird predators are another economical visual scare device. Their lifelike reflective predator eyes and markings drive birds away by creating an "Optical Distraction Zone." Although inexpensive these devices are usually a short term solution to the issue. The birds get use the scaring devices and eventually ignore them.

A more proactive approach to scaring birds is to employ a falconer to the facility periodically to drive the birds away. This could be fairly expensive and is a recurring cost for the facility.

C-3.5.2 Repellent Devices

C-3.5.2.1 Misting Systems

Bird-misting systems are ideal for both humane and effective bird control. These bird proofing systems work by releasing an ultra-fine mist that pest birds can't see and prefer not to be around. The mist typically employs a chemical called methyl anthranilate, a grape extract that naturally occurs in concord grapes. The extract has been widely used for decades to deter a wide variety of pest birds including, sparrows, pigeons, starlings, crows, blackbirds and geese. Yet it's safe for people, pets, plants and birds. The system requires refilling and maintenance and too much misting can lead to residue on the facility. Too little misting and you are not controlling the issue.

C-3.5.2.2 Electric Track

Another useful bird proofing repellent method is the electric-track bird repeller. Ideal for ledges, rooftops, and flat or curved surfaces, these low-profile electrified tracks deliver a non-lethal electric shock that discourages birds from landing or feeding. Some manufacturers offer a flow-through design to keep water from damming up on rooftops and other surfaces. These systems require maintenance and a constant electric source. It is difficult to install this system on all surfaces of the superstructure birds would use for nesting.

C-3.5.2.3 Bird Slope

A bird slope is a simple solution ideal for many government buildings. Suitable for eaves, ledges, beams and other 90-degree areas where pest birds tend to nest and

roost, the angled, slippery PVC panels cause pest birds to simply slide off when they try to land. For an even easier-to-install solution, there's bird gel. Birds hate this stuff because it creates a sticky surface that birds find very annoying to land in. It's safe for birds (except swallows) and a great way to keep birds from landing on ledges, I-beams, parapet walls, conduit, pipes, and most flat or curved surfaces. It is difficult to install this system on all surfaces of the superstructure birds would use for nesting.

C-3.5.2.4 Bird Spikes

A repellent method of bird spikes can be found on many military facilities. Bird spikes are ideal for pigeons and other large birds. Some bird spikes are made of strong, rigid unbreakable polycarbonate, others have stainless steel spikes. A cousin to the bird spike is the bird spider. The spider arms wave with the breeze, keeping wild birds from landing. Most come in a variety of diameters and install easily. And although they appear menacing, spikes and spiders won't harm birds. Once installed these systems require little maintenance besides fixing areas birds have found to next. It is difficult to install this system on all surfaces of the superstructure birds would use for nesting.

C-3.5.3 Net Systems

To bird proof large areas such as the aircraft maintenance bay, bird netting creates an impenetrable barrier for most birds. Some heavy-duty bird netting is made of polyethylene fabric and is UV stabilized, flame resistant and rot and waterproof. Netting comes in various mesh sizes to deter a wide range of birds. To seal out small openings, there's copper mesh cloth. Available in rolls, it's easily stuffed into cracks or holes to let air circulate but keep birds out. The system is quite noticeable in the aircraft maintenance bay even if it is painted to match the superstructure. The net needs to be located to not interfere with utilities such as fire protection, lighting and crane travel.

The net systems work well once they are installed and all the bird openings are secured. These systems require monitoring to see if and where birds are getting through the netting and getting them out. The netting may become an issue with maintaining equipment located above the netting. Place the outlet of the high-expansion foam fire protection system below the netting because the netting tends to disrupt the foam flow.

C-4 STRUCTURAL

C-4.1 Foundations

C-4.1.1 Geotechnical Investigations

It is recommended that a thorough geotechnical investigation be performed for aircraft maintenance hangars. The large column free hangar space results in highly concentrated foundation loads in remote portions of the building footprint. Areas of particular concern include towers or columns supporting long span trusses, cross-braced bays along the perimeter of the building, towers supporting cantilevered roof trusses and the tension anchorages for such trusses. The geotechnical investigation should pay particular care to these points of load concentration.

C-4.2 Floors

Ground floors are typically slabs on ground. In some circumstances with particularly poor geotechnical properties and schedules which do not allow for remediation, pile supported slabs may be desirable. It is typical for the main structural frame to be built on deep foundations while the ground floor slabs are soil supported. In this circumstance, differential settlement is a potential risk to the serviceability of the facility. The designer may consider careful detailing between the floor slabs and the surrounding structure or, in the most severe circumstances, pile supporting the floor slab.

C-4.2.1 Floor Coatings and Vapor Retarder/Barrier

Floor coatings are moisture sensitive materials and care must be taken in construction of the concrete slab. In the Aircraft Maintenance Bay, install the vapor retarder/barrier as shown in Figure 3-4: Typical Aircraft Maintenance Bay Slab on Ground Cross-Section.

For all other slabs on ground use ACI 302.2R-06 *Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials*. In general, the flow chart in Figure 7-1: Aircraft Maintenance Bay Striping Requirements of ACI 302.2R will be followed to ascertain the location of the vapor Barrier/Retarder relative to the concrete slab and subgrade materials. If the questions asked in the flow chart can't be answered at the time of design, then it is suggested that Figure 3-4: Typical Aircraft Maintenance Bay Slab on Ground Cross-Section be used for locating the vapor retarder/barrier under the slab.

C-4.3 Superstructure

Single points of failure are undesirable in any facility but are historically common in long span-steel structures. A single connection or member failure can result in catastrophic collapse or failure of a large portion of the facility. Investigate secondary or back up load paths for single points of failure and provide them where practical. If secondary or back up load paths can't practically be provided, then thoroughly design and review these single points of failure.

C-4.3.1 Static Determinacy

While the structural engineer is typically advised to avoid interfering with the means and methods of the construction professionals, he should have an understanding of the consequences that accompany any chosen erection method. The design documents should indicate if and when the structure is statically indeterminate. The designer of record should consider the effect which various erection approaches may have on the loads in an indeterminate structure and the documents must clearly indicate any restrictions required on the erection to ensure a safe, serviceable building.

C-4.3.2 Construction and Erection

Hangar construction involves the creation of a long-span, column-free space. These requirements complicate the erection of the building and make the steel erection contractor a much more important partner in the process than is typical of most

government construction. Two general approaches are applicable to the erection of large hangar bays, ground assembly with heavy lift and aerial assembly with shoring towers.

C-4.3.2.1 Ground Assembly with Heavy Lift

While not unique to hangars, lifts of pre-positioned, pre-assembled hardware weighing 30 to 50 tons (27,000 to 45,000 kg) are uncommon in most construction but typical of hangar construction. Ground construction is typically the most common means selected by contractors. Large cribbing is set immediately adjacent to the lift location and leveled. Shims are set to adjust for elevation differences and to establish the proper camber. The structural element is then constructed on top of the cribbing. Once completed, the entire element is lifted into place and the final support connections made. Fabricating on the ground allows for enhanced safety for the bulk of the work as well as greater control of quality and ease of access for inspectors. The drawbacks of the approach include the cost associated with mobilizing a crane or cranes that can lift the assembly. Tight quality control is essential to ensure that the final fit is made.

Some issues for the designer to be aware of include: The rigging and lift may impose loads on a structural assembly that were not anticipated by the designer. Even if the assembly is not damaged by the lift, it may undergo unexpected deformations that may then be locked into the final structure once the last connections are made. The heavy lift may place the large, overhead elements into place prior to the remainder of the facility's framing being completed. This is often a physical requirement given the necessity of getting equipment adjacent to the lift operations. The designer should give some consideration early in the design as to the lateral stability of the building components that support the major roof elements.

C-4.3.2.2 Aerial Assembly with Shoring Towers

This approach is becoming increasingly uncommon with the general availability of large cranes and the increased emphasis on avoiding fall injuries on the work site. The approach involves the fabrication of temporary towers to support the piece-by-piece fabrication of the major components in their final place. The temporary shoring tower’s location will determine the actual deflected shape of the structure resulting from the dead load of the structural steel only.

The advantage of aerial assembly is that it avoids the necessity of having a large capacity crane and fabrication errors may be discovered and corrected without postponing a single milestone-lifting event. The disadvantage of the aerial assembly is the loss of productivity and potential for accidents related to high work. This approach also introduces the risk that unexpected loads may be introduced in the structural framing system by poorly designed shoring towers or long term settlement of the shoring towers. Additionally, the manner in which the temporary towers are removed may also introduce unexpected, albeit temporary, loads in the main structure.

C-4.3.3 Cantilevered Aircraft Maintenance Bay Framing System

A cantilevered system supports all of the gravity loads from the rear wall of the aircraft maintenance bay. Lateral loads are resisted by the structural framing around the perimeter of the structure. The roof framing system should be designed with a means to correct out of tolerance construction without resorting to field modifications of any member. Cantilevered roof systems are generally statically determinate in all phases of construction.

C-4.3.3.1 Advantages

The system is advantageous in that it provides a column-free building face towards the aircraft flightline. This maximizes the usable flightline frontage while decreasing the number of obstructions to aircraft movements and provides for the maximum flexibility to service future aircraft which may enter the inventory long after the hangar was designed. The system provides the maximum flexibility for structural expansion to either side of the hangar. However, if future expansion is anticipated, other disciplines must consider such expansion in their design development. Additionally, the highest point of the structure is generally towards the rear wall of the hangar, which may be advantageous when the hangar is located near a runway and must remain below a glide or transition slope.

C-4.3.3.2 Disadvantages

A cantilevered system is an inefficient method for supporting loads; is prone to larger deflections than other systems; and is more difficult to erect. Thermal cycles are also more likely to result in larger deflections affecting door operation, but will not result in thermal stresses unless the system is restrained in some unconventional manner. Additionally, the landward side of the facility must have some provision for tension anchorage of the rear of each cantilever. This anchorage may be in the form of massive dead-load or tension earth anchorages (typically tension piles). A cantilevered system also requires a more elaborate foundation. The tension anchorages, for both the above and below grade structures, require more elaborate coordination with the shops and office structure. The tension anchorages are also typically located outside of the building footprint and require greater coordinate with the civil site design.

C-4.3.3.3 Considerations

Design documents for a cantilever system need to carefully consider the effect of erection sequencing, actual versus predicted dead load deflection and environmental conditions during the fabrication and erection. Additionally, the possibility of load reversal on the main supporting elements as a result of high uplift forces must be considered.

C-4.3.4 Header Truss Aircraft Maintenance Bay Framing System

A header truss system spans the entire flightline face of the building and either rests upon columns or towers at each flightline corner of the building or is continuous to the foundation. The remaining walls of the hangar are conventionally framed. Lateral

support is provided through the framing in the perimeter walls. The truss is typically supported against lateral loads through dedicated horizontal truss system. The truss should be designed to maintain a slight upward camber after all dead loads have been placed. The truss may be fabricated on shoring towers in the air or on the ground and lifted as a single unit. The truss may be designed as statically determinate, indeterminate or initially determinate but becoming indeterminate at some point during the erection sequence. The design should consider the effect of erection methodology and sequence, in conjunction with determinacy of the system. Additionally, thermal effects on statically determinate header trusses are particularly significant and the designer of record should carefully evaluate these effects.

C-4.3.4.1 Advantages

The header truss is an efficient system to span intermediate lengths and provides a relatively simple erection system, provided that the issues of static indeterminacy are dealt with.

C-4.3.4.2 Disadvantages

The structural efficiency and stiffness decrease exponentially as the span of the truss increases. This may be offset by increasing the depth of the truss. However, the practical limits of transporting the fabricated hardware, erecting the assembled truss and lateral bracing of the system and its individual components limit the truss depth to something on the order of 25 foot (7.5 m). A header truss virtually precludes the use of expansion joints; therefore, the hangar door span may be limited by the thermal response of non-structural components. However, a three-hinged arch system allows an expansion joint along the centerline of the hangar bay and extends the practical thermal expansion limit. The header truss system also requires that flightline frontage be dedicated to structural supports. Finally, the potential expansion of the hangar is constrained by the presence of towers and lateral load resisting systems.

C-4.3.4.3 Considerations

Construction documents for a header truss system must clearly indicate the camber requirements as well as supply the necessary information for the fabricator and erector to predict the truss’s response at various states of construction, handling and loading.

The header truss may be designed as fixed, pinned or partially restrained at its supports in order to balance the strength and deflection characteristics of the header truss with the complexity of detailing and erection. The designer of a statically indeterminate truss must carefully consider the influence that temperature, erection sequence and erection rigging will have on the difficulty of completing connections as well as final camber and this complexity must be communicated on the design documents.

C-4.4 Strength and Serviceability Requirements

The necessity of a large open, column free space will result in the lateral load resisting system being located along the perimeter of the building. Widely separated lateral load resisting elements may lead to high thermal stresses being developed. The designer is

cautioned to balance the needs of other disciplines as to the location of cross-bracing and the desire to produce a more torsionally resistant design against the potential for developing high thermal stresses.

C-4.4.1 Wind Loads

Hangars are prone to large eccentricities between centers of wind pressure and centers of rigidity (especially cantilevered hangars). Even unfactored loads resulting from this eccentricity may be significant. The designer should consider this eccentricity while laying out the lateral load resisting system to locate the center of rigidity as near to the center of applied force as practical.

C-4.4.2 Seismic Loads

Seismic design criteria may impose significant constraints upon the structural frame, not only in the loads applied but also in the fundamental choice of framing system. The allowable seismic force resisting systems and their limitations are identified in ASCE 7-10, Table 12.2.1. A combination of site condition, design approach and structural layout will determine the AISC criteria. A poor selection of framing, arrangement of bracing or large asymmetries may result in expensive connection fabrication and testing requirements or outright prohibition of the fundamental design. The facility designer's should investigate the seismic issues early in the design phase and plan the building's geometry and structure accordingly.

Hangars are prone to large eccentricities between centers of mass and centers of rigidity. This is especially true for hangars with cantilevered roof framing systems. Regardless of the structural system, the unfactored loads from this eccentricity may be significant. For general information about structural loads, refer to UFC 3-301-01. For detailed information, refer to UFC 3-310-04 and ANSI/AISC 341.

C-4.5 Main Structural Framing Materials

C-4.5.1 Hollow Steel Sections

There may be additional benefits derived from efficiency in steel use and minimization of exposed steel surfaces. The bi-axial strength characteristics provide for enhanced electability and greater resistance to progressive collapse resulting from localized damage. However, HSS connections are more challenging to design and often more difficult to fabricate. The engineer of record should consider and clearly represent in the contract drawings the difficulty of the HSS connections. Additionally, a greater reliance on shop connections is the norm in HSS practice. The designer is encouraged to consider the complications of transporting large, built-up elements to the site. HSS connections may involve the use of welds that are not pre-approved and/or more extensive weld testing than normally found on hot rolled steel construction.

C-4.6 Secondary Structural Systems

C-4.6.1 Roof Systems.

Historically, it has been difficult to maintain the necessary level of quality control required to weld decks at side laps and at supports. Mechanical fasteners are the desired option. Additionally, there may be significant economy in erection by allowing pneumatic and powder actuated fastening systems. Most pneumatic and powder actuated systems are proprietary in nature and not covered by the Uniform Guide Specifications UFGS 05 30 00.

C-4.6.2 Coordinating the Structure with the Hangar Doors

Hangar door guide systems are normally sized to allow total roof truss live load deflection not to exceed 200 mm (8 inches). The designer of record is responsible for coordinating the total anticipated roof deflection with the door guide manufacturer to ensure that the design stroke of the hangar door guides is not exceeded. For cantilever roof systems, the hangar door guide system should have adjustment capability to allow for final leveling after all loads are in place. The construction documents must indicate the expected maximum deflection, both upward and downward, as well as the allowable deflection of the hangar door guide system.

C-4.6.3 Diaphragms

Given the difficulty in providing lateral load resistance for the large open spans associated with hangar bay structures, it often appears desirable to incorporate the roof deck into the lateral load system as a flexible diaphragm. However, these same large spans involved in hangar structures often require large deflections in the frame before the deck produces the desired resisting forces. Designers are therefore prevented from relying on a steel deck as a diaphragm in the hangar bay and required to provide a dedicated secondary horizontal lateral load. The deck may, however, be assumed to provide local support to elements, such as top chord/flange support to joists/beams.

C-4.6.4 Wall Systems

Generally bearing or shear wall systems of masonry or concrete are much stiffer that the steel frame used in the hangar bay. Designers are cautioned to carefully consider the differential movement likely to occur between the maintenance bay and the shops/admin space when designing the interface.

C-5 MECHANICAL

C-5.1 Plumbing

C-5.1.1 Water Supply to Emergency Shower/Eyewash Stations

The domestic heating water system will need to be sized to deliver the required hot waterflow and temperature to meet the tepid water requirements for the operation of one shower or eyewash station for 15 minutes.

C-5.2 HVAC

C-5.2.1 Overhead Radiant Heat Systems

Overhead high intensity heaters for hangar bays are not allowed in Air Force and Navy hangar bays for two reasons: clearances to aircraft and bridge crane equipment are greater, presence of fueled, armed aircraft (Air Force). Low-intensity, gas-fired tube type radiant heaters are preferred for overhead heating systems in Air Force and Navy hangar bays.

C-5.2.2 In-floor Radiant Heat Systems

In-floor radiant heat systems must be carefully considered for heating in hangar bays in northern climates. This system is appealing because it does an effective job of heating the floor, but the installation costs and impact on the floor slab design are significant. Consider the amount of maintenance activities performed from the floor. Coordinate closely with the system supplier on the design of the hangar floor slab, location of insulation, and location of radiant tubing within the slab.

C-5.2.3 RPA Hangars

There are RPA aircraft that have internal avionics systems that are sensitive to high temperatures and will alarm when the inside temperature gets up to 100ºF to 120ºF. These aircraft might also have fuel systems that need to be kept below a certain temperature. A conditioned hangar bay might be required which is inconsistent with typical hangar design. Depending on the climate, evaporative cooling might be considered. Portable preconditioned air carts can be considered in lieu of conditioning the hangar bay.

C-5.2.4 Avionics/Electrical Repair

Localized exhaust is typically done using a wall-mounted fume extractor built specifically for small or limited workspace environments where air purification is desired. Includes a free-hanging, self-supportive flex arm that can be easily maneuvered by the operator to the desired location. Several filter combinations can be used depending on the application.

C-5.2.5 Army Hangar Heating Systems

Overhead low or high intensity radiant heaters are often the most life-cycle cost effective method of heating Army hangars and most other high bay facilities. Some quality high intensity radiant heaters have radiant efficiencies as high as 81%, meanwhile low intensity tube heaters typically range from 35% to 60%. It must be noted that radiant efficiency is not the same as thermal efficiency. Where work or maintenance activities may be limited at times to specific areas in a hangar bay (such as where maintenance is being conducted on one helicopter while other spaces have no activity), high intensity radiant heaters applied in a spot or area heating method may be the most life-cycle cost effective method of providing thermal comfort. The spot or area heating

method allows for maximum radiant asymmetry where the ambient temperature may be kept low.

In floor type radiant heating systems are more efficient than warm air systems as well; however, the in-floor systems have long response times which do not allow for effective unoccupied period temperature setbacks. Warm air systems should only be considered in mild climates where there is minimal need to heat, and where air delivery temperatures may be kept within 20 degrees of ambient room temperature. Delivery temperatures which are greater than 20 degrees above the ambient temperature can lead to excessive stratification in high bay facilities such as hangars.

C-6 FIRE PROTECTION AND LIFE SAFETY

C-6.1 Below Grade Water Supply Piping

Avoid locating piping under paved operational surfaces (taxiways and aircraft parking).

C-6.2 Welded Fire Suppression and Concentrate Piping

If using welded joints and fittings, give consideration to the maintenance of the system and the provision of flanged joints at certain locations to allow for maintenance.

C-6.3 Diverter Valve Location

When installing a diverter valve as part of a fire suppression containment system, consider placing the valve and valve pit within the hangar bay as a means reduce the rain water infiltration into the pit. When this is provided, locate the pit outside aircraft/vehicle traffic locations and rate the components in the valve pit for a Class I Division 1 hazardous classified location.

C-6.4 Fan Shutdown in the Hangar Bay

The hangar bay doors are often open for extended periods of time. Therefore, exposing the hangar bay to high humidity, below freezing, and high temperature conditions. Because of this, the hangar bay is considered an outdoor environment. Most addressable output modules (control modules) are not UL listed to operate in these conditions, and installing these devices in the hangar bay would be against the listing.

Therefore, it is recommended modules for controlling fans be located in a controlled environment. One option would be to locate the module next to the shunt trip breaker which removes power from the fan(s) in the hangar bay upon release of the foam system. Another option would be to extend the enable input circuit off the VFD/starter from the hangar bay to a module that is located in a controlled environment. In no case should the fans be shutdown through EMCS unless the EMCS is a UL 864 listed system, as this is not permitted by NFPA 72.

C-6.5 \2\ Trench Drain Location

For Navy: When approved by the NAVFAC FPE, under certain circumstances the dedicated nose-dock area may be excluded from the trench drain boundary.

C-6.6 Alternate Foam/Water Discharge Notification

For Navy: When approved by the NAVFAC FPE, a blue beacon notification system may be provided to indicate trench nozzle discharge where a fire alarm voice evacuation system is not provided. /2/

C-6.7 Voice Notification in the Hangar Bay

In most hangar bays, directional loudspeakers should be used. It has been found that providing directional speakers and aiming the speakers in the same general direction increases message clarity and improves CIS scores. An example of this type of installation includes providing ceiling only mounted speakers directed towards the floor or providing speakers mounted only on the back wall directed towards the hangar bay door opening. When opposing speakers are provided, such as speakers mounted on opposing walls, the sound from one speaker will reach the occupant before the sound from the other speaker. This results in an echo effect, which reduces message clarity. Hangar bays often seem quiet during commissioning. However, during normal operation and with the ventilation systems operating, hangar bays can have an average ambient sound level approaching 75-80 dBA. The speaker system should be designed to deliver a minimum sound power of 90 dBA throughout the hangar bay to account for the variety of operating procedures.

C-7 ELECTRICAL

C-7.1 Electric Door Track Heating System

In locations where snow and freezing temperatures occur and a rolling door is provided for the hangar bay consider a heating system for the tracks. If a heating system is not provided the tracks may accumulate ice and/or snow and then ceases to function properly. A hot water heating system may be used in lieu of an electric door track heating system.

C-7.2 Service Point Connection Pedestals

Pedestal mounted connections are placed within the hangar space. The pedestals are permanently mounted within the space and create a fixed obstruction. The pedestals bring the services closer to the aircraft and reduce the cable lengths. The cables may be reeled up at the pedestal location or stored separately. The pedestals create an obstruction free zone between the pedestal and the wall. Pedestals require little maintenance.

C-7.3 Aircraft Grounding Points

Different grounding points may be used for different types of aircraft based on the size of the aircraft. Consider the use of caps on the grounding point in the hangar bay. The caps on the grounding points are difficult to maintain.

\3\

C-7.4 Hazardous (Classified) Locations

Vestibules complying with 3-7.1 bullet 1 (two doors in close series) is the recommended best practice to provide suitable hazardous location cutoff. Use vestibules unless floorplan configuration precludes their use. /3/

C-8 COMMUNICATIONS

Communications may include many different types of systems including but not limited to unclassified data, classified data, telephone, public address, radios, satellites, and intercom system. Each system has a special set of requirements. Identify the types of systems required in the building early in the project and provision for the systems accordingly.

C-9 OVERHEAD BRIDGE CRANE

C-9.1 Overhead Bridge Cranes

Overhead cranes are often located close to overhead radiant heat systems. Coordinate the two systems to avoid heat damage to the crane equipment. Common approaches include automatic switching which deactivates the heaters located near the crane or, locating shields or deflectors to protect the vulnerable elements of the crane.

C-10 HANGAR DOOR

Coordinate with the user to provide type of hangar door and controls required for maintenance operations.

C-10.1 Horizontal Rolling Hangar Doors

Rolling steel doors require significant depth for multiple tracks. Door pockets are always preferred since they allow all door panels to be moved completely out of the door opening. A door pocket is required unless the hangar door is wide enough that it is acceptable to stack the doors along the tracks. Tracks extending the full length of the door provide more flexibility on where the doors can be stacked. Confirm if the climate requires the tracks to be heated. Specify rolling steel doors to allow them to be moved with an aircraft tug in case of power failure. Tracks usually will be drained. Sand can build up in the track in arid climates, requiring personnel sweep the tracks on a regular basis. Best practices suggest the project Planner consult the installation and users to choose a type of hangar door, and the operation requirements of the door.

Horizontal rolling hangar doors typically support their own gravity load and only impart lateral (wind, seismic) loads to the main structural system through a track system at the door head. The door head track is generally the responsibility of the hangar door manufacturer. The designer of the hangar generally provides the support for the door head track. The designer is cautioned to carefully consider the following:

- The manner in which the door head track is supported by the superstructure
- The vertical movement of the superstructure and the capacity of the door to accommodate the movement.

C-10.1.1 Horizontal Rolling Hangar Door Foundation

The door track foundation will be considered a building foundation since it supports building components. The door track foundation will bear below the building frost line at or near the depth of the Aircraft Maintenance Bay foundations. The designer is reminded that the door track foundation will be subject to aircraft wheel loads which may control the design of the foundation.

C-10.2 Vertical Lift Fabric Doors (VLFD)

Vertical Lift Fabric Doors require less depth and do not require pockets to provide access to the full width of the opening. Larger openings require multiple panels with fold-up mullions. Personnel doors in the hangar door may require the bottom 7 ft. (2.1 m) of the door to be rigid, causing unique header truss design to allow the door to extend up beside the truss. Currently, VLFD backup manual operation requires hand cranking from an elevated walkway at the VLFD hoist motor location and is extremely laborious, difficult and time consuming. For these reasons, the UFC requires backup systems to power the door. In case of a major failure such as a motor failure, the door may be practically unusable for an extended period of time.

C-10.2.1 VLFD Structural Considerations

Vertical lift fabric doors are lighter than rolling doors, but the entire weight is carried by the superstructure. Additionally, beyond a practical limit of about 60 ft. (18.3 m) multiple door leaves are required. A complicated swinging mullion with additional overhead equipment is required for every vertical lift fabric door beyond the first. However, vertical lifting fabric doors do not require door pockets to entirely clear the hangar opening nor do they require extensive support at grade.

The main load collecting members for a vertical lift fabric door panel generally span horizontally, from mullion to mullion. As such, the mullions serve as load collectors for a very large tributary area which is then delivered to the main framing system as a concentrated force. At a basic, conceptual level, the structural engineer is cautioned to consider how these forces will be collected and distributed back to earth. To the maximum extent practical, the principle framing of the hangar structure should align with the mullion locations.

C-10.2.2 VLFD Fabric

At present the fabric utilized on the VLFDs does not meet the minimum blast resistance requirements of UFC 4-010-01. Therefore, to utilize a VLFD in the Aircraft Maintenance Bay, the Aircraft Maintenance Bay needs to be classified as Low Occupancy as defined by UFC 4-010-01. If the Aircraft Maintenance Bay meets this requirement, then it must also be structurally isolated from any shops/office spaces that cannot be classified as Low Occupancy. Otherwise, it must be verified through analysis that the adjacent inhabited office/shops spaces would not collapse if the Aircraft Maintenance Bay collapses in accordance with UFC 4-010-01.

At present the fabric utilized on the VLFDs does not comply with impact-resistance requirements on facilitates located in "Wind-Borne Debris Regions". The fabric does not meet the testing criteria of ASTM E1996 *Standard specification for Performance of Exterior windows, Glazed curtain Walls, Doors, and Storm Shutters Impacted by Wind Borne Debris in Hurricanes* and ASTM E1886 *Standard Test Method for Performance of Exterior windows, curtain walls, doors and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials*. The designer is cautioned when using VLFDs in "Wind-Born Debris Regions".

C-10.3 Vertical Lift Canopy Doors

Large maintenance hangars usually opt for either rolling steel doors or vertical lift fabric doors. Vertical lift bi-fold/canopy doors are common on small hangars for private aircraft, but are much less common in military hangars. They have many of the advantages of VLFDs; no pocket required, very little depth. They are significantly limited in size.

Vertical lift canopy doors are typically constructed of steel framing (hot rolled and/or cold formed) and clad with metal panel siding. The entire weight of the door and associated counterweights is carried by the superstructure. Generally, the door width is limited to roughly 100 ft. (30.5 m) but longer spans have successfully been installed. Additionally, the height of the door is limited to roughly 25 ft. (7.6 m) because of the large cantilever that develops on the door jambs as the door opens. At a basic, conceptual level, the structural engineer is cautioned to consider how the weight of the door and counterweights and door opening forces and how they will be resisted by the superstructure and distributed back to earth. There has not been success installing these doors in a multiple leaf configuration with a swinging mullion similar to the Vertical Lift Fabric door.

C-10.4 Other Hangar Door Options

Aircraft Maintenance Hangars require a vertical lift fabric door system or horizontal sliding doors for the purpose of closing the aircraft maintenance bay. Best practices include the project Planner consulting the installation and users to choose a type of hangar door, and the operation requirements of the door before issuing the 1391.

However, less common hangar door options are available in the market place. These optional door types need project specific approval from the appropriate Service design criteria manager or waiver authority for this UFC. The design team is cautioned to consider all facets of these doors effects on the building design when considering these doors. The design team also needs to consider the ease of use, long term maintenance and emergency opening capabilities when considering hangar door types.

C-11 FALL PREVENTION AND PROTECTION SYSTEMS

C-11.1 Personal Fall Arrest Systems (PFAS)

Provide fall prevention and/or fall protection in accordance with UFC 3-110-03. Most hangars do not have mechanical equipment on the Aircraft Maintenance Bay roofs but there may be other equipment such as antenna platforms requiring interior access and fall protection. Aircraft maintenance workers are often required to work on top of aircraft, well above the floor surface. It is common practice and is a requirement in similar circumstances, for workers to be protected against falls from aircraft surfaces through the provision of a Personal Fall Arrest System (including flexible horizontal life line and rigid horizontal rail systems). However, hangars with bridge cranes represent a special challenge in that the cranes and personal fall protection system compete for access to same work space, workers protected from falls by the use of a personal fall arrest system are now at risk of having their self-retracting lanyards (SRL) struck by a moving crane. It is important for the designers of aircraft hangars to understand the conflicts between the two systems and the means by which they can coexist. Additionally, personal fall protection system may experience the same coordination issues with overhead radiant heat systems as do overhead cranes. The designer should consult the discussion on cranes which appear later in this section.

C-11.2 Description of Horizontal Lifeline (HLL) System

The HLL system consists of a flexible, wire rope or synthetic cable (usually a stainless steel cable) that is installed in a horizontal or nearly horizontal plane between two or more anchorages and to which a self- retracting lanyard (SRL) is attached. The SRL has an integral locking snap hook at the end that attaches to the dorsal D ring of the person's full body harness. Both the crane and HLL are usually installed at higher elevations. In order to perform work more efficiently on an aircraft, a network of HLL systems is generally required. The HLLs should be laid out in a system which accounts for the location of the aircraft and maximizes the freedom of movement of the users. Additionally, mobile attachment devices (trans-fasteners) used to have an added mobility to move between intermediate anchorages with 100% tie-off. The HLL may include energy absorber and lifeline tensioner. The self-retracting lanyard attached to the HLL is a deceleration device made of synthetic rope, webbing or wire rope that automatically locks at the onset of a fall. It pays out and automatically retracts onto the drum during normal movement.

C-11.3 Description of Rigid Horizontal Rail (RHR) Systems

RHR system is a pre-engineered anchorage subsystem that uses one or more trolleys on a horizontal track (often and I-beam or slotted tube) designed for the attachment of components of a personal fall protection system. Horizontal Track system is a form of RHR system that typically encloses a trolley inside a formed channel or track. A self-retracting lanyard (SRL) is also attached to the RHR system for tying off to the dorsal D ring of the full body harness.

C-11.4 Quality Control

Flexible HLL systems and Rigid Horizontal Rail systems are typically proprietary in nature. The manufacturer should provide calculation and drawings showing that the system was tested and certified under the supervision of a qualified person and is appropriate for the application. There two types of HLL and RHR systems. Type 1 are designed, tested and certified by the manufacturer of the system and installed and used by the purchaser (or purchaser's representatives) in accordance with the manufacturer's requirements, Type 2 systems are designed, tested, certified and installed by the manufacturer and used by the purchaser of the system (or their representatives) in accordance with the manufacture's requirements.

C-11.5 Issues and Conflicts between Crane Operation and PFAS

The following are few of the conflicts that will occur between the HLL system(s) and the crane(s):

C-11.5.1 If the HLL is installed above the Crane

During the movement and operation of the crane a conflict will exist when personnel are tied to the HLL systems because the SRLs when extended will be in the path of the crane. A Lockout/Tag out program should be in place which precludes the cranes and PFAS from being used simultaneously in a given area. If the crane is activated, personnel should detach themselves from the HLL systems and the lanyards of the SRLs should be retracted inside the elevation of the crane.

There is some difficulty in developing a system which raises and lowers the snap hooks. There are two methods to lower the snap hooks to personnel's level. The first one is using a power tagline system, which is a motorized winch that raises and lowers the lanyards to the users' level, activated by a control panel. The second method is using a manual tagline system to lower the snap-hook manually by a person on the ground level. In practice, the power tagline system is preferable in that it can be interlocked with the crane controls; however, the automatic system involves greater cost and complexity. The manual system is generally simpler but requires greater diligence in use. In any case, a tagline system will be required to ensure that both systems can be safely operated. When the lanyard of the self-retracting device is retracted out of the crane's path, there should be a minimum clearance around the crane envelope of 3 inches (75 mm) from the top and 2 inches (50 mm) on either side.

C-11.5.2 If the HLL is installed below the Crane

If the HLL is installed below the crane rail, there may be interference with the crane operation unless a system to retract the HLL to the sidewalls is provided. Such systems generally come in one of two forms: (1) The HLL is suspended from a bridge beam which is lower than the bridge crane and supported from tracks located outboard of the bridge crane tracks. (2) The HLL is suspended from beams cantilevered off of the side walls, much like a jib crane, which can rotate flush to the side walls. The large open, column-free areas of hangar bays generally make these systems impractical in hangar usage. If the HLL requirements can be narrowed to a smaller portion of the total hangar floor area, these systems may become acceptable. The above conflicts with the crane may also apply to the RHR systems.

C-11.6 Alternate Methods and Systems

There are other personal fall arrest systems that can be specified, but these are typically portable systems which can be more appropriately classified as equipment then building systems:

C-11.6.1 Work Stands

These are costly but safer than the use of PFAS. The work stands should be equipped with guardrails on three sides and a swing gate at the stairs or ladder side. Often, work stands must be customized to fit a small range of aircraft types. This then necessitates providing new work stands should the aircraft being serviced in the hangar change.

C-11.6.2 Portable Fall Arrest Systems

These are typically a single drop eyelet for a D-ring, supported from a jib arm on a portable derrick. The derricks are generally cumbersome, requiring additional equipment to relocate them, and offer only a limited range of movement to the user. These types of systems are generally not appropriate for a maintenance hangar unless the aircraft are expected to be static for long periods of time.

C-12 EMERGING AIRCRAFT

C-12.1 General

The aviation industry is constantly developing new aircraft. Emerging aircraft and variants of existing aircraft are entering the military arsenal more often than this UFC can be updated. When designing a hangar for an emerging aircraft there are a number of issues to confirm.

- Review the Facilities Requirements Document (FRD) for the aircraft for any specific requirements that could affect the hangar design.
- Communicate with the users to find out what is different or unusual about the new aircraft from a maintenance point of view that may require unusual systems or spaces.

- For example, The F-16 engine is dropped out of the aircraft for maintenance. However, the F-35 engine is pulled out of the aircraft, requiring significantly more space aft of the aircraft than the standard clearances in this UFC would provide.

- Emerging aircraft are more likely to have secret components that may require special storage rooms or other security measures.

C-12.2 Unmanned Aircraft Systems

C-12.2.1 General

Unmanned Aircraft Systems (UAS) are composed of the aircraft as well as personnel and equipment to launch, control, recover and maintain the aircraft. The aircraft itself is typically called an Unmanned Aerial Vehicle (UAV). The term Remotely Piloted Aircraft (RPA) is preferred by the Air Force. UAS are currently one of the fastest group of emerging aircraft with a number of different systems in use by each Service and new variants being introduced at an increasing rate. Review the Service-specific chapters for guidance on which UAS this UFC applies to.

C-12.2.2 Similarities and Differences

UAV/RPAs vary in size, range, capabilities, and many other characteristics. Aircraft Maintenance Hangars housing UAS have spaces similar to other military aircraft. The aircraft maintenance bays, maintenance shops, administration and support spaces are not appreciably different from those found in other hangars. As discussed in the C-12.1: General it is important to find out what may be unusual about the design aircraft that could affect the hangar.

C-12.2.3 Communications

Communication systems are more important to UAS than other aircraft and often require line of sight from the aircraft to antennae used to control the aircraft. As a result, the hangar may have an array of antennae on top of the building. Consider location as well as safe access to these antennae for maintenance.

C-12.2.4 Associated Facilities

Aircraft Maintenance Hangars may be stand-alone facilities, or may be connected to a number of difference associated facilities. Often hangars are attached to the administration unit maintaining or piloting the aircraft maintained in the hangar.

The Mission Control Systems (MCS) where the UAV/RPAs are controlled may be either separate or may be attached to the maintenance hangar. MCS spaces may have specific requirements such as higher security and back-up systems for power and communication. The MCS control rooms and electronic rooms may need to be shielded from electromagnetic interference. Designers need to seek requirements for associated facilities elsewhere, as they are not included in this UFC.

APPENDIX D: QUESTIONNAIRE

D-1 MAINTENANCE AND OPERATIONS QUESTIONNAIRE FOR NEW HANGAR DESIGN

D-1.1 Civil

- Will a security fence be required around the hangar?
- What type of lighting will be required in the employee parking lot?
- Will a guard booth be required at roadway entrance to hangar area?
- What type of lighting will be required on the parking apron?
- Will there be a need for exterior space to store deployment equipment/containers?
- Is there a need for a dumpster or waste recycling?
- Is there a need for a pedestrian turnstile gate with a swipe card access system, in the flightline security fence?

D-1.2 Architectural

- Identify the type of aircraft and the aircraft mix that will populate the hangar.
- Will aircraft be brought into the hangar with fuel in them? (Identifies the type of fire suppression system you need.)
- Consider towing vehicles turning clearances, access and egress from hangar bay when sizing hangar bays.
- Will spot repair of corrosion control, grinding, bird interaction repair, sanding, or painting on the aircraft frame or any parts be required inside the hangar? If so, provide Material Safety Data Sheets for all materials solid or liquid being used on the aircraft frame or inside the hangar to determine if engineering control is required to mitigate hazard. (This may impact spaces by requiring larger exhaust systems, specialized filters and other items when exposure to heavy metals is likely)
- Identify any area and/or need to weld, paint, grind, sand, or apply paint or corrosion control materials on the aircraft frame or other aircraft parts. Has a preliminary hazard list been completed and a risk assessment code been determined for the facility which identifies if controls are required? Based on the risk assessment code, is a preliminary hazard analysis required? (Engineering controls may be required) Provide this document to the designers for inclusion in the hangar design.
- Based on the operations and the exhaust from the building, will an air permit be required or will it need to be added as an air emissions source

to the permit for the installation? (Additional filtration may be required by the state for the exhaust. This increases the size of the fans and pollution control costs.)

- What is the total occupant load? How does administration occupancy compare to Aircraft Repair occupancy? (This identifies the size and number of changing rooms and lockers for each group) In addition, are work clothes or disposable suits (i.e. Tyvek suits) provided for those people working in the shops/ hangar bays who may be exposed to hazardous materials and chemical? Identify where laundry facilities or disposal facilities for Tyvek suits are located.
- Identify how the spread of hazardous materials, dust and/or chemicals are controlled, contained, and disposed. Segregation of regulated areas and methods of demarcation may be required (such as full height partitions and ventilation systems). (Note: Areas of facilities utilizing these hazardous materials and/or chemicals must be designated as regulated areas whenever exposure can be expected to be in excess of the permissible exposure limit(s), and must be demarcated from the surrounding workspace in a manner that establishes and alerts building occupants of those boundaries of the regulated area.) Identify containment processes and methods to monitor effectiveness of housekeeping procedures, decontamination procedures, and engineering controls tailored to each facility 8. Is Chromium VI or other toxins being utilized in the hangar bay or workshops? If so, then proper decontamination procedures and separate showers must be in place to protect the personnel and surrounding work areas.
- Will waste oil drains be required? If so, give locations in hangar for receptacles funnels.
- Will there be a drum room? If so, how many drums should it hold? What types of chemicals will be stored?
- Where are hazardous waste containers to be located?
- Will mission functions be incorporated into the hangar building?
- How many employees, both direct and indirect, are expected to occupy the hangar per shift?
- Will tail docks, wing docks, fuselage docks or nose docks be required? If so, what utilities will be hooked up to them?
- What type of power tooling will be mounted in hangar? Examples include drill presses, grinders, shear, and brakes. In what location will this machinery be mounted? What type of utilities will be required for operation?
- Will there be rolling service doors? If so, give location and size. (Will any locations require power for motor operators?)
- Verify shop requirements.

- Type of shops?
- Square footage needed for each shop?
- The location in the building?
- Machinery location?
- Floor coatings required?
- Number and size of roll-up doors to outside of hangar.
- Will the shops require any other services such as shipping and receiving docks? Waste disposal/recycling?

- Will there be an inspection area? If so, give square footage, location and utilities required.
- Will a parts cleaning shop be required? If so, give square footage, location, utilities required. Also, please note any special or heavy drain items such as salt bath ovens or large ovens. Provide material safety data sheets for all cleaning products including application rates, methods, durations and frequencies.
- Will there be a lunch/break room? If so, please indicate square footage, location of building, number of employees per shift, if vending machines will be used, what type of floor, and if suspended acoustical ceilings will be required.
- Will there be a secured area? Verify the requirements.
- What aircraft should the hangar be able to house/maintain?
- Will there be a wash bay in the hangar?

D-1.3 Structural

- Will maintenance platforms or scaffolds be required?
- Will stabilizer platforms or other overhead suspended scaffolding systems be required?
- Will overhead cranes be required?
- Will personal fall arrest systems be required above aircraft? If so, what type?
- Verify shop requirements.
  - Crane coverage and hook heights?
  - Special foundations for equipment?
- Will the hangar be designated an earthquake, hurricane or other emergency shelter?

D-1.4 Mechanical

- Will overhead or in-ground mechanical utilities be required? If so, what locations?
- Will breathing compressed air be required?
- What will be the heaviest cfm drawn from hoses? (Quantity of outlets?)
- Will door track heating be required?
- Will door track drainage be required?
- What type of utilities will be required around the inside perimeter of the hangar? Utilities may include compressed air, water, pre-conditioned air. Provide location and capacity required.
- If there is equipment mounted in the hangar bay what utilities will be required for the equipment?
- Verify shop requirements.
    - What mechanical utilities are required in each shop?
    - Are floor drains needed?
    - Overhead air reels?
    - Machinery utility requirements?
- Any fluid discharges that may harm metal piping that would require an acid waste system? (X-ray room)
- Will there be any operational requirements for emergency eye wash/shower units? (Locations?)
- What locations are required for hose reels for water or air? (Overhead, column mounted or shop areas?)
- What is the expected hangar bay maintenance occupancy?
- Does the maintenance schedule vary with seasons?
- How does the maintenance schedule vary dependent upon peacetime or military conflict status?
- What maintenance activities will be performed, and for what percentage of time?

D-1.5 Fire Protection

- What is the history of the site's domestic/fire water supply? Does the water supply pressure fluctuate throughout the year?
- Is the fire water supply at the site known to have MIC or galvanic corrosion?

- Will there be rack storage in the facility? If so, what is the product stored? How high will it be stored, and how will it be stored? Will open rack shelving be used? Will the product be stored on wood or plastic pallets?
- Will the facility have shelved storage exceeding 8 ft. (2.4 m)? If so, describe the shelving arrangement and products stored.
- Will there be flammable, combustible, or corrosive liquids in the building which will not be located in a flammable storage cabinet? If so, what is the liquid, how is it stored, and how much is stored?
- Will tires be stored in the building? If so, how will they be stored?
- What is the typical parking arrangement of the aircraft in the hangar bay, and what fuels will be used by these aircraft?
- Will ejection seat maintenance be done in the building? What is the largest quantity of ordinance accumulated in the seat maintenance room any one time?
- Are flares stored in the building? If so, what is the quantity of flares stored, how will they be stored, and where will they be stored?
- Is the site considered to have reliable power as defined by the UFC 3-600-01?
- What system is used by the fire alarm receiving station?
- Are there site specific mass notification messages required?
- Will live voice messaging be required in the building from the receiving station?
- Will the activation of pre-recorded mass notification messages by the receiving station be required in the building?
- Will a supervised Knox box be required on the building? If so, how many?

D-1.6 Electrical

- Will overhead or in-ground electrical utilities be required? If so, what locations?
- Will 400 Hz be required? If so, what space will utilize the 400 Hz?
- Will 270 VDC be required? If so, what space will utilize the 270 VDC?
- Will 28 VDC be required? If so, what spaces will utilize the 28 VDC?
- Will standard power be required overhead?
- What type and source of lighting will be preferred in the hangar? (Metal Halide, LED or T8/T5 linear fluorescent?) What lux (foot-candle) levels are required? (Per current UFC handbook.)

- What type of utilities will be required around the inside perimeter of the hangar? Utilities may include 480 volt, 120 volt, 208 volt, 400-Hz, 28VDC, 270 VDC, Provide location and capacity required.
- If there are rolling service doors, will the doors be powered?
- If there is equipment mounted in the hangar bay what power will be required for the equipment?
- What loads should be served with emergency power?
- Will emergency power be provided via a permanent generator or a portable generator?
- Will additional mission functions be incorporated into the hangar that requires a generator connection?
- Verify shop requirements.
    - What electrical utilities are required in each shop?
    - Overhead electric reels?
    - Machinery electrical utility requirements?
    - Will grounding be required in any shops?
    - Will static dissipative floors be required in any shops?
- Will the project site require a high level of corrosion protection? Is the site on the coast where it is susceptible to salt water corrosion?
- Will there be pedestals in the hangar bay?
- Define the limits of the electrical hazardous (classified) locations including the hangar bay, adjacent spaces and shops with hazardous locations.

D-1.7 Communications

- Will outside public address system be required?
- Will a PA system be required? If so, give location and number of microphones.
- Will there be a requirement for special devices to be mounted to hangar roof, such as an antenna, or microwave dishes?
- Will a close circuit television system (CCTV) be provided for operations?
- Will there be dedicated networks? Will the networks require separate communication rooms?
- Will additional mission functions be incorporated into the hangar that requires dedicated communication networks or a data center?
- Verify shop requirements.
    - Provide location and number of telephones.
    - Provide location and number of telecommunication outlets.

- Will satellites be connected to the shop?
- Will radios be connected to the shop?
- Will dedicated networks be connected to the shop?

D-1.8 Security

- Will security systems be required? If so, what types will be required (Intrusion Detection Systems (IDS), CCTV, or access control)?
- What type of door security devices will be used? How many and what locations?

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APPENDIX E: PHOTOGRAPHS

E-1 PHOTOGRAPHS

Figure E-1: Maintenance Hangar Including Two Hangar Bays and Associated Shops



Figure E-2: Maintenance Hangar Including Attached Command Mission



Figure E-3: Maintenance Hangar with Associated Shops and Office on Both Sides of the Hangar



Figure E-4: Integrated UAS/RPA Hangar with Maintenance and Mission Spaces



Figure E-5: Large Body Aircraft Hangar with Attached Shops and Office Space and Sliding Doors



Figure E-6: Helicopter Hangar Bay with Sliding Doors, Sliding Door Tracks and Overhead Cranes



Figure E-7: Helicopter Hangar Bay with Converters, Pedestals and Safety Lane



Figure E-8: UAS/RPA Casket in Hangar Bay Ready for Assembly



Figure E-9: Overhead Bridge Crane with Cabled Controls within Hangar Bay



Figure E-10: Hangar Bay with Bridge Cranes and Fall Arrest



Figure E-11: Overhead Bridge Crane within a Shop



Figure E-12: Sliding Hangar Door Tracks



Figure E-13: Vertical Lift Fabric Door with Mullions and Multiple Sections and Fall Arrest System



Figure E-14: Vertical Lift Fabric Door Mullion and Mullion Pit



Figure E-15: Floor Mounted 400 Hz Converter with Permanently Attached Cables



Figure E-16: Permanent Pedestals with 400 Hz, 120V, Communications and Compressed Air



Figure E-17: Example of Fire Pan, for Acceptance Test of Optical



UFC 4-211-02
1 December 2012

UNIFIED FACILITIES CRITERIA (UFC)

AIRCRAFT CORROSION CONTROL AND PAINT FACILITIES



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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes UFC 4-211-02NF, dated 10 January 2005, with Changes 1-4.

FOREWORD

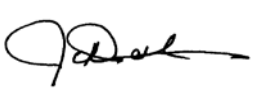
The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.



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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Document: UFC 4-211-02, *Aircraft Corrosion Control and Paint Facilitie*s

Superseding: UFC 4-211-02NF, *Corrosion Control and Paint Finishing Hangars*, dated 10 January 2005, with Changes 1-4

Description: This UFC provides criteria for the planning and design of Aircraft Corrosion Control and Paint Finishing (ACCPF) Facilities for the aircraft of the combined DoD United States Armed Forces.

Reasons for Document: This is a new Joint Service document. This new document represents another step in the Joint Services effort to bring uniformity to the planning, design and construction of military facilities. This UFC was developed to provide design requirements to accomplish the following:

- Assist planners in understanding the facility requirements to ensure accurate space programs and budgets.
- Provide architects, engineers, and construction surveillance personnel with the essential, minimum requirements for the design and construction of Aircraft Corrosion Control or Paint Finishing Facilities.
- Clarify the operational intent of the facility design.

Impact: The following will result from the publication of this UFC:

- This UFC creates a single source for common DoD ACCPF criteria and an accurate reference to individual Service-specific documents.
- This UFC facilitates updates and revisions and promotes agreement and uniformity of design and construction between the Services.

Unification Issues: The following are issues that remain non-unified and the reasoning for each:

- Section 2-1 identifies Service-specific documents for corrosion control requirements. The documents detail Service-specific aircraft corrosion control maintenance procedures and practices that may affect the facility design and are noted for reference.
- Section 2-5.3 identifies different minimum clearances and working space allowances. The exception is based on Service operational requirements for aircraft movement near fixed objects. The exception has little impact on Corrosion Control hangar size, since operational clearances control the size of the hangar bay.
- Sections 3-2.2.1, 3-4.3 and 3-6 identify different Service-specific Fire Protection requirements. These requirements are not currently unified by Fire Protection Working Group. These issues will be discussed in developing unified requirements for General Maintenance Hangars in the near future.

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CHAPTER 1 INTRODUCTION

1-2 SCOPE OF DOCUMENT.

This UFC provides requirements for evaluating, planning, programming, and designing Aircraft Corrosion Control and Paint Facilities (ACCPFs). The information in this UFC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental Unites States (CONUS) and outside the continental US (OCONUS). The requirements contained in this UFC apply to Army, Navy, Marine Corps and Air Force facilities unless specifically referenced to a single service. This UFC is not intended as a substitution for thorough review during design by individual Program Managers and Operations Staff in the appropriate Service.

1-3 APPLICABILITY.

This UFC provides planning and design criteria applicable to new construction as well as sustainment, restoration and modernization projects on all Department of Defense (DoD) facilities in the continental United States, (CONUS), and outside the continental United States (OCONUS).

1-3.1 General Building Requirements.

Comply with UFC 1-200-01, General Building Requirements. UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, sustainability, and safety. The design requirements in this UFC are to be used in addition to UFC 1-200-01 and referenced UFC's and criteria.

1-4 SCOPE OF FACILITY.

ACCPFs provide space, infrastructure and support facilities to conduct de-paint, paint, and corrosion control activities for DoD aircraft. There are three categories of facilities:

- Depot Facilities (DF) support comprehensive de-paint and paint programs. These facilities may operate almost continuously in support of the corrosion control program.
- Corrosion Control Facilities (CCF) support periodic activities on an as-needed basis. In the past, these facilities have also been called operational/intermediate level facilities, squadron level, field level, and patch and paint facilities.
- Wash Racks fulfill the requirement of periodic corrosion control on aircraft not requiring remedial corrosion maintenance. Wash Racks may be open, covered, enclosed, or integrated into the hangar bay, but the functions performed and the utilities provided at the Wash Rack are limited to the washing and rinsing of aircraft.

The ACCPFs described in this document are indicated in Figure 1-1. A comprehensive list of functional program spaces are listed and described briefly in Table 1-1 and described in greater detail in Chapters 2 and 4 through 7

FIGURE 1-1. ACCPF FACILITIES

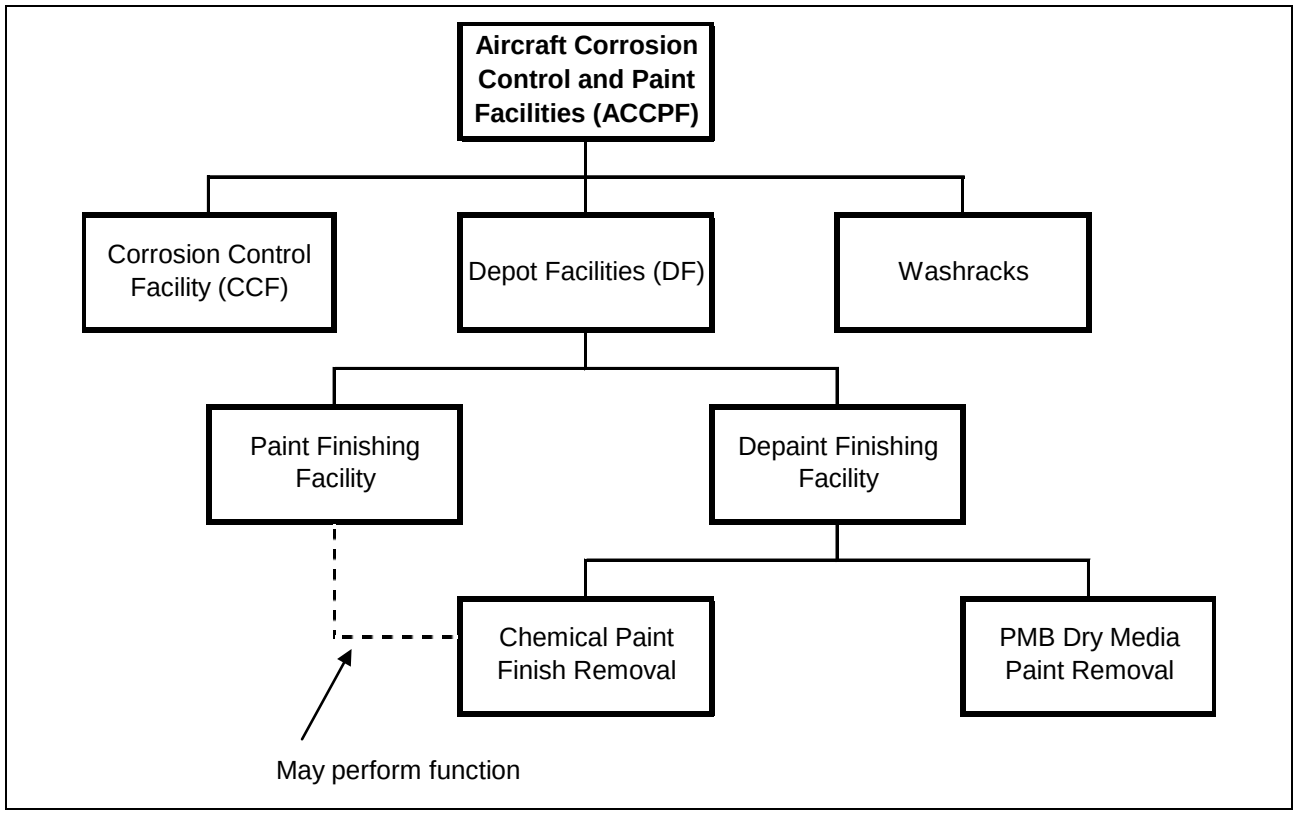


TABLE 1-1. ACCPF FUNCTIONAL PROGRAM AREAS

Functional Program Area	Description
Operational Spaces	
Aircraft Hangar Bay (Paint/Wash/Chemical Depaint)	Houses aircraft and equipment anticipated for the mission of Facility. The bay must be sized for the largest aircraft with additional space for anticipated maintenance platforms and equipment. The bay should also include utility connections required for the mission. Utilities will vary for paint application, and chemical depaint versus dry depaint.
Aircraft Hangar Bay (Dry Media Depaint)	Houses aircraft and equipment anticipated for the mission of Facility. The bay must be sized for the largest aircraft with additional space for anticipated maintenance platforms and equipment. The bay must be designed for a dusty environment and include strategically placed outlets for Dry Media Blast (DMB) distribution and spent DMB pick up /delivery system for DMB reclamation; with additional utilities specific for the mission.
Paint Mix Room	Coating mix and paint pot staging; should be adjacent to paint storage with easy access to paint bay.
Paint Storage Room	Aircraft coating container storage; adjacent to paint mix, with curbed storage area drained to I.W.; should also have access for deliveries.
Tool Crib	Special use equipment tools such as pallet jacks, ladders, facility maintenance items.
Equipment Storage	Paint application equipment storage; typically combined with paint equipment cleaning room.
Equipment Cleaning	Paint application equipment cleaning; room generally contains small paint booth or other solvent cleaning apparatus for use with paint spray guns and paint pots.
Solvent Storage	Large container (typ. 55 gal) paint solvent storage; requires pallet storage with door openings and aisles suitable for deliveries.
Central Acid Storage	Central storage for acid cleaner and conversion coating; may include central chemical mix and storage tanks with pumps and piping for distribution to the hangar bay.
Central Chemical Storage	Central storage/distribution for hot soap/water mix and hot and cold water; typically includes bulk storage of concentrated soap, central hot water heater/tank, soap/HW mix tank and associated distribution pumps.
Material Storage	Secure storage of non-hazardous paint prep materials; typically includes a window for distribution of materials to paint personnel; may also include storage of paint process equipment and parts.
PPE Storage	Room/area designated for secure storage of PPE; storage of PPE is typically combined with PPE cleaning.
PPE Cleaning	Cleaning of personnel protective equipment; typically includes divided sinks; central washer and drier (optional).
Paint Booth	Individual paint spray booth for small parts (may be located inside hangar bay or exterior to building).

TABLE 1-1. ACCPF FUNCTIONAL PROGRAM AREAS

Functional Program Area	Description
Operational Spaces (cont'd)	
Stencil Room	Houses aircraft stencil equipment; room size should consider size of aircraft stencils as well as equipment.
Composite Room	Composite/fiberglass layup/repair room will typically contain work benches with ventilation hoods, and curing ovens for repair of composite parts.
Dry Media Equipment Room	Centralized dry blast media retrieval, processing and distribution equipment
Dry Media Storage Room	Bulk dry media storage (palletized)
Dry Media Blast Booth	Fully enclosed self -contained room specifically designed with the equipment and utilities for the removal of coatings by the DMB method, generally manually performed by a DMB nozzle operator stationed inside the booth.
Wash Rack	Accommodates aircraft cleaning and can be open, covered, enclosed, or integrated into the hangar bay.
Administrative Spaces	
Supervisor's Office	Private office located with view of hangar bay
Offices	Private offices and/or workstations determined by mission requirements
Conference Room	Small assembly with conference table and chairs
Fax/Copy	Centralized fax/copy room
Break Room	Personnel break and assembly room
Locker Rooms (clean)	Male and female locker/shower/toilet facilities
Locker Rooms (dirty)	Male and female lockers used for disposition contaminated clothing worn by operators during the performance of their corrosion control duties
Technical Library	Storage of aircraft technical documents
Maintenance Shops (option)	Optional mission-specific maintenance spaces
Support Spaces	
Mechanical Room(s)	HVAC and miscellaneous mechanical systems
Compressor Room	Plant air and breathing air compressor systems .Note specific requirements for Breathing Air vs. Plant Air
Central Plant	Centralized chilled water and heating hot water supply
Electrical Room(s)	Switchboards, motor control centers, distribution transformers, circuit breaker and lighting panels, VFD equipment
Fire Protection Room	Fire water riser, distribution manifold, AFFF or HEF storage tanks
Communication Room(s)	Telephone switchboard and misc communications equipment

Note: All spaces listed above in Table 1-1 are examples of spaces common to DFs and CCFs. Actual spaces included in the planning phase must be based on the specific mission of the facility.

1-5 FACILITY PROJECT TEAM.

The planning and design team for ACCPF must include the following specialists in addition to the standard architecture and engineering disciplines:

- Aircraft Corrosion Control and Prevention Operations
- Aircraft Maintenance Operations
- Industrial Hygiene
- Environmental Quality and Protection
- Safety
- Fire Marshall
- Facility Maintenance
- Energy Manager
- Flight line and AT/FP Security

1-6 PROGRAM AUTHORITIES.

Prior to project development, confirm the acquisition methodology and coordinate facility requirements with the following contacts for the appropriate Service:

- Army. Aviation and Missile Command Corrosion Program Office
- Air Force. AF Corrosion Prevention and Control Office (AFCPCO)

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CHAPTER 2 PLANNING AND LAYOUT

2-1 FACILITY FUNCTION.

Design the corrosion control hangar to provide space and equipment for the specific corrosion control functions required by the project mission. These corrosion control functions can be performed at either a DF or CCF.

In general, base facilities designed for DF perform de-paint/re-paint maintenance on the entire aircraft. Base facilities designed for CCF perform de-paint/re-paint maintenance on repaired or replaced components only. Service-specific corrosion control requirements are defined in the following documents:

- Army and Navy. NAVAIR Technical Manual NAVAIR 01-1A-509-1, *Cleaning and Corrosion Control*
- Air Force. *Air Force Corrosion Control Facility Reference Guide*

Aircraft Corrosion Control Facilities, as a whole, encompass the following functions:

- Aircraft washing
- Repair and Touchup Painting
- Full Aircraft Repainting
- Finish Curing and Drying
- Depaint (Chemical and Dry Media)
- Component painting
- Paint mixing
- Chemical/paint storage

2-1.2 Depot Level Facilities.

The primary function of a Depot Level Paint or De-paint Facility is to provide the necessary space and services to perform complete corrosion control activities on aircraft undergoing scheduled major maintenance checks or a scheduled complete corrosion control repaint. Depot level facilities must be capable of providing complete services required for all operations involved with the total paint, or de-paint of an entire aircraft. While chemical de-paint operations are often performed in a depot level Paint Facility, Dry Media Blast operations must be performed only in facilities specifically designed and built for the DMB de-paint function.

2-1.3 Corrosion Control Facilities.

The primary function of a Corrosion Control Facility is the performance of minor corrosion control activities in support of an active squadron as part of non-scheduled maintenance completed on an as needed basis. Corrosion Control Facilities, in general,

must be able to perform all the functions listed above with the exception of the DMB De-paint. As noted above in 2-1.1, the DMB De-paint function should be reserved for a Depot Level Facility. The planner should also be aware that if the mission of the CCF includes the requirement to repaint an entire aircraft or any part of the aircraft, airflow requirements in the CCF paint bay will be the same as the Paint Finishing (Depot Level) Hangar.

In some cases, the mission of the CCF may require special functions such as composite or sheet metal repair. Extra shops will be needed for the completion of these tasks.

The primary difference then between the DF and the CCF is the projected aircraft throughput versus the necessity for operational flexibility.

Table 2-1 ACCPF PLANNING ISSUES, below provides the different functional issues which must be considered when planning a CCF or DF which must fulfill the mission requirements, and also be safe, cost effective, energy efficient, and environmentally compatible.

TABLE 2-1. ACCPF PLANNING ISSUES

Planning Issue	CCF	DF
GENERAL	*Low Aircraft Throughput *Greater Process Variety *Shorter Process durations *Increased Downtime *Limited Number of Personnel *Fueled aircraft	*High Aircraft Throughput *Limited Processes required *Longer Process durations *Minimum Downtime *More Personnel Involved *Defueled and purged Aircraft
SPACE PLANNING	Consider number of hangar bays WRT aircraft throughput & operation specialization. Lower personnel = lower area required for amenities. Higher number of processes = higher number of specialty spaces (Back shops)	Consider number of hangar bays WRT aircraft throughput and processes performed. High personnel reqs = large area needed for amenities. Minimum specialized processes = fewer number of Back Shops.
HVAC DESIGN PLANNING	Increased downtime allows for use of prevailing weather to provide window of opportunity for correct Temp/ humidity conditions. Heating only systems typical. Horizontal air flow offers flexible, economic Supply Air design.	24/7 type operations with minimum downtime call for full temp./ humid. HVAC Systems. Exhaust Recirc + add'l energy recovery systems should be considered. Downflow Air Supply an option; offers high quality "Auto" finish; with fast production for hangars designed for single aircraft.
FACILITY ENVIRONMENTAL	Air: Consider air emissions WRT overall Base Permit.	Air: Consider air emissions WRT overall Base Permit.

TABLE 2-1. ACCPF PLANNING ISSUES

Planning Issue	CCF	DF
IMPACT	Water: Consider Industrial Waste (IW) treatment requirements wrt existing base capabilities and capacity	Water: Consider increased and special CCF Waste treatment reqs. with respect to existing base capacity, and possible need for a new WT system required for pretreatment of IW effluent
MECHANICAL EQUIPMENT REPAIR & REDUNDANCY	Increased available hangar downtime allows for less critical timing for repair/replacement of failed systems.	Longer processes, low available downtime mandate an increased level of redundant equipment.
FIRE PROTECTION	AFFF, HEF and/or DELUGE FP systems required for facilities housing aircraft with any fuel on board.	Typical installation for defueled and purged aircraft requires a closed head sprinkler FP system
	Fewer personnel, shorter processes call for minimal number of Ceiling supported man lifts, high use of ground supported man lifts and maintenance stands	Higher number of personnel with longer processes call for higher density of Ceiling & ground supported man aboard systems
WORKER ACCESS/SAFETY	Fall Protection required.	Fall Protection required.
	Change Rooms, Lockers, Showers and Contamination Control required.	Change Rooms, Lockers, Showers and Contamination Control required.

2-1.4 Wash Racks.

The variety of wash racks are as follows and are discussed in greater detail in UFC 3-260-01, *Airfield and Heliport Planning and Design*:

a. Open (uncovered) Wash Rack – an open air paved area specifically designed for the manual washing of aircraft. This facility should include wash utilities, drainage capability for both storm water and wash water waste, and may include lighting and power outlets for night operations, depending on the mission.

b. The Covered Wash Rack – The Covered facility will provide the same capabilities as noted above in Item A. with the added benefit of a non-climate controlled roof structure, typically with open sides. The covered

facilities are used primarily to keep aircraft out of direct sun to reduce the skin temperature and improve wash conditions.

c. Interior Wash Racks –Interior Wash Racks for the purpose of this document will be considered fully enclosed environmentally controlled facilities with all utilities required for the washing of aircraft. The DF (Paint) and CCF as described in this document are required to provide all services for the Interior Wash Rack. Please refer to the appropriate DF and CCF sections for those requirements.

d. Birdbaths (Aircraft Rinse Facility) – An Aircraft Rinse Facility referred to as a ”Birdbath” provides an unattended taxi-through treadle-operated freshwater deluge system to rinse aircraft typically subjected to accelerated corrosion due to low-level over water operations or a corrosive atmosphere at the installation.

2-1.5 Multi-Use Facilities.

Multi-use facilities, for the purpose of this document, refer to ACCPF that include functions outside the family of corrosion control, such as Fuel Cell or Maintenance activities. This document does not address those functions outside the corrosion control capability nor the special requirements those functions may impose on an ACCPF facility.

2-1.6 Technical Complexity of Ventilation Systems

Corrosion control facilities normally require complex, and expensive ventilation systems in order to comply with applicable environmental, fire protection, and occupational health requirements. It is essential that the system requirements and costs are identified during the project development and are included on the DD Form 1391.

The DD Form 1391 should also note that the facility requirements include the mandatory need for mechanical ventilation to remove paint particulates and solvent vapors. The inclusion of this statement, as well as including the costs for the system (including the acceptance test and associated report), as a separate line item in the facility cost estimate will help ensure that adequate funds are allocated for this extremely costly requirement. An example of a statement that might be included on the DD Form 1391 is shown below:

“Mechanical Ventilation is required to remove paint particulate and solvent vapors from the Corrosion Control Facility. Upon facility completion, an independent ventilation expert must evaluate the effectiveness of the mechanical ventilation system. The ventilation expert must provide a detailed evaluation report with recommendations regarding system acceptance and corrective action for discrepancies”.

2-1.7 Equipment Planning Issues.

It is imperative that all operational equipment anticipated for use in the new facility be identified and programmed early in the planning process in order to ensure the provision of adequate space and utilities in the facility design.

2-2 LOCATION DETERMINANTS.

2-2.1 Geographical Location

The location of a Depot Level and Corrosion Control Facility is generally predetermined by mission requirements, and climate is typically not a determining factor in location selection. Climate, however, has a significant effect on the design, energy usage and operational constraints of the facility. As part of the statement(s) which will go into DD Form 1391 regarding the mechanical ventilation system (ref. paragraph 2-1.5, above), the steps outlined in Section 2-3 HVAC System Selection must first be followed to determine the level, complexity and estimated cost of the proposed hangar bay HVAC system required to meet the mission of the facility.

2-2.2 Site Orientation.

Consider the prevailing wind in orienting the building in relation to aprons, taxiways, and parking, to avoid exhaust air dispersal over areas affected by solvent vapors and to avoid recirculation into the ventilation system intakes.

Orient hangar such that it complies with all geometric requirements of UFC 3-260-01.

2-2.3 Site Organization.

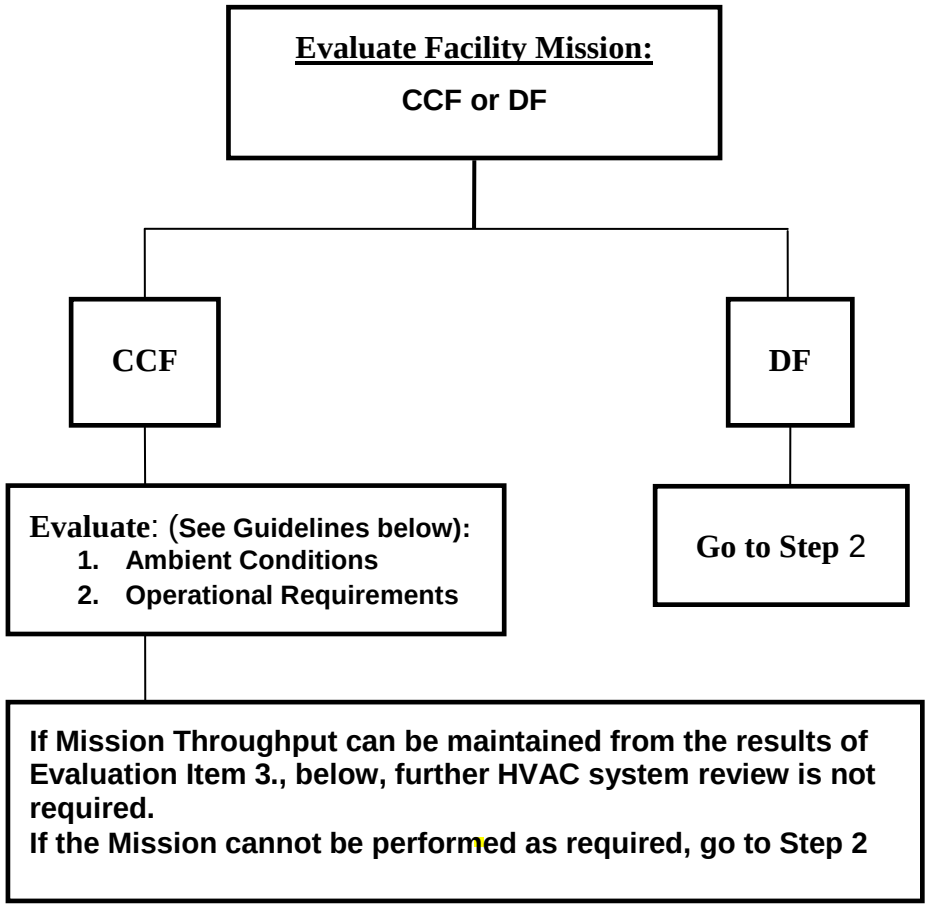
Locate the corrosion control hangar in close proximity to the maintenance hangars and as close as possible to an aircraft wash rack. Access between the corrosion control hangar, the maintenance hangar, and the aircraft wash rack is required. Locate the paint-finishing hangar with due regard to the requirement for aircraft and vehicle access.

2-3 HVAC SYSTEM PLANNING & SELECTION.

Non-process areas of hangars must meet all energy efficiency goals. Process areas must meet energy goals as much as practical. Systems also must conform to the latest service-specific policies for energy efficiency. See Chapter 3 for design applications and requirements for specific HVAC systems. For the initial facility planning phase, use the following steps in selecting the HVAC system for the Hangar Bay which will house the aircraft spray painting operations.

STEP 1. Define the facility mission to determine facility type (CCF vs. DF) and process requirements to establish HVAC objectives per Figure 2-1.

FIGURE 2-1. HVAC SYSTEM SELECTION STEP 1



1. CCF Baseline is 100% OA. See UFC 3-400-02 for dry bulb & humidity parameters: MEL, MEH@2%, MEH@97.5%, HR@2%. Evaluate need for heating for operations (~75 deg F [23.9 C]) and freeze protection based on ambient conditions. Also evaluate need for heat recovery.

2. Evaluate the operational requirements for temp and humidity and compare to the ambient conditions.

3. Establish the effect of 1. & 2 on the Mission Performance and Throughput

STEP 2. Identify requirements for interior conditions of the process hangar bay per Figure 2-2.

FIGURE 2-2. HVAC SYSTEM SELECTION STEP 2 TEMPLATE

Process Mode	Interior Conditions					
	% Usage Per Year	TEMP (F)*		RH*		Air Flow Requirements
		Max	Min	Max	Min	
Unoccupied						
Paint Prep						
Paint Removal						
Pre-treatment						
Paint						
Cure						
Min-Occupancy						

* Interior Conditions must be based on the more stringent of 1) coating manufacturer's temperature and relative humidity requirements or 2) personnel heat stress limitations per Chapter 3, Mechanical.

STEP 3. Establish a baseline HVAC System which represents the lowest perceived capital first cost that fulfills the requirements of Step 2. Based on the baseline system, develop an energy budget for each process. Service specific guidelines and the minimum guidelines of ASHRAE 90.1 must also be followed for auxiliary spaces.

Note that during the development of the energy budget, consideration should be given to utilization of the ambient conditions as much as possible during processes which require large amounts of outside air.

STEP 4. Analyze alternative HVAC systems and/or energy conserving methods as determined appropriate for the application as potential additions or alternatives to the baseline system. Examples of alternative systems or methods include recirculation, heat recovery, and ice storage.

With the emphasis on energy conservation along with recent improvements in mechanical system technology, recirculation of ventilation air is now being recognized as an accepted alternative to improving energy efficiency in a spray paint environment. The effectiveness of recirculation in reducing energy usage can vary widely depending upon climate. In locations where much energy is expended to keep the temperature and humidity of the facility within operational parameters, recirculation may be easily justified from an economic perspective. In very temperate climates, the mechanical complexity and additional equipment required for a recirculated ventilation system may negate the climate control savings advantage. It is important to evaluate the economic impact of recirculation over time based on anticipated energy savings. Also included in the evaluation for determination of exhaust air recirculation are the OSHA regulatory issues related to personnel safety and the required monitoring of the ventilation air and operations personnel.

STEP 5. Establish the potential Life Cycle Cost Analysis (LCCA) benefit to the project and select system with the lowest Life Cycle Cost (LCC) which fulfills current occupational safety, health, energy efficiency, and other related standards for the facility's process spaces.

2-4 LAYOUT AND ADJACENCIES.

2-4.1 General Building Layout and Adjacencies.

The appropriate building layout and adjacencies are illustrated in Figures 2-3 and 2-4. These diagrams do not convey a building shape. Figures 2-3a and 2-3b represents the DF and Figure 2-4 represents the CCF. Figure 2-5 provides a schematic representation of the personnel flow from the "dirty" or "hot" hangar bay areas and the "clean" or "cold" areas. This is to prevent any contamination from the cleaning, depainting or painting agents used in the hangar bay reaching the clean areas where protective equipment is not required.

Arrange work-bays so that each has ready access to the outside and to equipment and storage spaces of the hangar. Isolate work-bays in which cleaning and stripping are done from work-bays in which painting and curing are done. Administrative spaces such as work control offices may be accommodated in mezzanines. Provide mechanical equipment rooms with outside access. "Break" rooms must be on "clean" side, but areas can be included on "dirty" side for brief breaks without eating.

FIGURE 2-3a. DF PAINT & CHEMICAL DEPAINT BUBBLE DIAGRAM

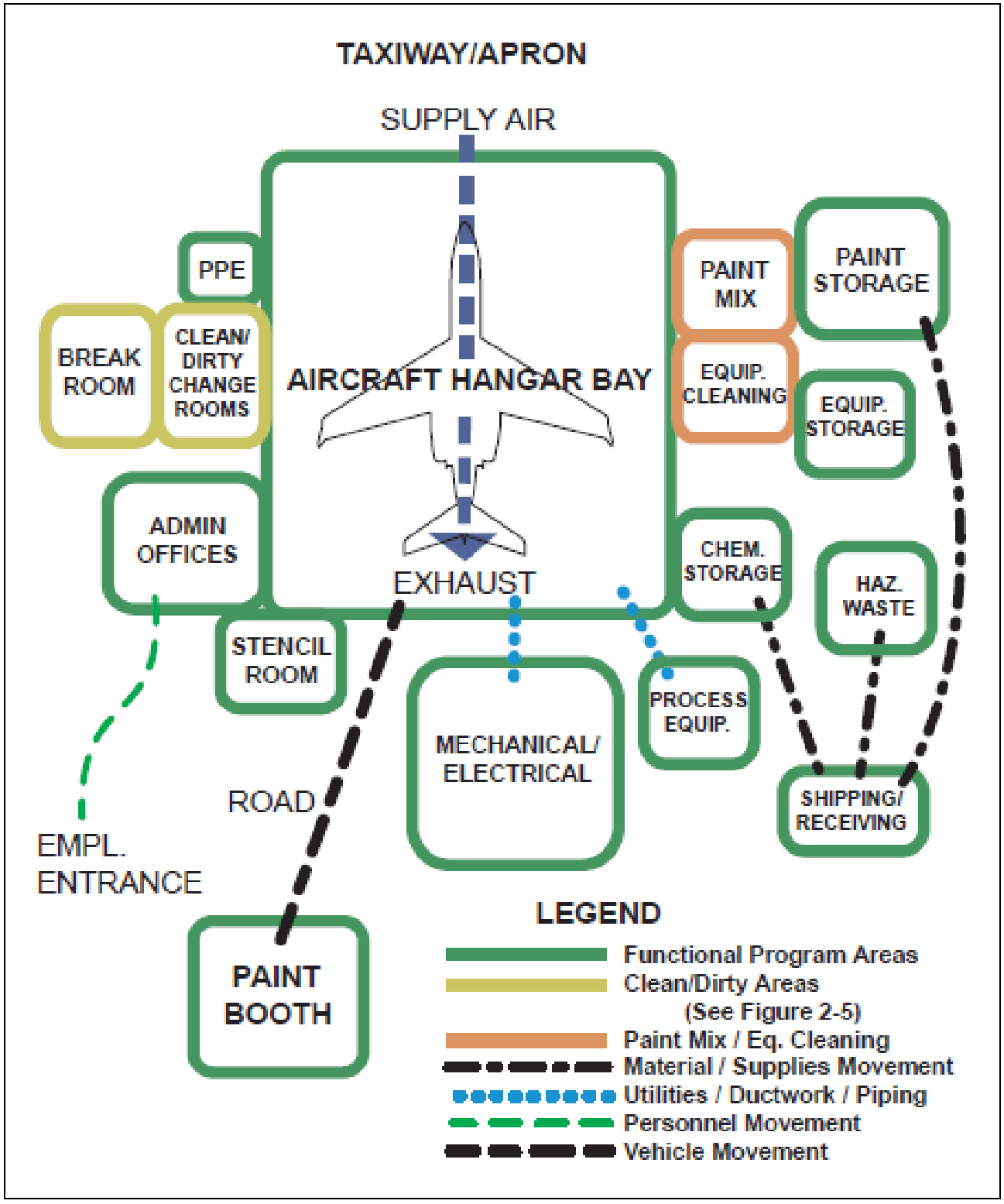


FIGURE 2-3b. DF DRY MEDIA DEPAINT BUBBLE DIAGRAM

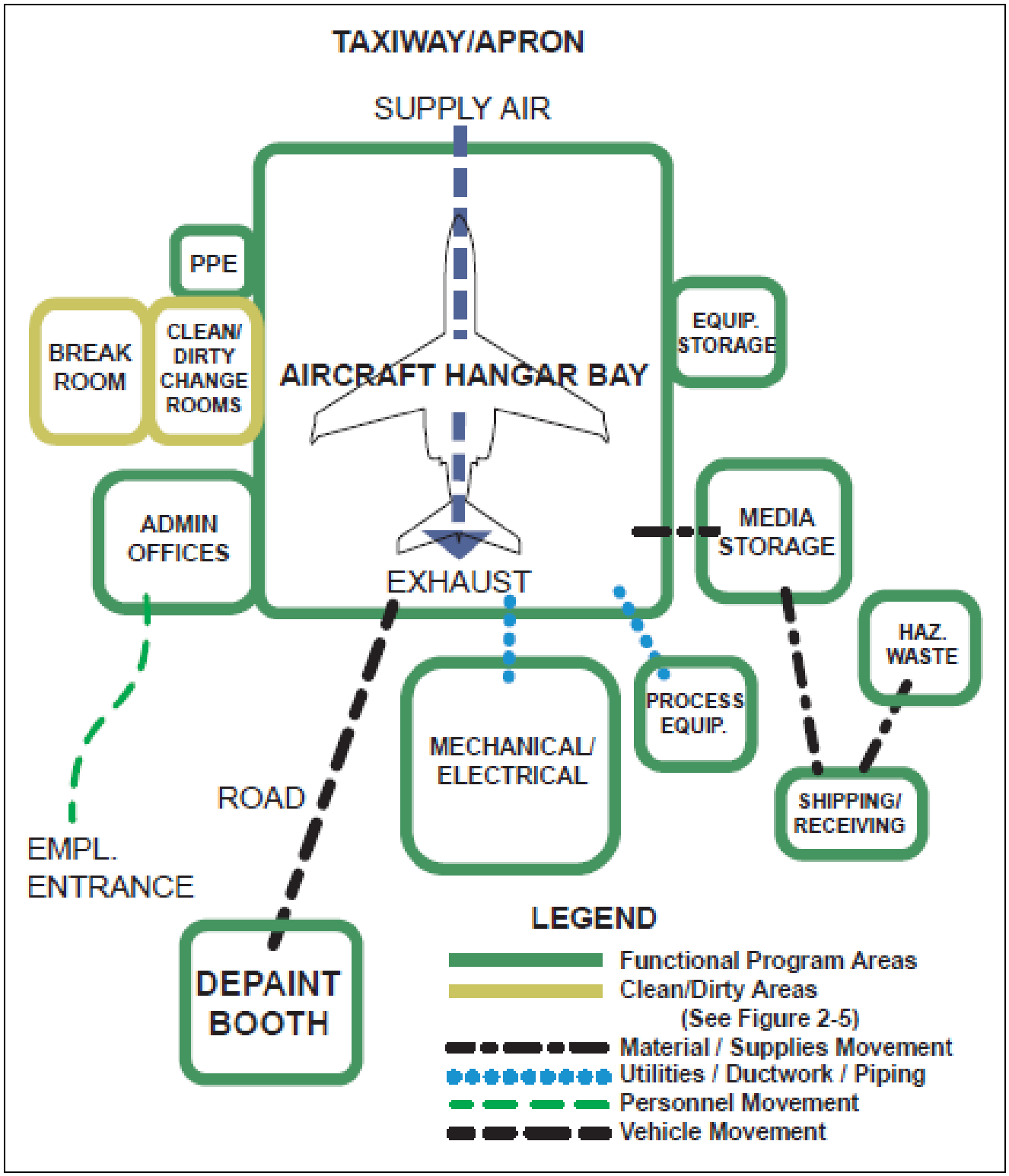


FIGURE 2-4. CCF BUBBLE DIAGRAM

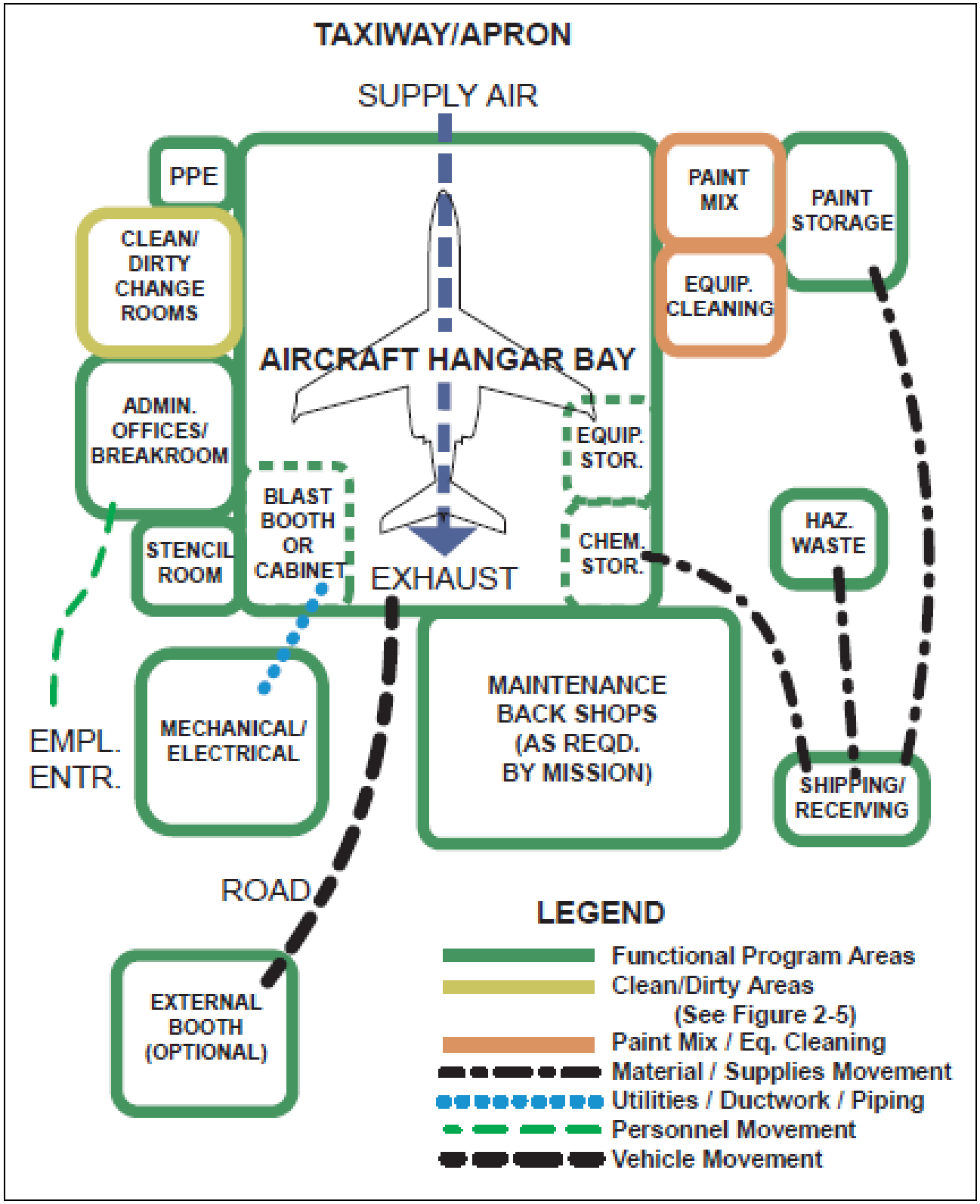
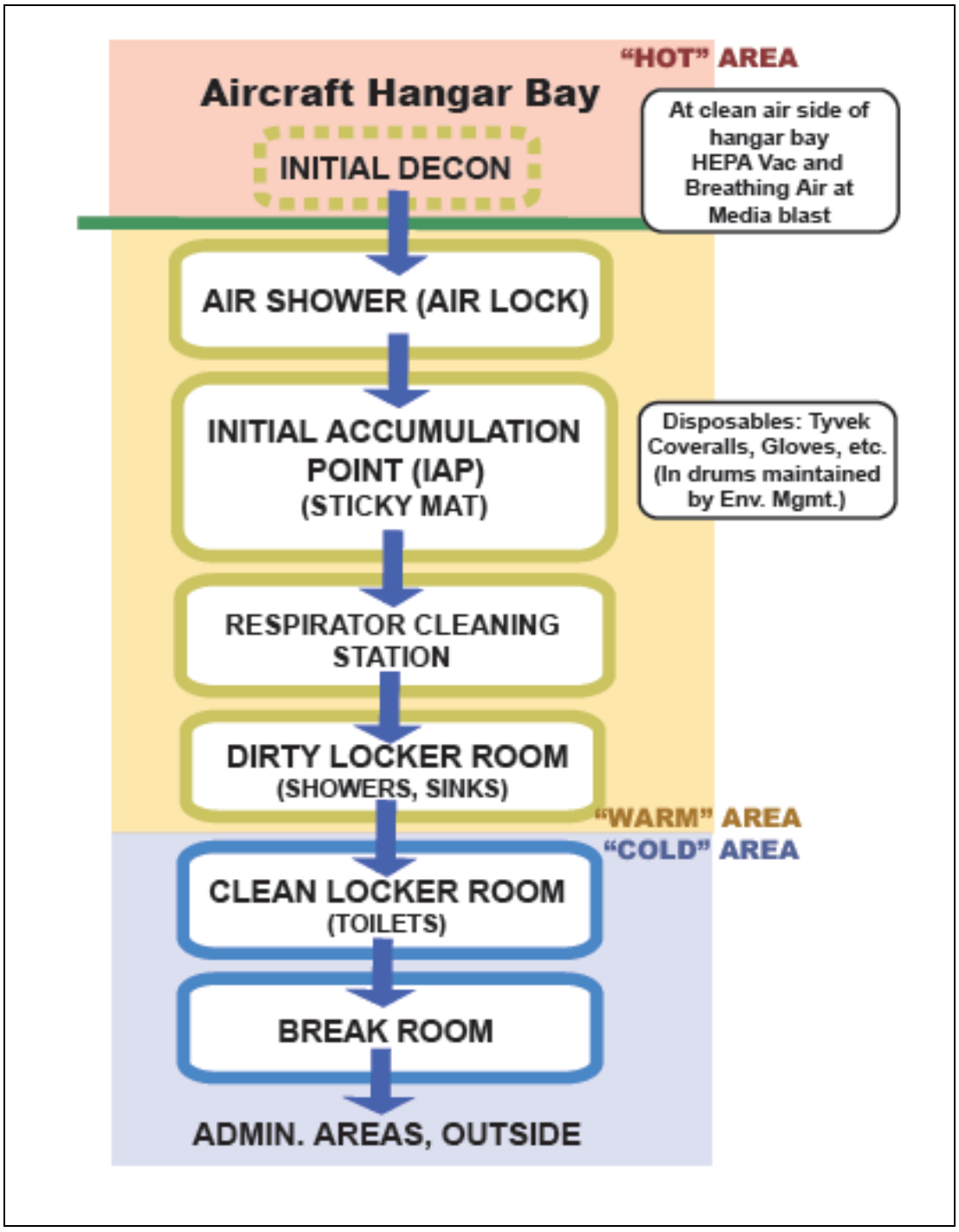


FIGURE 2-5. CLEAN-DIRTY SCHEMATIC



2-4.2 Combining Corrosion Control Functions.

Combining functions within the family of corrosion control tasks may only be considered as follows:

- Paint facilities may include both paint and chemical depaint functions with special care taken to address the industrial waste issues of chemical de-paint operations.
- All CCFs and DFs should have a wash function inside the hangar as described in this document as well as paint spray and/or chemical depaint capability (exception: dry depaint facilities will not have a wash function within the hangar bay, but will coordinate with near or adjacent wash racks).
- Performing Paint or Chemical De-paint functions in a facility where Dry Media Blast stripping operations take place is not allowed due to the critical nature of maintaining a dry environment for the Dry Media and the de-paint equipment. Dry Media Stripping and Painting/Chemical De-paint must always be accomplished in separate areas. If grinding operations (scuff sanding) are performed in a Paint Facility, vacuum pickup equipment must be utilized to minimize the spread of dust in the hangar bay. Every effort must be made to maintain a dust free environment where painting is performed.

2-5 FACILITY STUDY.

Due to the complexity and unique characteristics of Aircraft Corrosion Control & Paint Facilities, a facility study must be performed on all proposed CCF and DF projects to determine space and process system requirements.

2-5.1 Space Criteria.

ACCPF space needs are site and mission specific and must be individually programmed based on a facility study. Space program development guidance is provided in UFC 3-260-01, *Airfield and Heliport Planning and Design* and the following documents:

- Army TM 5-803-5, *Installation Design*
- Navy UFC 2-000-05N (P-80), *Facility Planning Criteria for Navy and Marine Corps Shore Installations*.
- Air Force AFH 32-1084, *Facility Requirements*
- *Department of Defense Unified Facilities Criteria UFC 3-101-01, Architecture*

Certain spaces are not defined specifically in space programming criteria. These spaces include air recirculation rooms, fan rooms, and filter plenums for example. These spaces should be considered and added to the space criteria if anticipated.

2-5.2 Facility Space Criteria Study.

Prepare a facility study with input from Chapter 1, Program Authorities, and Chapter 1, Facility Project Team. Also see Appendix B Section 2.2 for design guidance on programming an accurate estimate of the gross area for a new ACCPF. Ensure that the clearance factors in 2-5.3 are addressed in the facility space study to accurately determine the total square footage for the new facility.

2-5.3 Minimum Clearances and Working Space.

For minimum safety clearances based on aircraft type, reference the following documents:

- Army & Air Force: UFC 3-260-01, *Airfield and Heliport Planning and Design*
- Navy: UFC 2-000-05N, (P-80), *Facility Planning Criteria for Navy and Marine Corps Shore Installations*

The size of the various aircraft scheduled to use the facility will determine the hangar bay dimensions. Determine the interior dimensions of the Corrosion Control facility, by using the dimensions of the largest aircraft that will occupy the facility, and adding the minimum clearances indicated below. Include additional space as required for tow vehicles and turning radii. Size the bay to accommodate fixed-wing aircraft with wings unfolded, and helicopters and V-22 with rotors in place and unfolded unless it has been determined that aircraft surfaces are accessible with the wings/rotors folded. Verify the configuration of rotors on rotary aircraft undergoing corrosion control when sizing the process (hangar) bay.

The following minimum operational clearances are required to allow proper access for work platforms and to minimize paint overspray on hangar walls and ceilings:

- Top of aircraft (vertical fin, radome, rotor head, tail rotor) to underside of ceiling - 10 ft (3.0 m); For hangar bays required to have draft curtains, clearance must be to lowest point of draft curtains.
- Nose of aircraft to hangar door - 10 ft (3.0 m);
- Tail of aircraft or tail rotor to exhaust target wall - 10 ft (3.0 m); and
- Horizontal and vertical clearance from aircraft to inside face of open front door - 5 ft (1.5 m). In addition to these clearances, an approximate thickness of the supply and exhaust plenum (T) is required to properly size the gross area of the hangar bay. The equation T = 1/5H defines this approximate depth where H is the height of the aircraft at its highest point plus 5 ft (1.5 m). Note that the depth (T) does not include the thickness of the structure of the door or the filter media. The actual plenum thicknesses are dependent on the airflow required to ensure laminar flow in the hangar and as appropriate for the corrosion control and painting activities.

- Additional clearance between the work platforms and the hangar walls should be considered with respect to circulation space around the aircraft and avoiding pinch points, particularly at the wing tips. Consider tug and cart travel including turning radiuses in developing the required circulation clearances.

Base the number of hangar bays for each site on an analysis of aircraft types, production schedules, hours required for each corrosion control operation, and number of work shifts. Moveable partitions to subdivide the bay are discouraged, as they introduce complications to exiting, fire protection, air flow and balance. Separate spaces where painting is being done from bays in which dry stripping, blasting, or grinding are done.

2-5.4 Ancillary Spaces.

Provide the following Ancillary spaces as a minimum for the Facility

- Ancillary space requirements will vary based on facility requirements. Provide spaces for paint mixing, paint storage, waste paint area, bead blast rooms, gear equipment and tools, office, nondestructive inspection, strip/rinse, paint spray, and dry storage. Base the size of the rooms on the workload. Provide exit doors to the outside for rooms designated for storing or mixing chemicals or paints. Provide a depressed floor slab or doorsills with ramps to contain spills. Separate spaces where sanding, blasting, or grinding are done from spaces where painting is done.
- Provide storage space for dry filters. Provide stairs for personnel and a jib crane for materials transport to the roof or upper floors.
- Provide a loading dock with a manual dock leveler.
- Provide space for work on composite parts including helicopter rotor blades if applicable.
- Locate utilities on the side walls. Use of utility pits in hangar floors is prohibited.
- Decontamination Facilities (See Figure 2-5 for a schematic showing separation of clean and dirty areas):
- For operations where employees may be exposed to harmful contaminants, provide the following:

  a. An Initial Decontamination Area inside, or adjacent to the hangar bay. Provide HEPA vacuum for removing accumulations of contaminants from PPE. When located in the Hangar Bay, this area must be on the “clean side”, i.e. close to the supply air side and away from the exhaust air side.

  b. A walk-through vestibule with air shower (Air Lock) to capture contaminants between the Initial Decontamination Area and the Initial Accumulation Point.

c. An Initial Accumulation Point with space for drums for disposable PPE.

d. Provide an area with a sink for cleaning, drying and storing respirators.

e. Shower facilities with hot and cold water.

f. Change rooms with separate lockers for protective clothing and street clothes.

g. Toilet facilities must be located on the clean side of the locker rooms.

- Paint Mixing Rooms:

  All dispensing or transfer of flammable liquids from containers, mixing of flammable liquids, and filling of containers, including paint guns and pressure pots must be done only in an approved spray booth or mixing room. A separate paint mixing room will significantly reduce the amount of clutter in the paint booth. A properly designed and located paint mixing room must accommodate all equipment, cabinets, and tables associated with paint mixing and daily-use storage of paints and thinners, which otherwise, would be housed within the confines of the paint booth. Installing prefabricated mixing booth is a simple method to incorporate a separate mixing area into a new or existing facility.

  The design requirements in Chapter 3 are generally applicable to Paint Mixing Rooms. Additional requirements are listed below:

a. The size of the mixing room must not exceed 150 ft2 (14 m2).

b. Must have continuous mechanical ventilation as specified in NFPA 30.

c. Mixing rooms should be provided with a floor drain to make it possible to wash down spills. However, local installations must ensure that collection sumps are installed in the floor drain system and (or) that the wastewater treatment plant can process the spillage. If this is not the case, local installations must develop an alternate means of cleaning up the spillage.

d. Agitators must be driven by compressed air, water, low-pressure steam, or electricity. If powered by an electric motor agitator must meet all electrical codes and standards.

e. An EyeWash/Safety Shower must be located inside or adjacent to a Paint Mixing Room.

- Flammable and Combustible Liquid Storage

  Storage of flammable or combustible storage, in cabinets, specially designed room within the facility or in a detached structure is required.

  Design must comply with UFC 3-600-01, NFPA 80, and 29 CFR 1910.106. AFOSHSTD 91-17 also applies for Air Force Projects.

2-6 HEALTH, SAFETY AND THE ENVIRONMENT.

Planning activities for an ACCPF must address all requirements for worker health and safety, and environmental permitting. Compliance with all health, safety, and environmental regulations is required and is achievable without significantly disrupting the operations if adequate advanced planning and coordination is performed. These issues must be incorporated into the selection of HVAC Systems per this Chapter and Chapter 3. Appendix C provides an overview of the applicable environmental standards.

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CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL.

UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, sustainability, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

3-2 ARCHITECTURE.

3-2.1 Exterior Design.

3-2.1.1 Specular Reflectance.

To prevent mirror-like reflections from building surfaces to aircraft in flight, roofs and other external surfaces must have a specular reflectance compatible with the location of the building on the airfield.

3-2.1.2 Operational Hazard Glare.

If the building is located so that glare may be an operational hazard, the critical surfaces of the building must have a light reflectance of not more than 10, measured at an angle of 85 degrees in accordance with ASTM D523, *Standard Test Method for Specular Gloss*.

3-2.1.3 Roof.

The roof must be a smooth surface type or metal standing seam system. Exposed fastener (“Screw Down”) metal roofs must not be specified. If a membrane roof is chosen, gravel or any other material which could become loose and carried off the roof in high winds will not be permitted. The membrane must be specified as being capable of flexing in both directions independent of the roof structure.

Provide exterior access to the high roof the through a secured access panel or hatch, to prohibit unauthorized passage.

Roofs must slope only to the rear or sides of the hangar and not towards the flightline.

3-2.1.4 Exterior Walls.

Exterior walls must be impact resistant material coated with a weather resistant baked on PVDF finish or similar product.

Provide seals at doors, wall penetrations, and building joints in the hangar bays and ancillary spaces to ensure airtight performance to maintain pressure differentials and prevent contamination of the air in the hangar bay.

3-2.1.5 Doors.

3-2.1.5.1 Hangar Doors.

Hangar doors defined in this section are a specialized, insulated, hangar Supply Air type with swinging or sliding leaves. These doors are designed to serve as insulated supply air plenums when closed. Eighteen (18) gauge galvanized steel perforated plates are to be placed on the inside face of in the supply air plenums with a means to allow for balancing air of distribution to achieve evenly distributed laminar flow in the hangar bay. The hangar door acts as a plenum, thus see Section 3-5.2.8 Ventilation System Configurations for additional design criteria to construct Supply and Exhaust Plenums for horizontal laminar air flow. Other arrangements may be used if the required calculations are performed or if alternative successful designs can be proven. A Computational Fluid Dynamics study is required or other means of verification of the air delivery method if the proposed system is unproven.

The hangar doors must be electric motor operated. Each leaf must operate independently from its' own drive unit. Each drive unit must have a release mechanism, and the doors must be provided with a means of mechanical attachment for movement in the event of power failure. The minimum speed of door travel must be 60 feet (18.29 meters) per minute. Thresholds must be designed to minimize dirt accumulation and ice buildup.

Control of the doors must be by momentary contact type push buttons located near the leading edge on both sides of the door with limit switches on each door leaf to stop door movement. Safety devices must be installed to prevent injury to personnel and damage to equipment by moving door sections. If personnel access doors are provided in the hangar door leaves, an interlock must be installed at each access door to prevent operation of the hangar door leaves when the personnel access doors are open and halt the hangar door leaves in the event a personnel access door is opened while the hangar door leaves are in operation. An alarm must sound in conjunction with safety warning beacons when doors are in motion. Sliding steel hangar doors must be in accordance with UFGS 08 34 16, *Corrosion Control Hangar Doors*.

Configure horizontal sliding hangar doors such that they are operable during power outages, by both manual and electrical means (electrical means via emergency power).

3-2.1.5.2 Other Doors.

No hold-open devices are permitted. Take special precautions to seal doors between hangar areas and exterior or adjacent spaces.

Exterior doors with closers must be Level 4, physical performance Level A doors complying with ANSI/SDI A250.8. Frames must match door level. Exterior door frames must be welded type.

Provide Grade 1 hardware typical. Locksets must be mortise type, Series 1000 as defined by ANSI/BHMA A156.13. Hinges for all doors must be rated for heavy-duty. Closers must be the best and highest grade available from each manufacturer. Exterior doors must have overhead rain drips and door drips.

3-2.2 Interior Design.

3-2.2.1 Interior Walls.

See UFC 1-200-01, NFPA 101 and the IBC for general area separation requirements for interior walls. For Army and Navy projects, separate hangar bays in multiple-bay structures by 3-hour fire-rated walls. For Air Force projects, see ETL 02-15 for separation requirements.

Provide wall penetrations and building joints in the hangar bays and ancillary spaces to ensure airtight performance to maintain pressure differentials and prevent contamination of the air in the hangar bay.

The hangar bay must be provided with durable finishes. The exterior walls must have as a minimum, a protective panel along the exterior walls that will prevent damage to the exterior finish system. Generally, a hangar bay will be comprised of metal wall panels and protection must be provided from the interior of the hangar bay. The minimum protection can be provided by a non-insulated metal panel attached to the wall panel girts. The protective panel must extend to at least 7 feet (2.13 meters) above the hangar floor. Alternatively, a masonry panel may be provided.

All unfinished items must be painted. A wall base is not required in the hangar bay.

Partitions must extend to the floor or roof construction above unless allowed in the following sections.

Walls must be painted concrete masonry units or concrete around shop spaces. For shops without ceilings, partitions must extend to floor construction above.

Partitions separating administrative spaces may be gypsum board construction. Partitions may extend to above the ceiling for similar office types and spaces where noise between offices is not an acoustical issue. Extend walls to ceiling adjacent to noise-producing areas. Paint all unfinished materials.

Provide Concrete Masonry Unit (CMU) partitions around toilet and locker rooms. Partitions around perimeter of space must extend to floor or roof construction above. Provide ceramic tile wainscot and ceramic base. Provide ceramic tile wall finishes to the ceiling on all walls in showers.

3-2.2.2 Surface Treatment.

Provide the sidewalls, the inside of hangar doors, and the ceiling of the hangar area with a light color, smooth surface such as white enameled metal panels.

3-2.2.3 Floors.

Floors must meet the following criteria:

- The hangar area floor must be designed in accordance with criteria in UFC 3-260-02, *Pavement Design for Airfields*.
- Design other floors in accordance with UFC 1-200-01. Install resilient tile or sheet floor coverings.
- For new construction, provide a white dry shake floor hardener as the topping on the floor slab in the hangar area. Use of a thin epoxy white reflective floor coating is not recommended

3-2.2.4 Ceilings

Aircraft bays and paint storage, mixing, and spray areas must have water-resistant gypsum ceilings or a metal panel ceiling system. Provide a 1-hour fire-rated ceiling in paint bays. Consideration should be given to utilization of the ceiling deck above the hangar bay as a walking surface for access to the overhead light fixtures and also mechanical and electrical distribution systems generally located in the ceiling space above the hangar bay.

Provide suspended acoustical ceilings for corridors, toilets, locker rooms, and offices. Install suspended acoustical ceiling panels with vinyl plastic surfaces in shower areas.

3-2.3 Acoustics.

Develop a comprehensive acoustical design for the facility as required by UFC 3-101-01. Design the facility to provide a comfortable acoustical environment that limits exterior and interior noise intrusion to sensitive spaces.

Due to the industrial nature of a Corrosion Control Facility, an Acoustical Study must be performed on all occupied spaces during the design phase of each project. This study will entail assigning ambient noise levels to every occupied space, identifying all sound generating equipment and sources, then determining the method of sound isolation or reduction required to meet the required ambient noise levels.

Once the project construction is complete and all noise generating sources are operational, a sound level check must be performed to verify that predicted ambient noise levels have been met. Spaces not meeting the sound design levels will require additional acoustical treatment to bring all areas into compliance.

3-3 CONVEYING SYSTEMS.

3-3.1 Weight Handling Equipment.

Weight Handling Equipment must be of spark-proof construction with an explosion-proof motor. Controls must be operable from the floor level and, when electric, must meet the requirements indicated in Chapter 3, Electrical.

3-4 PLUMBING.

3-4.1 Water and Sewer

Provide plumbing in accordance with UFC 3-420-01 and as follows:

- Provide one shower for every ten (10) employees (or fraction thereof) of each sex who are required to shower during the same shift. Each rest room must have direct access to appropriate lockers and showers.
- Emergency eyewash/safety showers where required must conform to Appendix D of UFC 3-420-01.
- Floor Drains in the hangar area, paint mixing rooms and paint equipment cleaning rooms must be connected to the Industrial Waste system or piped to an isolated holding pit for testing to determine proper disposal of effluent
- Locate storm-water drains at least 12 in (310 mm) from the hangar access door rails.

3-4.2 Industrial Waste.

Provide a connection to an Industrial Waste Treatment System or to a collection containment tank or pit from all drains in process areas.

Provide for zero discharge from the facility unless the facility will discharge to an existing or new industrial waste treatment facility (IWTF) or to a municipal sewer system. The IWTF must be capable of handling both the type and volume of the chemicals that will be discharged. Disposal into a municipal sewer system requires a minimum pretreatment in compliance with 40 CFR Part 403, or AFI 32-7041.

3-4.3 Control of Hazardous Effluents.

Provide AFFF/Sprinkler discharge collection/retention system when required by environmental regulations for testing and pre-treatment prior to discharge into the appropriate waste stream. For design of containment systems and disposal requirements for AFFF solution, refer to ETL 1110-3-481, *Containment and Disposal of Aqueous Film-Forming Foam Solution*.

The corrosion control process generates large amounts of water that could potentially hold solid or liquid paint residue or other solvents and wastes. If the local wastewater treatment plant cannot accept the effluent generated from the facility, on-site treatment or containment and off-site disposal is required. Refer to UFC 4-451-10N, *Design: Hazardous Waste Storage*, and UFC 4-832-01N, *Design: Industrial and Oily Wastewater Control*. Design for accidental spill of paint strippers and thinners, paint, cleaning solvents, pretreatment chemicals, fuel or oil. Provide above-grade containment of accidental spills with appropriate sumps for pumping and cleanup of spilled wastes. Size the containment capacity for the largest possible discharge. Provide a method to prevent the drains from clogging.

3-4.4 Compressed Air.

Provide low-pressure air for operation of tools and for breathing air in accordance with the following criteria:

- Provide low-pressure compressed air at 40 percent to 60 percent humidity and at 125 psig (862 kPa) for shop use. Air should be oil-free to prevent paint contamination. Air outlets supplying tools requiring lubrication should be equipped with an in-line lubricator. Rotary oil-free compressors are recommended since this compressed air may be used as a source for breathing air at lower life cycle costs.
- Provide low-pressure compressed air at 20 psig (138 kPa) or higher if required, at 40 percent to 60 percent humidity for breathing air in the hangar bays. The breathing air compressor must minimize moisture content so that the dew point is 10 degrees Fahrenheit (5.56 degrees Celsius) below the ambient temperature. Breathing air must be obtained from the oil-free shop air source through final purifiers in each bay or from a separate breathing air compressor and piping system that meets requirements by OSHA for minimum Grade D air as described in ANSI/CGA G-7.1 Commodity Specification for Air. Breathing air from the oil-free shop air source is preferred because of lower cost.
- The air outlets (quick connect fittings) for oil-free shop air, lubricated tool air, and breathing air must be different for each service and must not be compatible with each other.
- Typical outlet quantities for each bay are: four breathing and four oil-free shop air and two lubricated tool air. Typically, two oil-free shop air outlets are required per ancillary space. Verify actual requirements for each site.
- Locate the intake for breathing air in an uncontaminated area. Air-line respirators approved with a vortex tube will substantially reduce the temperature of the air supplied to the respirator in cases where the supplied air is from a high temperature environment

3-4.5 Process Systems.

The chemicals used in the aircraft corrosion control process can be hazardous to workers, corrosive to the facility infrastructure, and require considerable floor space to store, access, and distribute. The Using Activity must provide a complete list of all chemicals used in the process with relevant MSDS's to the design team during the planning and design phases to insure that the facility can control the hazards appropriately. The data sheets will also be utilized in the design of the process systems to select compatible materials to contain and distribute the process chemicals used in the aircraft preparation and painting.

3-5 HEATING, VENTILATING & AIR CONDITIONING (HVAC)

General requirements for HVAC design are identified in UFC 1-200-01. Additional design guidelines for LonWorks® based control systems include UFC 3-470-01,

Lonworks (R) Utility Monitoring and Control System (UMCS), and UFC 3-410-02, *Lonworks (R) Direct Digital Control for HVAC and Other Local Building Systems.*

3-5.1 Hangar Bay HVAC Process Requirements.

A. The required hangar bay design heating temperature will normally be between 70 degrees F (24 degrees C) and 90 degrees F (32 degrees C) with a relative humidity between 50 and 70 percent. Some activities may require higher temperatures to accelerate curing cycles. Process temperature & humidity requirements for the CCF Hangar Bay will be the more stringent of either the following:

- environmental requirements from the coating material manufacturer
- personnel heat stress criteria requirements per USACE document EM 385-1-1, *Safety and Health Requirements Manual*, OPNAV Instruction 5100.23G *Navy Safety & Occupational Health (SOH) Program Manual* (specific ref. to Heat Safety) and AETC Instruction 48-101, *Prevention of Heat Stress Disorders*

a. Provide a snow-melting system at the hangar door tracks when the outside design temperature is +25 degrees F (-4 degrees C) or lower and when historical snow data supports the requirement.

b. Heating must be suitable for operation in the vapor hazard condition in the hangar bay, flammable storage/mixing areas and paint equipment cleaning spaces.

c. Refer to the Functional Data Sheets for design conditions in the ancillary spaces.

d. Provide a means to meter separately the ancillary HVAC loads from the Process Ventilation loads.

e. The design of a Depot Level facility must include equipment redundancy relative to the projected aircraft throughput for all systems where a critical component failure would render the facility's mission non-operational and repair or replacement timing would delay the schedule objective.

3-5.2 Ventilation for Control of Air Contaminants and Flammable Vapors

3-5.2.1 Ventilation – General.

The objective of the process ventilation design is to provide a system that is safe, energy efficient and cost effective (installation and maintenance) and environmentally compliant while maintaining the primary goal of ensuring operator health and safety at all times.

NOTE: All facilities must be designed to the requirements of 29 CFR 1910.94 *Ventilation*, 29 CFR 1910.106, *Flammable and Combustible Liquids*, and 29 CFR

1910.107, *Spray Finishing Using Flammable and Combustible Materials* as well as NFPA 33 and Subpart Z of 29 CFR 1910.

3-5.2.2 Paint Spray Systems.

The use of High Volume Low Pressure (HVLP) and HVLP electrostatic paint application techniques greatly reduces the amount of overspray exposure to workers, versus conventional air atomization or air-assisted airless. The reduced overspray increases exhaust filter life. The use of electrostatic paint systems also reduces the airflow requirements (per 29 CFR 1910.107) and related fan size and horsepower. When working *inside* the aircraft, portable supply and exhaust ventilation systems may be needed to control occupational exposures in the enclosed space.

3-5.2.3 Supply Air Requirements.

Provide ventilation in accordance with NFPA 33 and ANSI/AIHA Z9.2, AIHA Z9.4, and ANSI/AIHA Z9.7; refer to Appendix B for further guidance. For conventional air atomization paint spray systems operating within a “Paint Booth”, the supply air system must furnish 100 percent filtered outside air at a horizontal laminar flow velocity of 100 fpm (0.508 m/s) across the entire cross section area of the hangar bay for worker safety and overspray control in accordance with OSHA.

Due to the large volume within aircraft hangars relative to the actual quantity of spray paint being applied, the designer may now define the paint operation envelope as a Paint Area instead of a Paint Booth. The Paint Area interpretation of aircraft paint operations is concerned with the envelop within and immediately surrounding the paint sprayers (29 CFR 1910.107 (a)(2)). The volume of outside air and the velocity of the airflow may be decreased from that required for an entire hangar bay under the conventional interpretation as a Paint Booth in accordance with OSHA and its interpretations for consideration of Paint Spray Areas vs. Paint Booths. The reduction of the airflow cross sectional area must be reviewed with the local Industrial Hygienist and Safety entities and verified with an airflow study as part of the design process. Ultimate interpretation and acceptance of a paint spray envelop designation as a Paint Area will come from the local Industrial Hygienist, Safety entities and the other “Authorities Having Jurisdiction”.

OSHA also allows for a reduction in airflow velocity for paint spray systems which improve capture and reduce overspray. The minimum maintained air velocity required for hand held electrostatic paint spray operations as specified in 29 CFR 1910.107 (b)(5)(i) is 60 linear fpm. However, the requirements currently contained in 29 CFR 1910.94 (c)(6)(i) Table G-10 are somewhat more lenient and allows a range of 50-75 linear fpm. Due to the minor variations in these requirements, any Design Team planning a paint facility that will be used exclusively for electrostatic paint spraying must contact their local fire protection and bio-environmental engineering functions for guidance on current local OSHA interpretations.

Additional considerations for reducing the air volume requirements through a hangar bay during paint spray operations are as follows:

- Minimize the open cross sectional area in the hangar bay during the design of the hangar structure to reduce the total quantity of airflow while maintaining a safe, efficient working environment.
- Airflow recirculation may also be investigated as a means to reduce energy usage while still maintaining worker safety. See Section 3-5.2.7 Consideration of Airflow Recirculation and Section 2-3 HVAC System Planning & Selection.
- NOTE: Recirculation of exhaust air or reduced air flow during painting may result in a DeMinimus violation from OSHA. See Appendix D, Fig. D-2 – OSHA Interpretation regarding the DeMinimus violation.

Ventilation and airflow requirements for chemical de-paint operations are dependent upon the makeup and toxicity of the material being applied to the aircraft for paint removal. The de-paint material manufacturer must be consulted to obtain the applicable MSDSs for the determination of the appropriate ventilation rate.

Filtration must be provided for the Supply Air upstream of the supply fans and in the supply plenum doors. The filters must have a MERV 5 or better rating on the basis of ASHRAE 52.2 *Method of Testing General Ventilation Air-Cleaning Devices Used for the Removal Efficiency by Particle Size.*

Note: MERV or Minimum Efficiency Reporting Value, is a measurement of air filter efficiency established by ASHRAE. The MERV number ranges from 1 to 16; the higher the MERV number, the higher the efficiency of the air filter at removing particulate matter.

3-5.2.4 Space Static Pressure Controls.

The ventilation system must maintain a slightly negative static pressure of -0.02 to -0.04 in. water gage between the hangar area and the exterior to prevent fugitive hazardous emissions from escaping the hangar envelope and entering the atmosphere. Some studies indicate that a slightly negative pressure in the painting area also provides for more superior painting and reduces turbulent flow. (Refer to *System-Level Computational Fluid Dynamics: Advanced CFD Tools to Solve Problems of Operational Conditions, States of Large-Scale Engineered and Natural Systems* for additional guidance.) Maintain a slightly higher pressure in the adjacent ancillary and overhead ceiling spaces outside the hangar area to keep the hazardous vapors given off by painting agents from infiltrating into these spaces. Ventilate the space above the hangar bay ceiling to provide a non-hazardous space for light fixtures.

3-5.2.5 Gauges, Safety Interlocks and Alarms.

Install visual gauges, audible alarms, and/or pressure activated devices on filters to ensure that the minimum air velocity or volume is maintained. Interlock the fans and the process air compressors so that the paint spray air compressors cannot operate when the fans are inoperative or below a preset minimum. Breathing air must **never** have an interlocked shut down. Interlock the fans and the fire protection system so that the fans

cannot operate when the fire protection system is inoperative. The electrical equipment used in the electrostatic spraying process must be interlocked with the ventilation spraying area so that the equipment cannot be operated unless the ventilation fans are in operation. The operation can be verified by a total air volume flow monitor through the hangar bay. Air flow volume, space static pressure, fan status, breathing air system, and other critical component failures must be monitored by the building automated control system. All critical alarms, notifications and status points must also be indicated on a control panel either within or adjacent to the hangar at an operator monitoring station. The location of the Critical Component Monitor and Alarm Panel must be incorporated into the emergency/fire response action plan. An audible and visual alarm system, which activates in the event of a ventilation or other critical system failure must be provided and made active during the paint spraying process.

3-5.2.6 Energy Conservation.

Reference UFC 3-400-01, *Energy Conservation.* Include energy conserving designs such as ice storage, heat recovery or air recirculation for the ventilation system serving the hangar bay as part of the initial design development of the overall ACCPF. Heat recovery systems must not permit contaminated exhaust air from migrating into the supply air system.

Exhaust stacks must be the “no loss” type as shown in ACGIH *Industrial Ventilation, a Manual of Recommended Practice*.

See section 2-3, HVAC System Planning and Selection for guidance in the evaluation of a cost effective, energy efficient ventilation system.

3-5.2.7 Consideration of Airflow Recirculation.

The determination of the most energy efficient process ventilation system includes evaluation of alternative methods designed to reduce or optimize energy usage. One method which can potentially reduce energy usage in a ventilation system is recirculation of the ventilation or exhaust air. See Section 2-3 HVAC System Planning & Selection for the evaluation process to determine the most cost effective HVAC process ventilation system for a specific application. If recirculation is determined to be a viable option, see NPFA-33 and ANSI/AIHA Z9.7 and appendix D in this document for the AFRL on Recirculation and OSHA interpretations which allow for reduction in equipment sizing and re-circulated air flow.

3-5.2.8 Ventilation System Configurations.

3-5.2.8.1 Hangar Bay Air Flow Design.

Design or specify the entire supply and exhaust air system using criteria for a horizontal flow hangar configuration with supply air direction from aircraft nose to tail. Figure 3-1 and Figure 3-2 are two methods of designing hangar horizontal airflow distribution. Other configurations must be appropriate for the aircraft mission and approved by the AHJ. Effective capture of the paint overspray and worker safety must be the primary

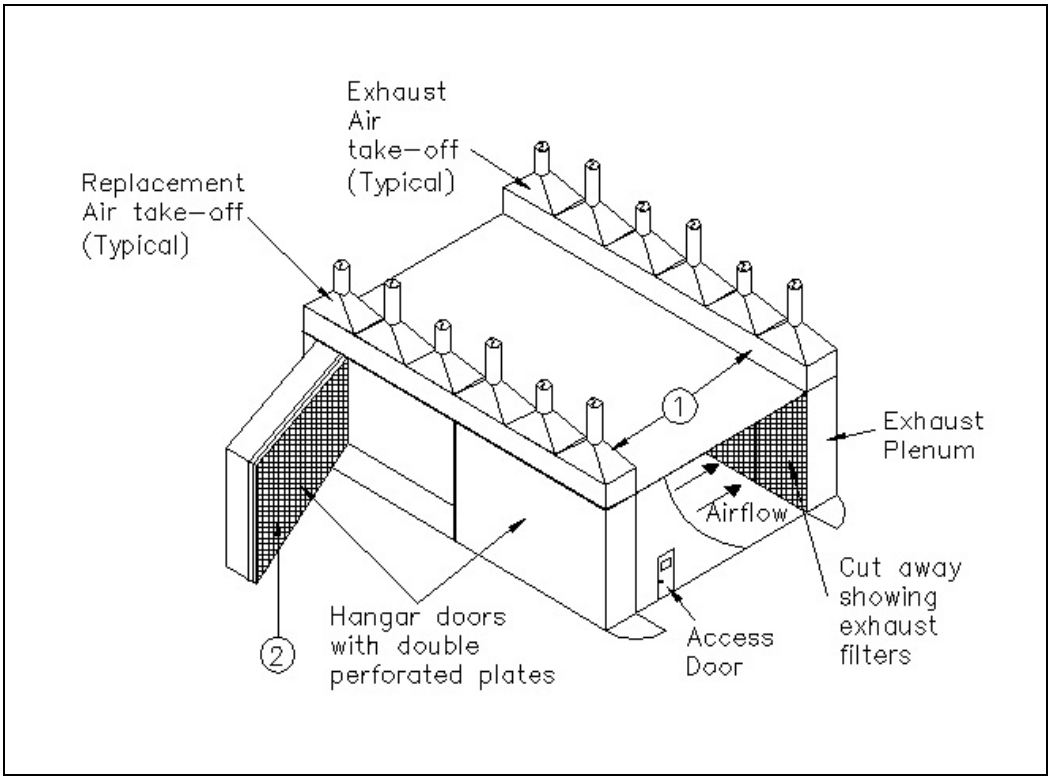
objective in determining the optimum airflow design. All designs for ventilation systems must introduce the makeup air in a laminar manner and minimize the creation of dead air pockets. This will help to capture the paint overspray and reduce the possible buildup of contaminants.

3-5.2.8.2 Hangar Door Plenums.

Air plenums may be incorporated into the design of the hangar doors as indicated in Figure 3-1. This design may be configured as a swing door as shown (most commonly utilized for fighter or similar sized aircraft), or a double rolling door arrangement where two sets of doors form an air plenum between the inner and outer sides. The double door configuration is generally selected for use with cargo or similar sized aircraft.

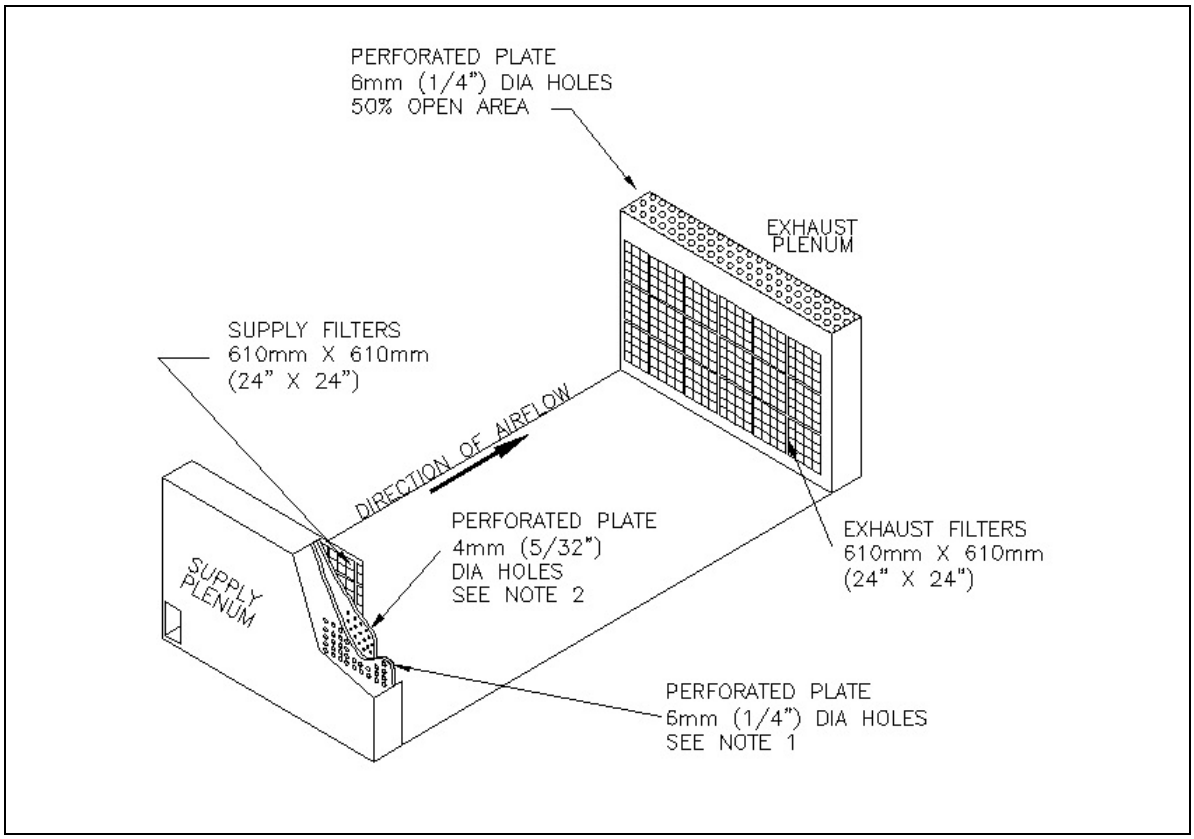
The incorporation of an air plenum into a hangar door requires that the air performance characteristics of the plenum remain primary in the Plenum/Door system. The integrity of the air side of the “Plenum Door” must always be maintained and not compromised in favor of space or door function considerations.

FIGURE 3-1. SAMPLE HORIZONTAL FLOW HANGAR CONFIGURATION



NOTES:
1. Size the exhaust plenum for a maximum plenum velocity of 1,000 fpm (5.08 m/s). Size the supply air plenum for a maximum plenum velocity of 500 fpm (2.54 m/s).
2. See Figure 3-2 for hangar doors and exhaust plenum details.
3. Although supply air is shown entering plenum/door from top, the more common supply air path is through door hinges.

FIGURE 3-2. SUPPLY AND EXHAUST PLENUM AIRFLOW CONTROL DETAILS



NOTES:
1. Size open area for an airflow velocity of 2,000 fpm (10.16 m/s) through holes.
2. Size open area for an airflow velocity of between 600 to 700 fpm (3 to 3.5 m/s) through holes.

3-5.2.9 Control of Air Emissions

3-5.2.9.1 Air Emissions Overview.

Emissions of volatile organic compounds (VOC), hazardous air pollutants (HAP) and particulates from surface coating facilities are regulated by USEPA and state environmental agencies via various air pollution regulations, including the National Emission Standard for Hazardous Air Pollutants (NESHAP) for Aerospace Manufacturing and Rework Facilities (40 CFR 63, Subpart GG). Consult the base environmental office and the cognizant Facilities Engineering Command for appropriate requirements for the site. Make every effort to achieve compliance with applicable regulations considering all available pollution prevention alternatives versus the use of VOC/HAP emission controls. Consider recirculation of airflow per NPFA-33 and ANSI/AIHA Z9.7. See appendix D for additional information for OSHA interpretations and the AFRL. Recirculation allows for pollution abatement sizing equipment reduction.

3-5.2.9.2 Aerospace Exhaust Filter Requirements.

A paint spray ventilation system is required to minimize the amount of hazardous air pollutants (HAPs) that are released into the atmosphere. The National Emission Standard for Hazardous Air Pollutants (NESHAP) for the Source Category: Aerospace Manufacturing and Rework Facilities ,commonly called the Aerospace NESHAP requires that particulate filters be installed in the ventilation system to control the inorganic HAP emissions(e.g., chromium, cadmium, lead for example) before they are exhausted to the atmosphere. Filters throughout must be made from noncombustible materials and must meet approval of the fire protection authorities.

Organic HAPS are Volatile Organic Compounds which cannot be captured by the particulate NESHAP filters used on the inorganic HAPS. The hazardous VOCs (or organic HAPs) include 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, trichloroethylene, and toluene. VOC (solvent vapor) capture methods such as carbon bed filters must be utilized when hazardous VOC removal or control is required. The requirement to control or capture VOCs is a function of state or local regulations, dependent upon the specific location's classification as an "attainment" or "non-attainment" area per the EPA's designation. The local air quality authorities must be consulted in order to determine requirements for VOC abatement.

Determine the specific type of exhaust filter system required by an analysis of the environmental control regulations at the site of the proposed ACCPF.

3-5.3 HVAC for Ancillary Spaces.

3-5.3.1 Operational Ancillary Spaces.

Provide exhaust ventilation from the floor level for the paint mixing and storage rooms. Refer to *ACGIH Industrial Ventilation* (ACGIH IV)*, A Manual of Recommended Practice*. Also, paint mixing can be done on ventilated benches. Refer to UFC 3-410-04, *Industrial Ventilation*. Provide ventilation systems for paint mixing and paint equipment-cleaning rooms in accordance with *NFPA 33* and the *ACGIH IV*.

3-5.3.2 Administrative and Miscellaneous Support Spaces.

The ventilation design of all spaces adjacent to, in close proximity with, or otherwise possibly affected by the paint spray area operation must provide a positive static pressure relative to the paint spray area in order to prevent the migration of paint vapors into the non-spray areas. Measuring devices must be provided to visually identify the static pressure differential between the paint spray and non-paint spray areas.

3-5.4 Noise and Vibration Control.

Design mechanical systems and equipment to limit noise and vibration in accordance with UFC 3-450-01, *Noise and Vibration Control,* and OSHA Pub 3048, *NPC Hearing: Noise Control – A Guide for Workers and Employees*. Navy projects must also follow NAVFAC P-970, *Planning in the Noise Environment*.

Design hangar bay for maximum 75 dBA space average. Provide sound traps to attenuate fan noise down to this level. Noise levels of 55 dBA in the hangar bay area with the ventilation system operating at maximum airflow have been achieved with careful design attention to fan and duct noise characteristics. Outdoor noise levels must not exceed 75 dBA and must comply with local regulations.

3-6 FIRE PROTECTION AND LIFE SAFETY.

Provide fire protection in accordance with UFC 3-600-01, *Fire Protection Engineering for Facilities* and the following documents:

- Army. ETL 1110-3-485, Fire Protection for Helicopter Hangars, and ETL 1110-3-484, Aircraft Hangar Fire Protection Systems.
- Navy. UFC 4-211-01N, *Aircraft Maintenance Hangars: Type I, Type II and Type III.*
- Air Force. ETL 02-15, Fire Protection Criteria - New Aircraft Facilities, and ETL 98-8, Fire Protection Criteria - Existing Aircraft Facilities.
- NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials;
- NFPA 101, Life Safety Code

Note: Foam Fire Protection is not required for hangars housing aircraft that are defueled and purged or have their fuel cells removed. The requirements in NFPA 409 for unfueled aircraft must be followed for these situations.

3-7 ELECTRICAL.

3-7.1 Electrical Installations.

3-7.1.1 General.

Provide electrical systems in accordance with UFC 3-501-01, *Electrical Engineering* and as follows:

3-7.1.2 Power.

All Areas - Provide separate dedicated panel boards to serve each separate use area.

Hangar Bay - Electrical equipment in the hangar bay must be waterproof or water protected when AFFF and/or deluge water protection is provided to prevent equipment damage in the event of testing or accidental discharge of the deluge system.

Power Service Points:

- Service Points for Ground Service Equipment (GSE), Portable Lighting, or other portable support equipment must meet requirements of the hazard classification of the space.

- Air Force only – The 6-pin “WMJ” receptacle may not be permanently installed in a depot paint/depaint or CCF hangar bay. The “WMJ” receptacle may be installed as a temporary GSE power supply only when non-painting activities are taking place. The “WMJ” receptacles must be removed prior to the initiation of paint/depaint operations.
- External aircraft power provided by the power service points must be within the voltage and frequency tolerances specified for aircraft type. The flexible power cable to the aircraft must be adequately sized to meet the specified aircraft loading (amperage) requirements.
- Three phase, 115/200V, 4-wire, 400 Hz, (kVA ratings as required by aircraft type). Refer to UFC 4-121-10N, *Design: Aircraft Fixed Point Utility Systems* for 400 Hz power requirements and to criteria for hangar bay space power and grounding requirements for aircraft maintenance. Spiral wrapped, six around one, flexible cables, designed specifically for 400-hertz systems must be used. The cable must consist of six power conductors, two per phase, helically laid around one central neutral conductor. The conductor size must be based on the KVA rating of the aircraft type. The cable must also contain a minimum of six control conductors, minimum size # 18 AWG.
- 270 VDC Power, and 28 VDC (interlock power), ratings as required by aircraft type. The 270 VDC power cables must be low inductance, low impedance in order to minimize cross-coupling. The 270 VDC cables must also contain 28 VDC safety interlock wiring. The conductor size must be based on the KVA rating of the aircraft type.
- 28 V direct current (kVA ratings as required by aircraft type) Coordinate with the activity.
- WARNING: Aircraft external power supplies are not rated for the hazard classification of a Paint Spray Bay (Class 1, Division 1). Therefore, all activities requiring the use of external power must be completed, the power cord disconnected from the aircraft and the power to the cord disconnected outside the hangar bay prior to the commencement of spray paint operations.

Emergency Power.-Emergency power must be provided to ensure safe egress from any point within the facility. Emergency power must also serve any component that is required for safe egress from any location on an aircraft in the hangar bay. Availability of breathing air must be included in the emergency egress considerations. Hangar doors must also be operable via emergency power. Coordinate and provide additional emergency power as dictated by the mission. A distinct audible and visual alarm must be initiated whenever the facility experiences a loss of main power

Ancillary Spaces. - Serve shop spaces by distinct panels dedicated to shop and equipment loads only. Do not supply office spaces from shop circuits or panels. Except as specifically noted otherwise, feed loads located in the Shop space from panel boards

located in the Shop space; feed loads located in the Office space from panel boards located in the Office space.

3-7.2 Electrical Hazardous Classifications.

Electrical installations in the following areas must meet the requirements in NFPA 70, *National Electrical Code* for the specific hazardous (classified) location:

- Hangar area,
- Paint and chemical mixing rooms,
- Paint equipment cleaning room,
- Paint storage room.

3-7.3 Grounding.

Provide grounding in accordance with UFC 3-575-01, *Lightning and Static Electricity Protection Systems.*

3-7.4 Lighting.

Provide lighting in accordance with UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls*, and as described below:

- Avoid the use of explosion-proof overhead fixtures by providing sealed, ventilated space above the finished ceiling. Fixtures may then be installed above the classified space.
- Hangar Lighting level – Interior lighting level of 100 FC measured 30 inches from floor must be available for Painting Operations inside the hangar bay. A lesser lighting level may be provided during non-critical operations to be determined by the Operating Group.
- Controllable Hangar Bay Lighting - min. 50 FC up to 100 FC in hangar bay. Provide to the best extent possible a lighting arrangement and control which allows for staged control of fixtures which can provide 50 FC, 75 FC and 100 FC progressively to the hangar floor.
- Vertical aircraft surfaces must be considered and incorporated into the hangar interior lighting design. This lighting may be permanently installed in the side walls, on man lift platforms (if provided), or as portable units. A minimum of 70 FC must be used as the design lighting level for vertical surfaces. Note: Hazard classification must be maintained in all cases.

3-8 EQUIPMENT

3-8.1 Work Platforms.

3-8.1.1 Floor Supported Platforms (FSPs).

Floor supported platforms offer an economical means of accessing elevated aircraft surfaces. Typical FSPs include under wing service decks, vertical scissor lifts, rolling step platforms and telescoping boom lifts. This type of equipment is generally purchased separately from the facility construction budget and not included as part of real property. Consideration of this equipment during the planning phase, however, is essential to ensure sufficient clearance around the aircraft when the lifts are in place, and housing the lifts when not in use.

3-8.1.2 Overhead Telescoping Manlift Platforms (TMPs).

The overhead man-aboard TMPs offer a great deal of flexibility and efficiency of operation for an ACCPF. The TMPs are generally considered when large vertical surfaces such as Vertical Stabilizers or Rudders on large aircraft require access for painting, depainting or repair. The platforms themselves can be designed to carry a painter (or two), his equipment and a technician/spotter (driver).The TMPs become essential for a Depot Facility when timing is critical due to the required aircraft throughput. For a CCF, TMPs offer quick access to virtually any part of an aircraft needing repair or corrosion attention when immediate response is called for in the stated mission. TMPs also provide the advantage of offering access to a variety of aircraft.

TMPs impart a significant load on the structure of the facility and ultimately to the foundations. Therefore, inclusion or exclusion of TMPS must be established early in the planning phase.

As a practical solution, a combination of FSPs and TMPs are generally selected to most efficiently cover an aircraft for a specific corrosion control operation. A full definition and understanding of the mission of the facility is essential in forming the basis for the selection of these systems.

3-8.2 Fall Protection.

Personnel fall protection is required when work platforms are not adequate or practical to reach the upper surfaces of the aircraft or when personnel must walk on aircraft wings or other surfaces during corrosion operations.

3-8.2.1 Personal Fall Arrest System (PFAS).

The PFAS consists of a full body harness, attached to a vertical life line cable or self retracting device which is then connected to a horizontal lifeline (HLL) installed below the ceiling/roof structure.

The PFAS must comply with ANSI/ASSE Z359 Fall Protection Code/Product Standards and 29 CFR 1910. For Navy projects also see UFC 4-211-01N. For Air Force Projects, see AFOSHSTD 91-100, EM 385-1-1 Section 21, and AFOSHSTD 91-501.

3-8.2.2 Flexible Horizontal Lifeline (HLL) Systems.

The HLL system must be constructed of flexible material such as wire rope, fiber or webbing spanned horizontally between two end anchorages and may have intermediate anchorages (singe lor multi span), in-line energy absorber, life line tensioner and turn buckles. HLL system shall be designed and certified by a professional engineer who is qualified in designing HLL systems. The designer must consider the number or workers attached to the system, the sag of the line, clearance requirements and the strength of the end and intermediate anchorages. The design, layout and performance of the flexible HLL shall be traceable to test results and engineering calculations. Calculations that predict the performance of the system shall be validated by tests performed on the system in accordance with the requirements of the ANSI/ASSE Z359 Fall Protection Code/Standards.

3-8.3 Rigid Rail Lifeline Systems

The horizontal rigid rail system (trolly system) shall be constructed of rigid steel track(s), mounted hangers, end stops bumpers, splices and swivel eye trolly. The planner must consider the number or workers attached to the system.

3-8.3.1 Facility design for PFAS.

The most significant fall protection requirement from a facility design perspective is the large load capacity which must be built into the permanent lifeline anchor points attached to the building structure.

Design of anchorages for fall protection is addressed in UFC 3-301-01, *Structural Engineering*. It is imperative that the fall protection system be incorporated early in the planning stage of the facility to allow these loads to be realized and included in the structural design.

3-8.3.2 PFAS Installation.

A Turnkey “furnish & install” PFAS/HLL system by an experienced fall arrest specialist is recommended for best assurance of an ANSI and OSHA compliant system. The manufacturer or installer must provide calculations and drawings to verify that the system meets the design and operational requirements. The manufacturer/installer must also be responsible for testing and certifying the system, providing all verification documentation and training the facility personnel as a requirement for Government acceptance.

3-8.3.3 PFAS and Overhead Crane Coordination.

Hangars with bridge cranes represent a special challenge to the planner/designer in that the Overhead Cranes and PFAS often compete for the same space and the workers attached to their PFAS are at risk of having their life lines struck by the moving crane if both operations happen simultaneously. The first recommendation is to design the two systems so that there is never an overlap or interference. If this is not possible, then it must be mandatory that the two operations can never occur at the same time. If

personnel are within a crane runway area, the cranes must be locked out. Likewise, if the Overhead Cranes are to be operated, the PFAS must be physically relocated out of the path of the crane. It is important for the designers of aircraft hangars to understand the potential conflicts between the two systems and the means by which they can coexist.

3-8.4 Blast and Paint Booths.

See UFC 3-410-04, *Industrial Ventilation*, for Modular "Stand Alone" Paint Spray Booths and Dry Media Blast (DMB) De-paint enclosures. All utilities for the booths must be included in the planning phase of the primary facility. If the booth is to be installed in an interior space, provide sufficient space around the booth to allow for access to maintenance and cleaning.

3-9 SITE WORK.

3-9.1 Aircraft Pavement Design.

Aircraft pavement must be in accordance with UFC 3-260-02.

3-9.2 Site Lighting.

Orient exterior fixtures to minimize glare on ramps and taxi-ways. Refer to UFC 3-260-01, *Airfield and Heliport Planning and Design* for clearance requirements, obstruction lighting requirements, and airfield utility lighting information.

3-10 HEALTH SAFETY AND ENVIRONMENTAL CONTROLS.

3-10.1 Health and Safety

The following Health and Safety standards must be incorporated into the design of all Corrosion Control and Paint Finishing Facilities:

- 29 CFR 1910 Subpart D – *Walking-Working Surfaces*, Sections 1910.21 thru 1910.27
- 29 CFR 1910.94 – *Ventilation*, OSHA
- 29 CFR 1910.106 – *Flammable and Combustible Liquids*
- 29 CFR 1910.107 – *Spray finishing Using Flammable and Combustible Materials*, OSHA
- 29 CFR 1910.169 – *Air Receivers*
- 29 CFR 1910.179 – *Overhead and Gantry Cranes*
- AFOSHSTD 91-501 *Air Force Consolidated Occupational Safety Standard*
- EM 385-1-1 *USACE Safety and Health Requirements Manual*
- OPNAVINST 5100.23 *Series*

3-10.2 Environmental Controls.

The facility must comply with all applicable environmental regulations. The Whole Building Design Guide web site (http://www.wbdg.org/) provides information and links to the various laws and guidance documents pertaining to the environment. For site-specific information, contact the base environmental office and the local Facility Engineering Command.

The type of environmental controls required will depend on the pollution abatement regulations at the site and the type and quantities of paints used. Environmental controls can be a major construction and operating cost item; therefore, an accurate determination of regulations and paints (existing and proposed) is required prior to design. Design must be in accordance with environmental protection regulations per Appendix C.

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CHAPTER 4 MEDIA BLAST HANGAR DESIGN CRITERIA

4-1 FUNCTION.

The basic function of a Dry Media blasting facility is to remove coatings and/or corrosion from aircraft, aircraft components, ground equipment, or other types of equipment in preparation for the application of surface coatings and corrosion treatment. Plastic Media Blast (PMB) media is the most common type of Dry Media Blast (DMB) abrasive used during depot and field level abrasive blasting operations. Other types of abrasive materials are used so design the facility to accept other abrasives.

During blasting operations, abrasives and the surface coatings on the blasted materials are shattered to varying degrees. This generates dust, which may contain particles of respirable size (0 to 5 micrometer). The composition and toxicity of the dust is often a health or combustion hazard.

A blast cleaning room is defined as an enclosed space where the worker operates the blasting nozzle inside with the component. A blasting cabinet is defined as an enclosure where the operator stands outside and operates the blasting nozzle through an opening or openings in the enclosure of the cabinet. This chapter defines requirements for facilities which are sized to accommodate entire aircraft. For Blast Cleaning Rooms and/or blasting cabinets, see ref. UFC 3-410-04, *Industrial Ventilation*.

4-2 DMB MATERIAL

4-2.1 DMB Material Combustibility

Data sheets for the Plastic Media blast (PMB) material indicate it is non-combustible at the particle size that the material will be initially used at (a PG-1 size which is 5% > 12 mesh, 12 mesh > 80% > 16 mesh and 16 mesh > 15% > 20 mesh). It is typical for many dusts that are not combustible until they reach a particle size of 420 microns or less in diameter (i.e., material passing through a U.S. No. 40 Standard Sieve). The PMB material behaves in this manner, being combustible when particles are small enough; and thereby having the potential to generate a dust explosion when enough of these very small particles are in a uniform fine suspension in air and are heated to a high enough temperature.

4-2.2 DMB Recovery.

Provide a system and equipment to recover, and reclaim the dry media. The media reclamation design must be in accordance with 29 CFR 1910.94. A pneumatic recovery system is recommended instead of mechanical recovery system for dry media (Mechanical systems tend to abrade the media).

Dust collectors must be set up so that the accumulated dust can be emptied and removed without contaminating other working areas or the workers.

4-2.3 DMB Recycling.

In the DMB process for aircraft stripping functions the blast media is recycled when particles are between 12 and 60 mesh. As particle size becomes smaller (i.e. pass through a 60 mesh sieve) the particles become uneconomical for the stripping process and these smaller particles are removed in the stages one and two of the media reclamation process. As particles between 12 and 60 mesh are recycled, some of the media that is returned to the stripping process falls in the particle size range that is combustible (i.e. between 40 and 60 mesh for the plastic media currently in use).

The following system elements are also required:

- Do not integrate the exhaust ventilation system with the media recovery system
- Protect the media recovery system and ductwork from moisture and rainwater intrusion to keep the media from caking and plugging up the system.
- Use a pneumatic recovery system instead of mechanical recovery system for plastic media. (Mechanical systems tend to abrade the media.)

4-2.4 PMB Hangar Cautions.

The premise of the building design is that the system interlocks, media recovery, media recycling, interior space design and housekeeping policies must be such to minimize the amount of small dust particles that may accumulate anywhere in the hangar. The Interior design must emphasize the exclusion of horizontal areas where dust may settle. However, due to the constant generation of this dust, specifically during the depaint process, the space must be rated as hazardous for dust, as absolute control over dust buildup is difficult to achieve. Designers must be aware that PMB materials in a laboratory setting have been shown to form dust clouds that can result in dust explosions. Research reports by US Bureau of Mines have concluded that:

- As delivered PMB material is not hazardous with respect to potential explosion hazard. This refers to material in the 12-16 Mesh size range when delivered, and 12-60 Mesh size range when recycled.
- In PMB media where all material is fine i.e. below 40 Mesh, an explosion is possible under some conditions in an explosive test chamber with a spark igniter.
- In PMB where all material is very fine i.e. all below 140 Mesh, an explosion is likely in an explosive test chamber with a spark igniter.

4-3 WASH RACKS FOR DMB OPERATIONS.

The Aerospace NESHAP requires residual dust resulting from de-painting by DMB be completely removed. In response to this requirement, locate a Wash Rack as close as practical to the Dry Media De-paint Hangar and include this in the planning phase of a new DMB DF. Note that the DMB hangar itself must not be used for the aircraft wash process.

4-4 ARCHITECTURAL AND STRUCTURAL REQUIREMENTS.

Design each hangar for the size and configuration of the specific aircraft to be handled. Determine work-bay dimensions, ceiling heights, and door openings by the aircraft dimensions. Determine the number of work-bays by the workload. In addition to the following specific requirements, design the DMB Depaint hangar using the general architectural criteria set forth in Chapter 3.

4-4.1 Interior Surfaces

In addition to the requirements in Chapter 3, blast bay must be a fully lined and sealed space with hard, light-colored, smooth, surface provided on walls, inside surfaces of doors, and ceilings; all joints sealed, and doors made weather tight to prevent migration of dust into the cavity behind the wall or ceiling. Horizontal surfaces and ledges (Cabinet tops or beam flanges) must be covered with a sloping surface such that the accumulation of dust is mitigated.

4-4.2 Use Group Classifications.

DMB hangar bay area must be classified by the IBC as a Factory and Industrial use group F-1.

4-4.3 Other Architectural Requirements

- Isolate the abrasive blasting operations from other processes, functions, and activities to eliminate contamination.
- Doors on blast bays must be operable from both inside and outside, except that where there is a small operator access door, the large work access door may be closed or opened from the outside only
- An observation window and an access door(s) must be provided in accordance with 29 CFR 1910.94 and AIHA Z9.4. Position the observation window(s) in the hangar bay walls as required to allow for continuous observation of the workers inside the hangar bay from outside the space. Provide the number of doors and windows as appropriate for the size of the hangar bay
- Provide emergency exits on opposing walls. Make sure personnel doors are operable from both inside and outside of the room. Doors must be flanged and tight when closed.

4-5 MECHANICAL REQUIREMENTS.

Design the DMB De-paint Hangar to meet the criteria set forth in Chapter 3, with the following special requirements:

4-5.1 Plumbing.

Industrial waste drainage system must not be installed inside a DMB Depaint hangar bay. No floor drains are to be installed in the hangar floor.

4-5.2 Ventilation for Control of Air Contaminants.

Determine the type of dust hazard and the minimum average air velocity through the blasting enclosure in accordance with 29 CFR 1910.94. The ventilation systems must be specifically designed to remove dust in the combustible particle size range.

Blast-cleaning enclosures must be exhaust ventilated in such a way that a continuous inward flow of air will be maintained at all openings in the enclosure during the blasting operation.

The air exhausted from blast-cleaning equipment must be discharged through dust collecting equipment.

Interlock the ventilation system with the blasting equipment power supply. This will prevent the use of the blasting equipment without proper ventilation controls.

4-5.3 Noise and Vibration Control.

Design mechanical systems and equipment to limit noise and vibration in accordance with UFC 3-450-01. The DMB Depaint operation and the media support equipment generate significant levels of noise by the nature of the process. Special design emphasis therefore must be placed on separating the DMB spaces from the non-DMB occupied spaces to ensure proper sound levels are maintained through out the facility.

4-6 ELECTRICAL REQUIREMENTS.

Design the DMB Depaint Hangar to meet the criteria set forth in Chapter 3 GENERAL DESIGN CRITERIA with the following special requirements:

4-6.1 Hazardous Classification.

Due to the constant presence of dust generated by the DMB depaint process, the potential exists for there to develop an explosive atmosphere in the hangar bay at certain times during the DMB operation, regardless of the emphasis on dust mitigating design and housekeeping diligence. Therefore, the hangar bay must be classified as a Class 2, Division 1 space per NFPA 70.

4-6.2 Grounding.

Provide grounding in accordance with UFC 3-575-01, *Lightning and Static Electricity Protection Systems.*

4-7 FIRE PROTECTION.

DMB Depaint operations are performed only on defueled aircraft. Fire protection requirements for facilities housing only defueled and purged aircraft follow NFPA 409

guidelines which allow the use of sprinkler systems for area protection in the hangar bay. Foam fire protection systems are therefore not necessary for facilities containing aircraft that are defueled and purged or have their fuel cells removed. Aircraft entering sprinkler protected hangar bays must have all fuel tanks defueled and purged. Signs must be installed on all access doors and hangar doors stating “NO FUELED AIRCRAFT” for facilities with sprinkler protection only in the hangar bay.

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CHAPTER 5 CHEMICAL DEPAINT DESIGN CRITERIA

5-1 GENERAL DESIGN REQUIREMENTS.

ACCPF designed in accordance with Chapter 3 of this document will generally be able to meet the criteria required for chemical depaint operations. Special attention must be given to the interior surfaces (floors, walls, ceilings, trenches, pits) that could come in contact with the paint removal solution due to the inherent corrosive properties of the chemicals. Also, the chemical depaint solution is considered toxic and with the removed paint hazardous waste, requiring specific industrial waste treatment to maintain the mandated zero discharge or meet the input requirements of the Industrial Waste Treatment Plant serving the facility.

5-2 CHEMICAL DEPAINT (ONLY) FACILITIES.

Ventilation air requirements for chemical depaint only facilities may be reduced from a paint finishing facility due to the reduced flammability and toxicity of the current paint removal processes. This evaluation will require 1) exclusion of the depaint facilities from paint spray operations and 2) verification of the reduced flammable properties of the depaint solution and 3) concurrence from the authorities having jurisdiction. The depaint solution will also require evaluation with respect to toxicity for required ventilation and PPE for personnel protection.

5-3 DRAINAGE SYSTEMS FOR CHEMICAL DEPAINT.

The hangar floor drainage system for a chemical depaint facility fully capable of chemical stripping an entire aircraft must incorporate a trench and piping design that has sufficient diameter and slope to carry all paint chips and residue to a collection/holding tank. Trenches in the hangar must be sized with sufficient width to facilitate cleanout on a regular basis. The tank must be sized for a three month projection of activity, assuming that all removed paint will go through the system. The tank must be capable of being emptied of the paint residue manually or automatically. Regardless of the removal means, proper access must be designed into the tank to permit manual clean out and/or inspection.

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CHAPTER 6 AIRCRAFT WASH RACKS

6-1 INTRODUCTION.

Aircraft Wash Racks are paved areas or facilities provided at all aircraft base facilities for the purpose of cleaning aircraft in conjunction with periodic maintenance and corrosion control activities.

6-2 DESIGN CRITERIA.

Design aircraft wash racks in accordance with UFC 3-260-01, *Airfield and Heliport Planning and Design*.

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CHAPTER 7 SPECIFIC DESIGN CRITERIA

7-1 INTRODUCTION.

This chapter identifies the specific design needs for the individual spaces. Building design criteria are provided in a standard Functional Data Sheet (FDS) table format that generally follows the Uniformat II/Work Breakdown Structure. The Interior Construction/Built-in Equipment category includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window treatments, laundry machines, and retractable overhead screens. The Furnishings and Equipment category includes loose/moveable items.

7-2 BUILDING DESIGN CRITERIA.

TABLE 7-1. AIRCRAFT HANGAR BAY(PAINT/WASH/CHEM. DEPAINT)

Description/ Usage	Houses aircraft and equipment anticipated for the mission of Facility. The bay must be sized for the largest aircraft with additional space for anticipated maintenance platforms and equipment. The bay must also include utility connections required for the mission. Utilities will vary for paint application, and chemical depaint versus dry depaint.
Ceiling Ht.	Based on largest aircraft. See required clearances above aircraft.
Windows/Doors	Translucent panels for day lighting in exterior walls; tempered glass windows in hollow metal frames between supervisors' offices and Hangar Bay; supply plenum in hangar doors for cross-flow hangar; heavy duty hollow metal personnel doors and frames with closers, included in hangar doors as required for exiting; factory-finished galvanized steel coiling doors at larger openings; insulated doors between conditioned and unconditioned spaces; openings between Hangar Bay and adjacent spaces protected per code requirements; STC ratings of windows and doors must match that required for walls
Interior Construction/ Built-in Equipment	Interior walls, painted CMU or metal liner panels from floor to 7'-0" (2.1 m) min., rated as required per code; walls between hangar bays rated as required by NFPA 409; cranes and teleplatforms as required by mission requirements
Finishes	**Walls.** Factory finished metal liner panels or painted CMU from floor to 7'-0" (2.1 m) minimum; Block filler must be applied to CMU prior to painting; metal panels above advisable where budget allows or where required for linear air flow **Floor.** Dry shake hardener on concrete is minimum requirement. Coating must provide smooth, easily cleanable surface that will not accumulate dust; verify coating compatibility with chemical strippers and other chemicals that may be present; follow coating manufacturers' recommendations for sealing and bridging concrete joints. **Base.** - **Ceiling.** Exposed construction, painted. Metal panel advisable where budget allows or where required for linear air flow; provide draft curtains as required by NFPA 409
Plumbing	Emergency Showers and Eyewashes, floor drains to IW system
HVAC	See Chapter 3 for requirements as appropriate for paint spray application
Fire Protection and Life Safety	HEF/AFFF for fueled aircraft; Per NFPA 409 for Defueled aircraft
Power	Convenience outlets, dedicated equipment outlets ;aircraft ground power connections Classified area Class1, Div.1, Group C
Ground	Aircraft static grounding system required

TABLE 7-1. AIRCRAFT HANGAR BAY(PAINT/WASH/CHEM. DEPAINT)

Lighting	HID
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Public address** – Required, origination in Supervisor's Office **Security.**
Acoustics	Minimum STC 40 assemblies between Hangar Bay and adjacent normally occupied spaces
Furnishings and Equipment	
Special Requirements	Avoid ledges and other horizontal surfaces that are capable of collecting dust.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-2. AIRCRAFT HANGAR BAY (DMB DEPAINT)

Description/ Usage	Houses aircraft and equipment anticipated for the mission of Facility. The bay must be sized for the largest aircraft with additional space for anticipated maintenance platforms and equipment. The bay must be designed for a dusty environment and include strategically placed outlets for Dry Media Blast (DMB) distribution and spent DMB pick up /delivery system for DMB reclamation; with additional utilities specific for the mission.
Ceiling Ht.	Based on largest aircraft. See required clearances above aircraft.
Windows/Doors	Translucent panels for daylighting in exterior walls; tempered glass windows in hollow metal frames between supervisors' offices and Hangar Bay; supply plenum in hangar doors for cross-flow hangar; heavy duty hollow metal personnel doors and frames with closers, included in hangar doors as required for exiting; factory-finished galvanized steel coiling doors at larger openings; insulated doors between conditioned and unconditioned spaces; openings between Hangar Bay and adjacent spaces protected per code requirements; STC ratings of windows and doors must match that required for walls
Interior Construction/ Built-in Equipment	Interior walls, painted CMU from floor to 7'-0" (2.1 m) min., rated as required per code; walls between hangar bays rated as required by NFPA 409; cranes and teleplatforms as required by mission requirements
Finishes	**Walls.** Factory finished metal liner panels or painted CMU from floor to 7'-0" (2.1 m) minimum. Factory finished metal wall panels to ceiling. Block filler must be applied to CMU prior to painting. **Floor.** Dry shake hardener is minimum requirement. Coating must provide smooth, easily cleanable surface that will not accumulate dust **Base.** - **Ceiling.** Factory finished metal liner panels

TABLE 7-2. AIRCRAFT HANGAR BAY (DMB DEPAINT)

Plumbing	Emergency Showers & Eyewashes, no floor drains
HVAC	See Chapter 3 for requirements appropriate for DMB De-paint operation
Fire Protection and Life Safety	Per NFPA 409 for Defueled aircraft
Power	Convenience outlets, dedicated equipment outlets ;Aircraft ground power connections HZD Loc-Class II, Div.1, Group G for dusty environment
Ground	Aircraft static grounding system required
Lighting	HID
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Public Address –**Required, origination in Supervisor's Office **Security.**
Acoustics	Minimum STC 40 assemblies between Hangar Bay and adjacent normally occupied spaces
Furnishings and Equipment	
Special Requirements	Avoid ledges and other horizontal surfaces that are capable of collecting dust.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-3. PAINT MIX ROOM

Description/ Usage	Coating mix and paint pot staging; adjacent to paint storage with easy access to paint bay.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames, rated as required by code
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code
Finishes	**Walls.** Painted CMU. Block filler must be applied to CMU prior to painting. **Floor.** applied to concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system; containment or trenches to IW at doors; compressed air for CA powered paint shakers(optional)
HVAC	Heating, ventilation and cooling required and per NFPA 33
Fire Protection and Life Safety	Required per NFPA 33 and NFPA 101

TABLE 7-3. PAINT MIX ROOM

Power	Convenience outlets; Space classified Class 1 Div 1
Ground	Required - Ground connections for equipment
Lighting	Fluorescent (Hzd Loc-Class 1,div 1)
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Public Address -** Speaker **Security.**
Acoustics	Minimum STC 40 assemblies between Paint Mix and adjacent normally occupied spaces
Furnishings and Equipment	Provide built-in counters as required for paint mix equipment
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-4. PAINT STORAGE ROOM

Description/ Usage	Aircraft coating container storage; adjacent to paint mix, with curbed storage area drained to I.W.; should also have access for deliveries.
Ceiling Ht.	As required to accommodate storage and material handling equipment
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors, rated as required by code; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other material handling equipment
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code; extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only; provide protection from impact by forklift or other material handling equipment
Finishes	**Walls.** Painted CMU or factory finished metal panels. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system; containment or trenches to IW at doors
HVAC	Heating, ventilation and cooling required and per NFPA 33
Fire Protection and Life Safety	Required per NFPA 33 and NFPA 101
Power	Convenience Outlets
Lighting	Fluorescent (Hzd Loc-Class 1,div 2)

TABLE 7-4. PAINT STORAGE ROOM

Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Drum racks, pallet racks and cabinets for storage as requested by facility users
Special Requirements	Provide storage conforming to applicable flammable and combustible liquids codes and standards
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-5. TOOL CRIB

Description/ Usage	Special use equipment tools such as pallet jacks, ladders, facility maintenance items.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other equipment; provide tool issue window and counter with rolling service counter door as required by facility users
Interior Construction/ Built-in Equipment	CMU walls or wire mesh partitions as required by facility users, extending to roof or ceiling above
Finishes	**Walls.** Painted CMU or galvanized wire mesh partitions. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete as minimum requirement **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	

TABLE 7-5. TOOL CRIB

Furnishings and Equipment	Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets, parts storage bins. Coordinate the quantities of furniture with the users. Other types of furniture may be required based on user and airframe type utilizing the hangar.
Special Requirements	Due to the potentially large pieces of equipment brought into this shop, a rolling service door is recommended in lieu of double doors opening onto the hangar bay. Door must be at least 5 feet (1.52 m) wide and 6'-8" (2.03 m) high. If a 4' (1.22 m) wide opening is adequate, provide a single 4' (1.22 m) wide personnel door in lieu of double doors. Consider using modular rolling storage shelving units for large tool rooms.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-6. EQUIPMENT STORAGE

Description/ Usage	Paint application equipment storage; typically combined with paint equipment cleaning room.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest equipment
Interior Construction/ Built-in Equipment	CMU walls or wire mesh partitions as required by facility users, extend to roof or floor structure above; if combined with equipment cleaning, may require rated walls and/or electrical classification
Finishes	**Walls.** Painted CMU or galvanized wire mesh partitions. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete as minimum requirement; users may require thin film coating such as epoxy **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Steel shelves and storage cabinets as required by facility users

TABLE 7-6. EQUIPMENT STORAGE

Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-7. EQUIPMENT CLEANING

Description/ Usage	Paint application equipment cleaning; room generally contains small paint booth or other solvent cleaning apparatus for use with paint spray guns and paint pots.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames, rated as required by code
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code
Finishes	**Walls.** Painted CMU. Block filler must be applied to CMU prior to painting. **Floor.** Sealer or thin film coating applied to concrete as requested by facility users **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Industrial Ventilation	See UFC 3-410-04, *Industrial Ventilation*, for requirements if small non walk-in paint spray or cleaning booth is present.
Fire Protection and Life Safety	Required
Power	Convenience Outlets; power to optional specialized cleaning booths
Lighting	Fluorescent
Communication	**Telephone.** Required **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Electrical classification may be required in vicinity of solvent cleaning equipment
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-8. SOLVENT STORAGE

Description/ Usage	Large container (typ 55 gal) paint solvent storage; requires pallet storage with door openings and aisles suitable for deliveries.
Ceiling Ht.	As required to accommodate storage and material handling equipment
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors, rated as required by code; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other material handling equipment
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code; extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only; provide protection from impact by forklift or other material handling equipment
Finishes	**Walls.** Painted CMU or factory finished metal panels. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete or thin film coating as requested by facility users; coating to be resistant to solvents stored. **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system; containment or trenches to IW at doors
HVAC	Heating and ventilation required and per NFPA 33
Fire Protection and Life Safety	Required per NFPA 33 and NFPA 101
Power	Convenience outlets; Space classified Class II Div 1
Lighting	Required - Ground connections for solvent containers
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Drum racks, pallet racks and cabinets for storage as requested by facility users
Special Requirements	Provide storage conforming to applicable flammable and combustible liquids codes and standards
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-9. CENTRAL ACID STORAGE

Description/ Usage	Central storage for acid cleaner and conversion coating; may include central chemical mix and storage tanks with pumps and piping for distribution to the hangar bay.
Ceiling Ht.	As required to accommodate storage tanks and equipment
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors, rated as required by code; provide double doors or overhead coiling doors as required to accommodate material and equipment movement
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code; extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only
Finishes	**Walls.** Painted CMU or factory finished metal panels. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system; containment or trenches to IW at doors
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Allow space for maintenance, repair and replacement of equipment
Special Requirements	Conform to applicable codes and standards regarding hazardous materials storage
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-10. CENTRAL CHEMICAL STORAGE

Description/ Usage	Central storage/distribution for hot soap/water mix and hot and cold water; typically includes bulk storage of concentrated soap, central hot water heater/tank, soap/HW mix tank and associated distribution pumps.
Ceiling Ht.	As required to accommodate storage tanks and equipment
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors, rated as required by code; provide double doors or overhead coiling doors as required to accommodate material and equipment movement
Interior Construction/ Built-in Equipment	Walls and floor-ceiling assemblies rated as required by code; extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only
Finishes	**Walls.** Painted CMU or factory finished metal panels. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system; containment or trenches to IW at doors
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Allow space for maintenance, repair and replacement of equipment
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-11. MATERIAL STORAGE

Description/ Usage	Secure storage of non-hazardous paint prep materials; typically includes a window for distribution of materials to paint personnel; may also include storage of paint process equipment and parts.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other equipment; provide tool issue window and counter with rolling service counter door as required by facility users
Interior Construction/ Built-in Equipment	CMU walls or wire mesh partitions as required by facility users, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or galvanized wire mesh partitions. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete as minimum requirement **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping.
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Desks and Chairs, bookcases, vertical file cabinets, workbench with stools, aircraft parts shelf, vice, storage cabinets, parts storage bins. Coordinate the quantities of furniture with the users. Other types of furniture may be required based on user and airframe type utilizing the hangar.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-12. PPE STORAGE

Description/ Usage	Room/area designated for secure storage of PPE; storage of PPE is typically combined with PPE cleaning.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames
Interior Construction/ Built-in Equipment	CMU walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU. Block filler must be applied to CMU prior to painting. **Floor.** Sealer or thin film coating applied to concrete as requested by facility users **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Steel shelves and storage cabinets as required by facility users
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-13. PPE CLEANING

Description/ Usage	Cleaning of personnel protective equipment; typically includes divided sinks; central washer and drier (optional).
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames
Interior Construction/ Built-in Equipment	CMU walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU. Block filler must be applied to CMU prior to painting. **Floor.** Sealer or thin film coating applied to concrete as requested by facility users **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Hot and cold water; laundry sink; clothes washer and drier connections; floor drains to IW System
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area; clothes drier exhaust to the exterior
Fire Protection and Life Safety	Required
Power	Convenience Outlets; power for Washer and Drier
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-14. PAINT BOOTH

Description/ Usage	Individual paint spray booth for small parts (may be located inside hangar bay or exterior to building).See UFC 3-410-04 Industrial Ventilation for specifications and facility requirements
Ceiling Ht.	Based on largest part anticipated, with sufficient clearances for movement of personnel and equipment
Windows/Doors	Supply plenum and/or paint filters in doors for cross-flow booth; size doors to accommodate movement of parts; heavy duty hollow metal personnel doors and frames with closers; insulated doors between conditioned and unconditioned spaces;
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** Factory finished metal panels **Floor.** Thin film coating or dry shake hardener is minimum requirement. Coating must provide smooth, easily cleanable surface that will not accumulate dust **Base.** - **Ceiling.** Factory finished metal panels
Plumbing	Drains, if installed must be routed to IW systems for proper treatment. Emergency Shower & Eyewash, floor drains to IW system
Industrial Ventilation	For Paint Booths exhausted to the exterior installed in interior spaces, replacement air must be supplied to the space to maintain an even static pressure. See UFC 3-410-04 Industrial Ventilation for further information on Paint Booth ventilation.
HVAC	See UFC 3-410-04 Industrial Ventilation for information on Paint Booth ventilation.
Fire Protection and Life Safety	See NFPA 33 for Paint Booth Fire Protection requirements
Power	Power receptacles, if required inside the space must be rated Class 1, Div 1 for hazardous spaces.
Lighting	Provide lighting in ceiling and walls as required; light fixtures must be Class I, Division 1 rated; lamps must be capable of replacement either from inside booth or sufficient space and structure must be provided to allow replacement from exterior.
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Provide separate structure, exterior wall panels and roof panels if booth is not located in a hangar or other enclosed building; allow sufficient clearance for movement and maintenance around exterior of booth, but not less than 5 feet (1.5 m)
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-15. STENCIL ROOM

Description/ Usage	Houses aircraft stencil equipment; room size should consider size of aircraft stencils as well as equipment.
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Resilient tile or sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets; special power for stencil equipment as required.
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Stools, tables and work benches should be provided as required for layout and trimming of stencils; drawers and shelving should be provided for storage of stencils and tools
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-16. COMPOSITE ROOM

Description/ Usage	Composite/fiberglass layup/repair room will typically contain work benches with ventilation hoods, and curing ovens for repair of composite parts.
Ceiling Ht.	As required to accommodate movement of largest parts and equipment
Windows/Doors	Heavy duty hollow metal doors and frames,
Interior Construction/ Built-in Equipment	Extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only
Finishes	**Walls.** Painted CMU. Block filler must be applied to CMU prior to painting. **Floor.** Sealer or thin film coating applied to concrete as requested by facility users **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Emergency Shower and Eye Wash, floor drains to IW system
Industrial Ventilation	See UFC 3-410-04, Industrial Ventilation, for requirements.
HVAC	Special temperature and humidity controls may be required based on type of composite.
Fire Protection and Life Safety	Required
Power	
Lighting	
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-17. WASH RACK

Description/ Usage	Accommodates aircraft cleaning and can be open, covered, enclosed, or integrated into the hangar bay.
Ceiling Ht.	Based on largest aircraft. See required clearances above aircraft.
Windows/Doors	-
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** - **Floor.** - **Base.** - **Ceiling. -**
Plumbing	Safety Shower and Eye Wash(number as appropriate to WR size), floor drains to IW System
HVAC	As appropriate for type of Wash Rack; heating and ventilation required for enclosed spaces
Fire Protection and Life Safety	Fire Protection required for enclosed spaces
Power	Convenience outlets with specialized outlets as required for aux. portable equipment
Lighting	HID or Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Fall protection requirements are applicable to all Wash Racks, open or covered.
Special Requirements	Facility must have Hot water and Cold Water
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-18. SUPERVISOR'S OFFICE

Description/ Usage	Private office located with view of hangar bay
Ceiling Ht.	9 ft.
Windows/Doors	Window to hangar bay protected as required by code; medium duty hollow metal or solid core wood door in hollow metal frame; access via corridor, direct hangar bay access not allowed
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile, heavy duty carpet tile or sealed concrete. **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience and work station Outlets
Lighting	Fluorescent
Communication	**Telephone.** Required **Data.** Required **CCTV.** **CATV.** **Security.** **Public Address –** System cabinet with Microphone
Acoustics	
Furnishings and Equipment	Standard office furnishings and equipment
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-19. OFFICES General

Description/ Usage	Private offices and/or workstations determined by mission requirements
Ceiling Ht.	9 ft. (2.7 m)
Windows/Doors	Window to hangar bay, if provided, protected as required by code; medium duty hollow metal or solid core wood door in hollow metal frame; access via corridor, direct hangar bay access not allowed
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile or carpet tile **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience and work station outlets
Lighting	Fluorescent
Communication	**Telephone.** Required **Data.** Required **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Standard office furnishings and equipment
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-20. CONFERENCE ROOM

Description/ Usage	Small assembly with conference table and chairs
Ceiling Ht.	9 ft. (2.7 m)
Windows/Doors	Window to hangar bay, if provided, protected as required by code; medium duty hollow metal or solid core wood doors in hollow metal frame; access via corridor, direct hangar bay access not allowed
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile or carpet tile **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets; Power and Cable connection in Ceiling for projector
Lighting	Fluorescent
Communication	**Telephone.** Required **Data.** Required **CCTV.** Required **CATV.** Required **Security.** **Public Address** Required
Acoustics	
Furnishings and Equipment	Conference table and chairs; white board
Special Requirements	Room should be fitted for Audio/Visual presentations with built in speaker system, projector, and retractable viewing screen or equivalent media presentation equipment.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-21. FAX/COPY

Description/ Usage	Centralized fax/copy room
Ceiling Ht.	9 ft. (2.7 m)
Windows/Doors	Solid core wood door in hollow metal frame (optional)
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area; review ventilation requirements for copy equipment, exhaust to exterior may be required
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Standard reproduction/printing equipment as requested by users; built in cabinets for storage of paper and other supplies
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-22. BREAK ROOM

Description/ Usage	Personnel break and assembly room
Ceiling Ht.	9 ft. (2.7 m)
Windows/Doors	Window to hangar bay protected as required by code; heavy duty hollow metal or solid core wood door in hollow metal frame.
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	Sink, with water supply and drain piping
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-23. LOCKER ROOMS(CLEAN)

Description/ Usage	Male and female locker/shower/toilet facilities used for storage of operators' personal items
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal or solid core wood door in hollow metal frame; access via corridor, direct hangar bay access not allowed
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** Glazed ceramic tile on CMU **Floor.** Unglazed ceramic tile **Base.** Ceramic tile **Ceiling.** Suspended acoustical panels with moisture-resistant finish
Plumbing	Flush valve toilets, flush valve urinals, countertop or wall mounted lavatories, showers, floor drains
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets, GFI protected
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	Minimum STC 40 assemblies between Locker Rooms and adjacent normally occupied spaces
Furnishings and Equipment	
Special Requirements	Number of fixtures will be determined by the RFP preparer for design build projects or must provide adequate information for the Design Builder to establish the correct number of fixtures required. Provide 2 tier-1/2 height lockers on concrete base. RFP preparer must determine the number of lockers required. Lockers must be sized based on activity requirements. Provide number of accessible fixtures required
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-24. LOCKER ROOMS(DIRTY)

Description/ Usage	Male and female lockers used for disposition contaminated clothing worn by operators during the performance of their corrosion control duties
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal or solid core wood door in hollow metal frame; access via PPE staging/cleaning area to clean locker room; direct hangar bay or clean corridor access not allowed
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** Glazed ceramic tile on CMU **Floor.** Unglazed ceramic tile **Base.** Ceramic tile **Ceiling.** Suspended acoustical panels with moisture-resistant finish
Plumbing	Hand washing facilities, floor drains
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets, GFI protected
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	Minimum STC 40 assemblies between Locker Rooms and adjacent normally occupied spaces
Furnishings and Equipment	
Special Requirements	Provide 2 tier-1/2 height lockers on concrete base. RFP preparer must determine the number of lockers required. Lockers must be sized based on activity requirements.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-25. TECHNICAL LIBRARY

Description/ Usage	Storage of aircraft technical documents
Ceiling Ht.	9 ft. (2.7 m)
Windows/Doors	Solid core wood door in hollow metal frame
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** CMU or gyp. bd., painted; block filler must be applied to CMU prior to painting. **Floor.** Resilient tile or carpet tile **Base.** Resilient base at gyp. bd. walls **Ceiling.** Acoustical panels
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** Required **Data.** Required **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	Shelves and cabinets for documents; tables and chairs, as required; computer and telephone
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-26. MAINTENANCE SHOPS

Description/ Usage	Optional mission-specific maintenance spaces
Ceiling Ht.	As required for the specific maintenance operation
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other equipment
Interior Construction/ Built-in Equipment	CMU walls and/or wire mesh partitions as required by facility users, extend to roof or ceiling above
Finishes	**Walls.** Painted CMU or galvanized wire mesh partitions. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete as minimum requirement **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	As required; Emergency eyewash/showers may be required depending on processes performed and materials used; floor drains to IW
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	To be determined by mission and specified by RFP writer
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-27. MECHANICAL ROOM(S)

Description/ Usage	HVAC and misc mechanical systems
Ceiling Ht.	As required to accommodate equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU or gyp. bd. and metal stud walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Floor drains
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience outlets plus equipment power
Lighting	Fluorescent
Communication	**Telephone.** **Data.** Connection to EMCS as required for energy monitoring. **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Provide sufficient clearance around equipment for repair and replacement of key components.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-28. COMPRESSOR ROOM

Description/ Usage	Plant air and breathing air compressor systems .Note specific requirements for Breathing Air vs. Plant Air
Ceiling Ht.	As required to accommodate the equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU or gyp. bd. and metal stud walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Floor drains
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	
Lighting	
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Provide sufficient clearance around equipment for repair and replacement of key components.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-29. CENTRAL PLANT

Description/ Usage	Centralized chilled water and heating hot water supply
Ceiling Ht.	As required to accommodate the equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU or gyp. bd. and metal stud walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp.board. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Floor drains
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience outlets plus equipment power
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Provide sufficient clearance around equipment for repair and replacement of key components.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-30. ELECTRICAL ROOM(S)

Description/ Usage	Switchboards, motor control centers, distribution transformers, circuit breaker and lighting panels, VFD equipment
Ceiling Ht.	As required to accommodate equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overheard coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU or gyp. bd. and metal stud walls as required by facility users, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	As required for heat load from electrical gear
Fire Protection and Life Safety	Required
Power	Convenience outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-31. FIRE PROTECTION ROOM

Description/ Usage	Fire water riser, distribution manifold, AFFF or HEF storage tanks
Ceiling Ht.	As required to accommodate tanks, equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU or gyp. bd. and metal stud walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	Floor drains
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-32. COMMUNICATION ROOM

Description/ Usage	Telephone switchboard and misc communications equipment
Ceiling Ht.	9 ft. (2.7 m) minimum
Windows/Doors	Heavy duty hollow metal doors and frames; provide double doors if required to accommodate equipment racks
Interior Construction/ Built-in Equipment	CMU or gyp.board. and metal stud walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU or gyp. bd. on metal studs. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** Resilient base at gyp. bd. walls **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating, ventilation and cooling required, positively pressurized in relation to paint spray area
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-33. DRY MEDIA EQUIPMENT ROOM

Description/ Usage	Centralized dry blast media retrieval, processing and distribution equipment
Ceiling Ht.	As required to accommodate equipment and maintenance activities
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors or coiling doors sized to accommodate equipment, maintenance, repair and replacement activities
Interior Construction/ Built-in Equipment	CMU walls, extend to roof or floor structure above
Finishes	**Walls.** Painted CMU; block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience Outlets; power as required for DMB Depaint Equipment
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-34. DRY MEDIA STORAGE ROOM

Description/ Usage	Bulk dry media storage (palletized)
Ceiling Ht.	As required to accommodate storage and material handling equipment
Windows/Doors	Heavy duty hollow metal doors and frames, overhead coiling doors; provide double doors as required to accommodate material movement; provide coiling doors sized to accommodate movement of largest forklift or other material handling equipment
Interior Construction/ Built-in Equipment	Extend and seal walls to floor-ceiling or roof structure above; CMU preferred for walls; metal panels allowed at exterior walls only; provide protection from impact by forklift or other material handling equipment
Finishes	**Walls.** Painted CMU or factory finished metal panels. Block filler must be applied to CMU prior to painting. **Floor.** Sealed concrete **Base.** - **Ceiling.** Exposed painted structure; paint exposed ductwork, conduit or piping
Plumbing	None required
HVAC	Heating and ventilation required
Fire Protection and Life Safety	Required
Power	Convenience Outlets
Lighting	Fluorescent
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	Include means of media handling, including hopper filling
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

TABLE 7-35. DRY MEDIA BLAST BOOTH

Description/ Usage	Fully enclosed self contained room specifically designed with the equipment and utilities for the removal of coatings by the DMB method, generally manually performed by a DMB nozzle operator stationed inside the booth. See UFC 3-410-04 Industrial Ventilation for specifications and facility requirements
Ceiling Ht.	Based on largest part anticipated, with sufficient clearances for movement of personnel and equipment
Windows/Doors	Supply plenum and/or dust collection filters in doors for cross-flow booth; size doors to accommodate movement of parts; heavy duty hollow metal personnel doors and frames with closers; insulated doors between conditioned and unconditioned spaces;
Interior Construction/ Built-in Equipment	
Finishes	**Walls.** Factory finished metal panels **Floor.** Thin film coating or dry shake hardener is minimum requirement. Coating must provide smooth, easily cleanable surface that will not accumulate dust **Base.** - **Ceiling.** Factory finished metal panels
Plumbing	Emergency Shower & Eyewash; no floor drains
Industrial Ventilation	See UFC 3-410-04, *Industrial Ventilation*, for requirements
HVAC	Ventilation
Fire Protection and Life Safety	Required
Power	Class 2, Div 1 if provided
Lighting	Provide lighting in ceiling and walls as required; light fixtures must be Class II, Division 1 rated; lamps must be capable of replacement either from inside booth or sufficient space and structure must be provided to allow replacement from exterior
Communication	**Telephone.** **Data.** **CCTV.** **CATV.** **Security.**
Acoustics	
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Other.
Min. net ft^2 (m^2)	

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APPENDIX A REFERENCES

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29 CFR 1910.169, *Air Receivers,*
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29 CFR 1910.179, *Overhead and Gantry Cranes,*
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29 CFR 1926.502, *Fall Protection Systems Criteria and Practices,*
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1330 Kemper Meadow Drive, Cincinnati, OH 45240, www.acgih.org

ACGIH *Industrial Ventilation, A Manual of Recommended Practice*

American Industrial Hygiene Association
3141 Fairview Park Drive, Suite 777, Falls Church, VA 22042, www.aiha.org

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25 West 43rd Street, 4th Floor, New York, NY, 10036, www.ansi.org

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1791 Tullie Circle, N.E., Atlanta, GA 30329, www.ashrae.org

ASHRAE 52.2, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*

ASHRAE 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

AMERICAN SOCIETY OF TESTING AND MATERIALS
100 Barr Harbor Drive, West Conshohocken, PA, 19428-2959, www.astm.org

ASTM D523, *Standard Test Method for Specular Gloss*

INTERNATIONAL CODE COUNCIL
500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001, www.iccsafe.org

International Building Code (IBC)

NATIONAL FIRE PROTECTION ASSOCIATION
1 Batterymarch Park, Quincy, MA, 02169-7471, www.nfpa.org

NFPA 30, *Flammable and Combustible Liquids Code*

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*

NFPA 101, *Life Safety Code*NFPA 409, *Standard on Aircraft Hangars*

NFPA 410, *Standard on Aircraft Maintenance*

NATIONAL INSTITUTE OF BUILDING SCIENCES
1090 Vermont Avenue, NW, Suite 700, Washington, DC 20005, www.wbdg.org

Whole Building Design Guide

SOUTHWEST RESEARCH INSTITUTE
6220 Culebra Road, San Antonio, TX, 78238-5166, www.swri.org

System-Level Computational Fluid Dynamics: Advanced CFD Tools to Solve Problems of Operational Conditions, States of Large-Scale Engineered and Natural Systems

STEEL DOOR INSTITUTE
30200 Detroit Road, Westlake, Ohio 44145, www.steeldoor.org

ANSI/SDI A250.8, *Recommended Specifications for Standard Steel Doors and Frames*

APPENDIX B BEST PRACTICES

B-1 INTRODUCTION.

The following material identifies background information lessons learned and other current, good design practices. The designer is expected to review and interpret this guidance and apply the information according to the needs of the project.

B-2 RECOMMENDED DESIGN GUIDANCE

B-2.1 Process Ventilation Systems.

Ventilation Fans – General.

Use centrifugal fans with backward curved blades (non-overloading), whenever possible. Centrifugal fans with radial blades are less efficient, but still acceptable. Place the exhaust fan and outlet ductwork outside of the building.

Ventilation during Spray Paint operations.

The ventilation system for an aircraft corrosion control hangar must be designed to prevent fire and explosion. At a minimum, the volumetric airflow rate must keep the concentration of vapors and mists in the exhaust stream of the ventilation system below the 25 percent of the LEL. A well-designed ventilation system will also reduce paint overspray, help control workers' contaminant exposure, and protect the paint finish. Workers must use appropriate respiratory protection irrespective of the airflow rate. On 8 April 1997 and 1 July 1999, OSHA issued interpretations of 29 CFR 1910.94 and 29 CFR 1910.107 for determining the airflow rate required for an aircraft corrosion control hangars. In accordance with OSHA's interpretation letters, see Appendix D, an aircraft corrosion control hangar must minimally comply with the requirements of NFPA 33 and with Subpart Z of 29 CFR 1910 for hazardous substances. Consideration, however, may be given to reduced or recirculated airflow deviating from the velocity levels stated in 29 CFR 1910.94(c)(6)(i)and 29 CFR 1910.107(6)(5)(i).

NOTE 1. Recirculation of exhaust air may be considered provided requirements of ANSI/AIHA Z9.7, NFPA 33, ASHRAE, and OSHA are met and coordinated approval is received from the Facility Project Team.

NOTE 2. Recirculation of exhaust air or reduced air flow during painting may result in a DeMinimus violation from OSHA. See Appendix D, Fig. D-2 – OSHA Interpretation regarding the DeMinimus violation.

Ventilation during Drying (Curing)

Review the paint drying requirements before specifying temperature and humidity ranges. Although the airflow level may be used for drying or curing, a lower ventilation airflow rate is recommended during drying the Drying (Curing) mode to conserve energy. Recirculation of exhaust air can be used if sufficient outside air is provided to

keep the concentration of vapors and mists in the exhaust stream of the ventilation system below the 25 percent of the LEL. Note that the quantity of off gassed vapors is higher early in the drying process, tapering off at the end of the drying cycle. Refer to ANSI/AIHA Z9.7 for exhaust air re-circulation requirement. During the Drying (Curing) process, the hangar must be given the same operational status as the Paint Spray Operation, requiring that all personnel who enter wear the appropriate protective gear for the duration of the Cure cycle. If the ventilation rate is reduced during the Cure cycle, the hangar must be considered unoccupied with restricted access.

Sanding Operations.

Sanding in a space designated for paint spray operations is not recommended. However, if relocating the sanding process is impractical, vacuum exhaust systems must be provided for the sanding tools to minimize the dust generated in the space during sanding operations.

Ventilation Air Flow Study.

A detailed, in-depth analysis must be completed or other historical verification must be provided to prove that the airflow introduced into the paint area will be uniform in distribution and velocity, and that the system can be properly operated for building pressure requirements. Many systems do not perform as anticipated during the design process, due to lack of foresight of real world conditions, the influence of building structure, the air delivery system inlet and outlet conditions, the air exhaust system, the actual aircraft characteristics and surrounding scaffolding and access equipment, among other things. The analysis can be performed by scaled mockup, scaled wind tunnel analysis or Computational Fluid Dynamics (CFD) modeling, among others. The Navy has also specifically endorsed the use of CFD. Refer to OPNAVINST 4790.2. For more extensive information on CFD modeling refer to High Performance Computing Modernization Office (HPCMO), the National Institute for Occupational Safety and Health (NIOSH), the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), the American Society of Mechanical Engineers (ASME), the U.S. General Services Administration (GSA) and the U.S. Environmental protection Agency (EPA) for studies using CFD analysis for industrial ventilation requirements. It is suggested to employ a third party consultant to perform these functions.

B-2.2 Program Planning for Determination of Areas for a New ACCPF.

Gross Area Calculations for Corrosion Control and Paint/Depaint Hangars

Note: for clarity of calculations, all dimensions are in English inch-pound units.

1. Introduction
    a. This method is being provided to allow better accuracy in estimating gross areas by programmers and base project managers. This can be used ahead of, or in conjunction with, developing the Requirements Document. It needs only a minimal amount of information to arrive at a reasonable gross area for programming purposes.

b. There are a large number of required and optional rooms/spaces to be accounted for. In the past, most of these rooms were never identified until late in the process - well after the gross area had been fixed. By providing a list of potential spaces, a series of yes/no decisions can be used to quickly determine the area requirement.

c. The following areas are typical CCF spaces and do not necessarily represent all possibilities. The addition of spaces unique to the specific mission should be reviewed and added to the area total as appropriate.

2. Hangar Bay

a. The hangar bay size is set by the size of the largest aircraft anticipated. To meet UFC requirements, a minimum 10 feet clear to structure is added to each side, front and back of the aircraft dimension (an additional 5 feet is added to account for building structure to arrive at gross area). This creates a rectangular hangar bay.

b. (Aircraft width + 30)x(Aircraft Total Fuselage length + 30) = Hangar Bay (Base Amount)

c. Most medium/large aircraft save space by creating a nose or tail pocket. The dimensions of the pocket are determined by the need to keep a minimum of 15 feet from either the leading or trailing edge of the wing to the pocket; and by the need to keep 15 feet clear on either side of the fuselage/tail within the pocket.

d. This space is subtracted for the hangar bay, but is added back as support spaces below.

e. The physical shape of these pockets is difficult to calculate without significant effort. However, the following calculation will identify the gross square footage that can be carved out by the pockets.

f. (Aircraft Width x Aircraft Length[forward or aft of the wing]) = Hangar Bay (Amount to be Subtracted)

g. Finally, the team must determine if and how much user equipment is to be stored/located within the hangar bay. This may include parking for lifts, process tanks for wash/etch/conversion coatings or wing/tail stands. While the exact position of these items will not be known at this time, the following calculation will allow sufficient GSF.

h. (Process Width x Total Fuselage Length) = Hangar Bay (Process Support)

i. B - F + H = Gross Hangar Area

Note: Some facility missions require the flexibility to house different or multiple aircraft in a single facility. This flexibility requires advanced planning, significant design input and will incur impact to the budget. Careful consideration should be given early in the planning stages to the current and possible future missions to provide the most cost effective facility which fulfills its current mission while requiring minimal retrofit as future projected mission changes occur.

3. Supply Air Plenum/Exhaust Air Plenum
    a. These are usually needed to provide laminar flow, but there are some alternatives where they may not be needed.

    b. The supply air plenum requires space for distributing the air across the cross-section of the aircraft. This space needs to be somewhat larger than the exhaust air plenum.

    c. (Aircraft width + 30) x (25 feet) = Supply Air Plenum Space

    d. (Aircraft width + 30) x (15 feet) = Exhaust Air

4. Air Recirculation Fan Rooms
    a. If air recirculation is used, space is required for the recirculating air fans separate from the exhaust fans.

    b. Assuming an average hangar bay velocity of 60 fpm, 80% recirculation would equal 50 fpm.

    c. Since the actual hangar bay geometry is not known, assume a rectangular space based on the aircraft width times aircraft height.

    d. The area needed is directly proportional to the number of fans and the size of the fans.

    e. For allocating space requirements, the calculation of 20,000cfm/fan and 60sf/fan provides a good estimate of the total area needed. This is in spite of the likelihood that on larger (cargo-size) hangar bays, the fans could be as much as 100,000 cfm/fan and 300sf/fan.

    f. If the space is less than 2000 sf, allocate 2000 sf minimum to ensure accessibility, maintainability, clearance to electrical equipment)

    g. (Aircraft width x Aircraft height) x 50fpm ÷ (20,000 cfm/fan) x 60sf/fan

    h. Adjust the total ventilation and recirculation rate (sub.para. b. above) to the actual application in order to most accurately estimate the area of the Air Recirculation Fan Room.

5. Supply Fan Rooms

a. This space includes both outside air and recirculated air supply fans necessary to provide the total air required across the cross-sectional area of the hangar bay. So, this space is needed regardless of the use of air recirculation.

b. Similar to the Recirculation Fan Rooms analysis, the room size is dependent on the size and number of fans.

c. For gross area calculations, use a conservative 75fpm across the cross-section of the hangar.

d. Due to differences in how the fans operate, this calculation uses 25,000cfm as the match to a 60sf fan requirement.

e. As above, a minimum space allocation of 2000sf should be used to ensure adequate space.

f. (Aircraft width x Aircraft height) x 75fpm ÷ (25,000cfm/fan) x 60sf/fan

g. Adjust the total ventilation rate (sub.para c. above) to the actual application in order to most accurately estimate the area of the Supply Fan Room.

6. Paint Storage
    a. Generally, if paint is stored in the facility, sufficient space needs to be provided to allow for two full paint operations (where applicable, this means two full prime and top coat).

    b. A standard 50 sf should be allocated for entry into the room

    c. Include the room's ventilation system which is required but who's size is generally independent of the actual paint stored.

    d. Use 5sf/gallon to determine the room size. This takes into consideration that most paints are 2-component systems and are provided in one- and five-gallon containers with 1-pint to 1-quart for the second component.

    e. (Number of gallons to paint two aircraft) x 5 + 50sf

7. Decontamination
    a. This includes all space associated with the decontamination process. For very minor corrosion control operations in existing hangars, an alternative decontamination process may be permitted locally but this is not recommended.

    b. Size is based on total number of workers since size is mostly determined by the lockers required. Also, one shift is normally 70 - 80% of the total so shower/wash requirements are close to that required for a total number of

workers basis. To ensure adequate space for both male and female workers, this calculation sizes the rooms to accommodate up to 100% male and up to a 50/50 male/female ratio. A lower ratio may be considered, but must be at least double your current female population count.

c. To account for air locks, separation walls or other hidden spaces, include a standard 500sf.

d. Use 40sf/worker to account for clean/dirty lockers, showers, wash basins and the above mix of male/female.

e. (Total number of workers on all shifts) * 40 + 500sf

8. Special Allocation
   a. If you have a large number of workers, the room layout will likely become less efficient.

   b. If the number of workers exceeds 25 per shift, add 200sf.

9. Communications Rooms
   a. If the maximum length inside the facility (corner to corner) is less than 290 feet, a single communications room should be adequate for planning gross area. Even if this assumption is later found to be incorrect for other reasons, the small size of the room is covered by other allowances in these calculations.

   b. Generally, the individual services have their own standard for the primary communications room. Since there are very few phone/data requirements compared to the size of the facility, the minimum size will almost always be sufficient.

   c. Use 100sf for the primary communications room, and 80sf for any secondary communications room, unless your service has a different criterion.

10. Wash Rack Equipment
    a. Where the corrosion control facility has an associated wash rack, space must be provided for that equipment within the facility. Note that dry media paint removal requires, under the Aerospace NESHAP, a wash rack either at the facility or within a short distance of it.

    b. The wash rack itself is not addressed here for gross area calculations. Since this is the most common, an interior wash rack facility area is not addressed.

    c. The wash rack equipment includes hot water, hot soap solution, cold water, concentrated soap, pumps, and storage for hoses. Generally, the

maintenance space requirements outweigh any differences in quantities to be stored.

d. Use 400sf for wash rack equipment if identified.

11. User Equipment Storage (Adjacent to Hangar Bay)
    a. This includes items that are used in the hangar bay by the user, are contaminated or potentially contaminated, but cannot (for various reasons) be left in the hangar bay itself. Typical items are paint carts, dry media hoses, and similar equipment.

    b. The amount of equipment is dependent on production rates and, consequently, the number of workers per shift.

    c. As with other rooms, there is a fixed requirement for room access and ventilation that adds 200 sf to any other actual requirement.

    d. While highly variable in function, a space allocation of 4sf/person will normally provide adequate storage.

    e. (Number of workers on a shift) x 5 +200)

12. Chemical Storage
    a. This space includes rooms for storing detergents, acids and solvents. For fire safety and other reasons, these are usually separate rooms (very small quantities can be stored in flammable cabinets in a single room).

    b. To account for spill containment, egress and circulation space, use a standard 50sf.

    c. Each 55-gal drum requires 5 sf.

    d. (Number of 55-gal drums) * 5 + 50sf

13. Corridors
    a. For corrosion control and paint/depaint hangars, corridors can become a significant space. In many cases, the site constraints will force a less-efficient room layout. In every case, the need to handle material with a fork lift creates the need for much wider corridors and more space.

    b. Since most rooms are accessed from a corridor (either a personal or material handling), the number of individual rooms is the best guide for determining the space needed.

    c. For basic egress routes, allocate 1000sf in addition to all other requirements.

d. Most rooms will run 10 - 20 feet along a corridor. An average corridor width is around 6' (4' for personnel, 8' for material handling), but shared between rooms on both sides. Use 40sf/room.

e. (Number of Rooms) x 40sf/room + 1000sf

14. Electrical Rooms
    a. The single largest load in most corrosion control and paint/depaint hangars is from the fans and hangar lighting. Therefore, the size of the hangar can be used to size the electrical room(s).

    b. Most panelboards will be located in other rooms; this room is primarily for switchgear and similar items.

    c. Due to the higher risk of electrocution, and to meet egress requirements, greater clearances are needed

    d. Use 1% of the hangar bay area, plus a standard allowance of 200sf to cover egress requirements.

    e. The addition of process cooling will increase the size of the electrical room, but for ease of use, that space is calculated within the process cooling room.

    f. (Hangar Floor Area) * 0.01 + 200sf

15. Storage for supply and exhaust filters
    a. If filter replacement is by service contract, this space may still be desirable, but is not critical since the service contractor can be expected to stage the filters ahead of their need.

    b. New facilities need to store supply filters, plus NESHAP-compliant exhaust filters (3-stage). A "filter set" is made up of one 24x24 supply filter, one 24x24 paint arrestor area, one 24x24 second-stage filter, and one 24x24 final filter.

    c. This calculation is for sizing the room as simply as practical - the actual design will be based on more rigorous mechanical engineering analysis. Presuming horizontal air flow, one set of filters (generally 24x24 size, except for paint arrestor blankets that are rolls) is needed for every 400 to 800 cfm (this gives 100-200 feet per minute through the exhaust filters, which optimizes the number of filters while maintaining laminar air flow). Consult the filter manufacturer to verify NESHAP certified airflow for the proposed paint arrestor exhaust filters.

    d. At the least, it is likely that a set of filters will need to be staged within the facility for at least several days to several months.

e. To get a rough idea of the number of filter sets multiply aircraft width by height to get a conservative cross-sectional area and multiply by 50 to get a rough order of magnitude for the air flow cfm. Divide by 150 feet per minute to arrive at the number of square feet of filter area. Divide by 4 sf to get a rough count on the number of filter sets; then divide by the planned stacking density (approx. 3-4 high). Multiply the number of stacks by 2 sf/stack to arrive at the space needed for storing filters, plus allow 100sf for accessibility to deliver and retrieve the filter boxes.

f. Generally, you cannot stack boxes more than 3 - 4 high.

16. Heating System

a. This is space for hot water boilers and steam boilers (for humidification). If direct or indirect fired burners are used within the air handling units, the AHU space should already properly account for that space.

b. As with the electrical room, the size of this equipment (and the room area) are proportional to the hangar floor space.

c. Generally, this room must be isolated with a fire-rated wall separate from all other functions. To account for this, include a base 200sf requirement.

d. Note: this space is sized on the presumption that the coat must cure in 8 hours, which requires a higher temperature and humidity than the application of the coating. If a longer cure time is acceptable, this space can be reduced by 25% or more.

e. Use 1.33% of hangar bay floor area to size this room.

f. <u>(Hangar Floor Area) * 0.0133 + 200sf</u>

17. Process Cooling

a. Note: the cooling equipment is considered required when its purpose is to meet bioenvironmental (heat stress) and paint application requirements.

b. The space is proportional to the hangar dock area.

c. For depot-level (paint/depaint) operations, consideration should be given to the addition of one spare chiller (or space for an additional chiller) which may be required to fulfill the mission of the facility. For Corrosion Control Facilities, the space may not be needed at all. But, if needed, reduce by 25% to account for not needing the spare chiller.

d. To account for pumps, air separators, and access around equipment, include a standard 300 sf.

e. Use 4% of hangar dock floor area to size this room.

f. (Hangar Floor Area) * 0.04 + 300sf

18. Special Allocation
    a. If the combined space for heating and cooling exceeds 4000sf, include an additional 1000sf to account for greater accessibility needs. This will ensure that all pieces of equipment can be replaced at the end of their useful life.

19 Administrative Spaces
    a. For depot-level (paint/depaint) hangars, a new, compliant, efficient, facility tends to draw additional administrative requirements (e.g., second level supervisors).

    b. See other sections of this UFC for the list of administrative spaces. Spaces such as conference rooms, Fax/Copier rooms [ASHRAE Indoor Air Quality Standards generally require a separate room for fax/copiers/printers] T.O. Library Room are fixed generally regardless of the population. To account for all spaces, use a standard 250sf.

    c. Otherwise, admin space can be calculated on a per-person basis without regard to rank/supervisory level.

    d. To account for gross square feet, use 120sf/person.

    e. (# of Admin/Supervisory persons) * 120 + 250sf

20. Break Area
    a This area should be as far from any contamination sources as possible and must be large enough to support the largest number of workers (aircraft and admin) expected. OSHA is paying very close attention to workers being provided the space to eat away from their work.

    b. A standard break area should include space for sinks, counters, microwaves (as many as one for every 10 workers), refrigerators (some organizations are now using commercial refrigerators that may be as large as 3'x6', and may have more than one), vending machines (for space purposes, assume 3 vending machines), ice machine, trash/recycling receptacles, or other storage unit. To account for these items, include a standard 500sf.

    c. The remaining space is for tables, chairs and circulation. The general guidance is to estimate 15sf/person.

    d. (Total Number of Workers in the Facility) * 15 + 500sf

21. Sprinkler Risers
    a. Usually, these are located in other spaces, but this ensures that the required space is considered in the total gross area.

b. Generally, assume one riser per 15,000sf of the otherwise total area.

c. (Entire Calculated Area) / 15,000 * 50sf/riser

22. Fire Pump Room
    a. Most hangars will need fire pumps because of the fire protection water demand, unless the installation has a separate water distribution system designed to support the fire protection systems in the hangars

    . b. Use a standard 1000sf.

23. Blast Media Unload/Storage
    a. Blast media is subject to two primary issues. First, the blast media is broken down by the blast operation and a certain amount of makeup media is needed. Second, it is possible to contaminate a full batch of media in a way that requires replacement of the entire batch.

    b. The quantity of blast media is very dependent on the specific operation and size of aircraft. Depaint hangars may need sufficient media on-hand to completely replace a contaminated batch. For a large aircraft, this could be 50 - 100,000lbs. For a corrosion control operation, it may be only necessary to have a two- to four-week supply based on normal depletion rates.

    c. Material is frequently delivered in 500-lb “super-sacks”. These are usually delivered on a 4x4 pallet so each super-sack will need about 20sf of space.

    d. Delivery paths for forklifts and normal circulation will add a standard 500sf.

    e. (Weight of Media Stored) * 0.04 + 500sf

24. Blast Media Recovery and Feed
    a. Blast Media is recovered using at least three and sometimes four processing steps. These include magnetic separation of iron particles, cyclone separation of media that has become too fine to be useful.

    b. The equipment is fairly large, so even a small operation should allocate 2000sf as a minimum standard area.

    c. The equipment size is, as above, dependent on what the user intends to use the system for. For depaint hangars, assume that the system must hold sufficient clean media for a full strip. In this way, even if the recovery system should fail, one complete aircraft could be stripped.

    d. (Total Weight of Media to Strip one aircraft) * 0.04 + 2000sf

25. Issue Room/Pharmacy

a. Most aircraft operations involve some amount of aircraft preparation (masking, replacement of sealants, small tools and parts, coveralls) In addition, it may be necessary to dispense solvents from an open container, which requires a separate, rated, room. This space covers these items. If the user has a list of material, it is relatively simple to calculate the shelving needed and, from that, the total space.

b. However, since that may not be available, for ease of calculation, use the number of workers per shift.

c. To account for workers assigned to the issue room/pharmacy and basics (desks, issue window, standard circulation), use a standard 500sf.

d. Use 30sf/worker.

e. (Total number of workers per shift) * 30 + 500sf

B-3 PERSONNEL SAFETY ISSUES.

B-3.1 Respiratory Protection.

29 CFR 1910.134(d), *Respiratory Protection*, specifies requirements for respiratory protection. Consult with an industrial hygienist or occupational health specialist to determine the appropriate type of respiratory protection required for each process.

B-4 MAINTENANCE CONTRACTS.

B-4.1 Service Contracts.

The process HVAC system for an ACCPF represents the most significant and critical function essential to fulfill the mission of an aircraft corrosion control facility. Today's controls are designed to operate automatically to maintain proper temperature, humidity, air velocity, hangar bay static pressure with numerous interlocks to ensure personnel safety. The precision of the controls along with the absolute necessity of high performance from the mechanical systems puts the process HVAC systems of an ACCPF into the category of demanding rigorous and specialized preventative maintenance on a regular basis. Because of the uniqueness and complexity of the equipment, these systems generally fall outside of the normal maintenance capabilities. It is therefore recommended that this preventative maintenance function be delegated to a company (or companies) who specialize in such systems on a regular basis through an annual service contract. Consider an annual service contract during the planning phase of a new Project.

The recommended annual tasks to be performed on the system at a minimum would include verification of control functions, test and balance and calibration of all air and water system temperatures and flow volumes. This work would be completed most efficiently in two parts, during the winter season for the heating system, and then in late spring, prior to the summer season for the cooling system. This work must be

accomplished in addition to any other mechanical preventative maintenance (belt adjustment/ replacement, filter changes, greased bearings) that is normally performed on the mechanical equipment.

B-5 LESSONS LEARNED

The purpose of this section is to highlight selected lessons learned during the design, construction, and operation of corrosion control facilities that have been previously built. These lessons can be a good tool for guidance in the design of new and renovated facilities. By not repeating these mistakes, we hope to be able to design better facilities that will meet the needs of the users, state, local, and federal regulatory agencies. Eliminating the need for modifications to new or renovated facilities could potentially save millions of dollars.

The following are lessons learned from existing Air Force corrosion control facilities.

B-5.1 Dimensions of Booth/Bay.

Ensure that all dimensions of the largest aircraft to utilize the facility are taken into consideration during the design phase of the booth. The measurements must include adequate additional space for maintenance stands and work areas.

B-5.2 Incorporating Fall Protection Control Measures.

If fall hazards cannot be eliminated, fall protection and prevention measures must be incorporated or installed in all corrosion control facilities to ensure the safety of all personnel while working on the aircraft. If fall protection are incorporated into the design phase of the project, it will eliminate the need for added cost in rework to later install the system. Attached safety harnesses will allow for proper complete aircraft paints and eliminate the need to paint portions of aircraft outdoors or in unauthorized hangars. AFOSHSTD 91-100, *Aircraft Flight Line – Ground Operations and Activities*, paragraph 8.2.5 states that *"Whenever it becomes necessary to perform required tasks where a worker can fall 4 feet or more, fall protection will be used."* See AFOSHSTD 91-501, Air Force Consolidated Occupational Safety Standard, for more information on fall protection equipment. EM 385-1-1, Section 5 and Section 21, addresses fall protection requirements.

B-5.3 Proper Sizing of Air Compressors.

Research what size compressor will be needed to accommodate all facility requirements based on all workers using tools simultaneously. It is also important to ensure that the building is wired to accommodate the proper size compressor.

B-5.4 Equipment Designation.

For some services and installations, it may make a difference if special equipment is designated as real property. This designation may effect which parties can accomplish repairs and routine maintenance. It may be beneficial to coordinate equipment

purchase with the local installation support offices to ensure support for maintenance and repairs. Also, it is highly recommended that a maintenance contract with the manufacturer be considered.

B-5.5 Airflow Requirements

The objective of an optimum airflow design in a spray paint environment must be to achieve a linear near laminar air flow pattern. 29 CFR 1910.107 (b)(5)(i) states, "*The spraying operations except electrostatic spraying operations shall be so designed, installed and maintained that the average air velocity over the open face of the booth (or booth cross section during spraying operations) shall be not less than 100 linear feet per minute. Electrostatic spraying operations may be conducted with an air velocity over the open face of the booth of not less than 60 linear feet per minute, or more, depending on the volume of the finishing material being applied and its flammability and explosion characteristics. Visible gauges or audible alarm or pressure-activated devices shall be installed to indicate or insure that the required air velocity is maintained. Filter rolls shall be inspected to insure proper replacement of filter media.*"

B-5.6 Air Exhaust

Do not locate exhaust ports below the hangar air intakes, or in any configuration to create a potential for contaminated air to be recirculated through the facility. This may increase the solvent concentrations above the lower LEL limits creating a potential fire hazard. AFOSH Standard 161-2, *Industrial Ventilation*, paragraph 2.b. (6), notes that "*the air supply intake or process exhaust must be located to prevent contaminates being brought back into the facility*." 29 CFR 1910.107 (d)(9) states, "*Air exhaust from spray operations shall not be directed so that it will contaminate makeup air being introduced into the spraying area or other ventilation intakes, nor directed so as to create a nuisance. Air exhausted from spray operations shall not be recirculated*."

B-5.7 Electrical Equipment in Spraying Area

29 CFR 1910.107 (c)(5) states, "*Unless specifically approved for locations containing both deposits of readily ignitable residue and explosive vapors, there shall be no electrical equipment in any spraying area, whereon deposits of combustible residues may readily accumulate, except wiring in rigid conduit or in boxes or fittings containing no taps, splices, or terminal connections.*"

B-5.8 Pressure Differential Devices

Ensure the exhaust ventilation systems for the main aircraft hangar have a pressure differential manometer and/or other devices to ensure the system is operating as designed. 29 CFR 1910.107 (b)(5)(i) states, "*The spraying operations except electrostatic spraying operations shall be so designed, installed and maintained that the average air velocity over the open face of the booth (or booth cross section during spraying operations) shall be not less than 100 linear feet per minute. Electrostatic spraying operations may be conducted with an air velocity over the open face of the booth of not less than 60 linear feet per minute, or more, depending on the volume of*

the finishing material being applied and its flammability and explosion characteristics. Visible gauges or audible alarm or pressure-activated devices shall be installed to indicate or insure that the required air velocity is maintained. Filter rolls shall be inspected to insure proper replacement of filter media."

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APPENDIX C APPLICABLE ENVIRONMENTAL STANDARDS

C-1 FEDERAL.

Many different federal environmental standards and regulations significantly impact the design of a Corrosion Control Facility. This vast array of requirements exceeds the scope of this guide and will not be covered in significant detail. For more information of environmental standards and regulations, contact your local environmental engineer and bioenvironmental office. During the planning stage of the corrosion facility, planners will complete a General Conformity applicability analysis before completion of the Environmental Impact Analysis Process (EIAP) to allow incorporation of its information into the EIAP. Federal actions must conform to the approved State Implementation Plan (SIP) until the State modifies the SIP or EPA approves the SIP.

C-1.1 Clean Air Act.

The Clean Air Act (CAA) is the major Federal statute (EPA 40 CFR Chapter I) governing the quality of ambient air and permitting releases to the air. There are several programs in the CAA that may have significant impacts or restrictions on the corrosion facility. One main way that the air quality is assured is the new source review (NSR) program. NSR program requires operators of certain types of air pollution-emitting facilities to apply for permission to build in certain areas to prove that the air will not result in worse air quality. These new major sources must not upset the established national ambient air quality standards (NAAQS) and may be required to implement Best Available Control Technology (BACT) to reduce hazardous air pollutants (HAPs) to Lowest Achievable Emission Rates (LAER). There are three types of permits issued under the NSR Program. The permits are Prevention of Significant Deterioration (PSD), nonattainment area NSR, and minor source NSR. The permit is based basically on the threshold values of regulated pollutants.

The National Emission Standards for Hazardous Air Pollutants for Source Categories: Aerospace Manufacturing and Rework Facilities (commonly called the Aerospace NESHAP) EPA 40 CFR Parts 9 & 63 must be applied as applicable in the design of Corrosion Control and Paint Finishing Facilities. This EPA standard applies to facilities that are a “major source” of hazardous air pollutants (HAP) and are involved in the manufacture or rework of commercial, civil, or military aerospace vehicles. (A “major source” of HAPs is defined as a facility or group of aerospace facilities within a contiguous area that emits or has the potential to emit 10 tons per year or more of any listed HAP or 25 tons per year or more of any combination of listed HAP) The local Environmental Management function will use many references, such as a NESHAP flow chart (Figure C-1) to determine if the proposed facility has the potential to be designated as a major source. This important determination will provide key information on whether or not Aerospace NESHAP requirements will apply to the facility, and will have very significant bearing on many design requirements for the facility.

It is important to note that many bases have elected to comply with NESHAP requirements even if they are not currently legally required to do so. Although the

decision to voluntarily elect to comply with NESHAP requirements might initially lead to expensive facility design requirements, it ensures the facility will already be NESHAP compliant if circumstances change at the base and the facility is required to comply with NESHAP requirements at a later date. Reference the National Environmental Policy Act Compliance Guide.

Control of Volatile Organic Compounds.

EPA provides Control Technique Guidelines that States may incorporate into their rules limiting volatile organic compounds for non-major sources of Hazardous Air Pollutants. Reference EPA-453/R-97-004, *Control of Volatile Organic Compound Emissions from Coating Operations at Aerospace Manufacturing and Rework*.

C-1.2 Clean Water Act.

The Clean Water Act (CWA) is the primary Federal statute (EPA 40 CFR Chapter I) governing the quality of the Nation's water. It prohibits the discharge of any pollutant into navigable waters without a permit. Review the National Pollutant Discharge Elimination System Permits (NPDES) permits, the installation of the Spill Prevention, Control and Countermeasures (SPCC) and related documents pertaining to water quality. Also, remember that the Storm Water Pollution Prevention Plan (SWPPP) may need to be reviewed or updated. If the construction disturbs one or more acres, a completed SWPPP and submission of Notice of Intent (NOI) must be timely.

Wastewater discharges from Federally Owned Treatment Works (FOTWs) that is a point source into waters of United States require a NPDES permit. Discharges to Publicly Owned Treatment Works (POTWs) are considered as secondary discharges and are regulated by the POTW authority. POTW authority may have applicable regulations, permits, and agreements.

C-1.3 Resource Conservation and Recovery Act.

The Resource Conservation and Recovery Act (RCRA) is the broadest and widest waste law [40 CFR Chapter I, Subchapter I]. It manages waste included in a variety of other Federal statues such as Toxic Substances Control Act (TSCA), Used Oil Recycling Act, CAA, CWA, and Occupational Safety and Health Act. RCRA regulates solid waste (SW) and hazardous waste (HW) under the concept known as "cradle to grave". Many routine aircraft maintenance operations produce HW because of RCRA's definition. The hazardous waste management plan (HWMP) covers issues such as training, characterization, accumulation, treatment, recycling, inspections, and disposal of HW. One area that might be overlooked is industrial wastewater. Governmental regulations may prohibit discharging such wastewater into domestic wastewater or other non-industrial sewer systems. Pretreatment may not be practical also resulting in the wastewater to be managed under RCRA.

The bulk of what has to be done as RCRA is actually found in the Hazardous and Solid Waste Amendment (HSWA) that was pasted in 1984. Care must be taken with RCRA regulations found in EPA 40 CFR Chapter I, Subchapter I, Parts 260-281. In some

activities, the generator can become the transporter or the treatment, storage, and disposal (TSD) facility based on HW duties and activities. This can have a major impact on training and the HWMP. Be sure to coordinate with local environmental engineers and bioenvironmental personnel for complete RCRA understanding.

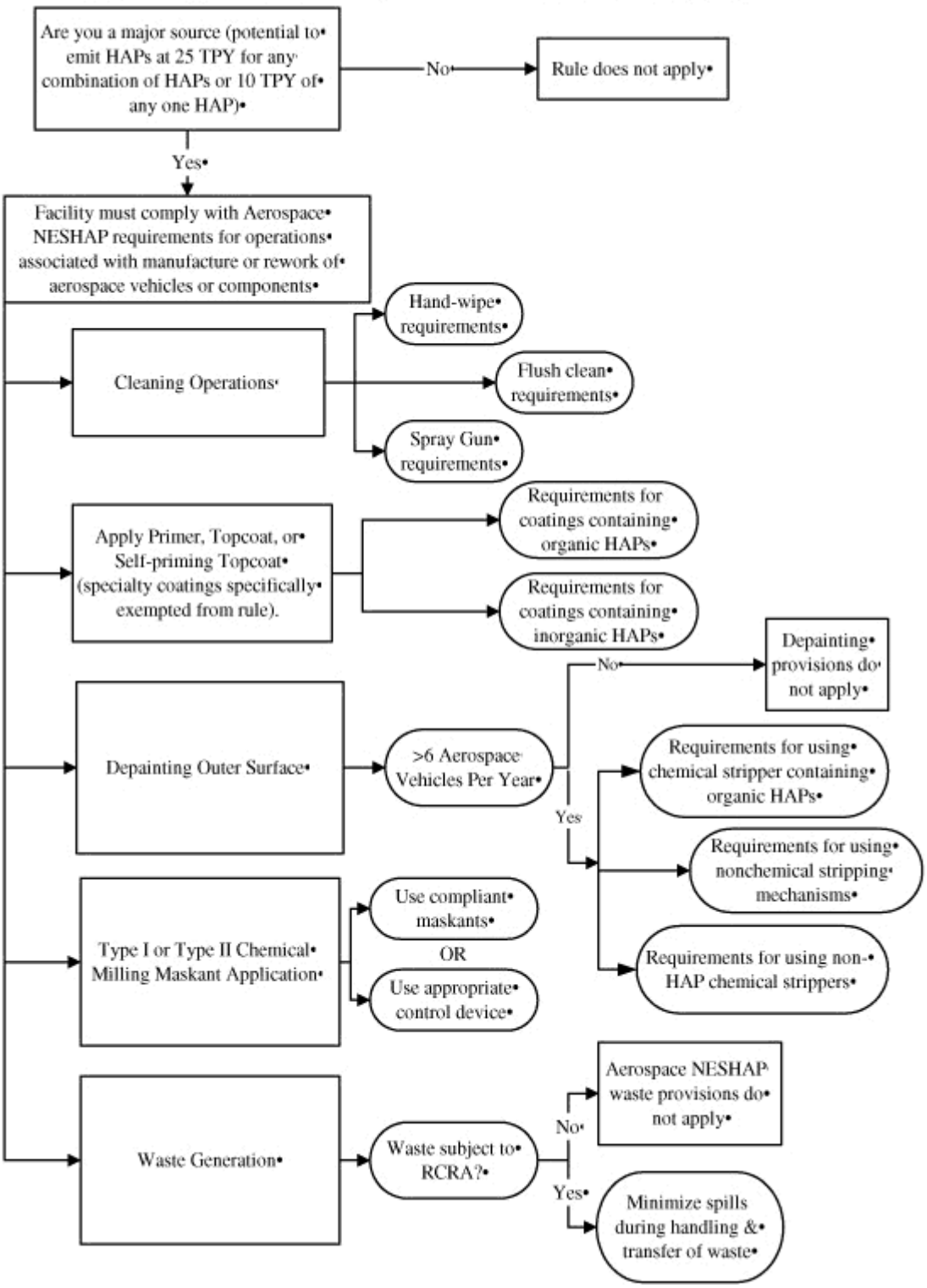
C-2 STATE.

In addition to meeting various federal laws, regulations and standards, the facility will also be required to comply with many different requirements mandated by the state the facility is located. Unfortunately, individual state environmental programs sometimes vary greatly. Therefore, it is important for local base agencies assisting in the design process to have access to the most current information. This type of information that is specific to each state can be found at the following website: http://www.rmis.com/db/lawepa.htm.

C-3 LOCAL.

More focus is being placed on the impact of local regulations through the Public Owned Treatment Works (POTW). Local systems are under tighter demands for drinking water, water usage, and sewer treatment. Industry programs many times focus only on the end-of-pipe solutions, which only handles wastewater pollutants. Yet, facilities that work with local regulators can help reduce pollution and waste cost. Ensure that local regulations are reviewed to prevent construction delays and reduce potential construction retrofits.

Figure C-1 Application of Aerospace NESHAP to Various Operations



APPENDIX D OSHA INTERPRETATIONS AND REFERENCES FOR REDUCED AIRFLOW AND RECIRCULATING AIRFLOW

This appendix is included as an aid to the designer for information regarding OSHA requirements for both reduced airflow velocity in the painting zone and allowance of recirculation of exhaust air when proper measures are taken for corrosion control hangars. The U.S. Air Force, which bears the largest share of corrosion control expenses for its fleets of aircraft, have taken a pro-active approach in these matters. Refer to Appendix B, page, B-4, of AFRL-ML-TY-TP-2004-4518, for a detailed analysis, response and requirements of the OSHA interpretations and supporting calculations for the recirculating model. The following is the Abstract from that publication-

"*The text of 29 CFR 1910.107(d)(9), which was imported from the 1969 revision of a fire safety standard, prohibits recirculating ventilation in spray painting facilities. Devices to measure vapor concentrations obsolete this standard almost immediately, but efforts to amend this statement have been frustrated. To accommodate advances in technology, OSHA invoked the designation "de minimis violation" to enable the use of recirculation and other technologies that comply with the most current consensus standards applicable to their operations . . . when the employer's action provides equal or greater employee protection. Whereas industry has adapted to this expedient, Department of Defense agencies have consistently interpreted that if 107(d)(9) is still in print and the alternative is called a violation, however qualified, military installations will not be given permission to employ exhaust recirculation (ER). Individual bases working in isolation have built a few examples of painting hangars using ER, but each of these facilities suffered from one or more serious design faults. Robins Air Force Base (RAFB), near Macon, Georgia, is acquiring a painting hangar to accommodate painting of C-5 aircraft in an ER ventilation system. Because the economics of exhausting 2.5 million cfm of temperature-controlled air is untenable, critical justification for using ER is provided by RAFB's environmental conditions, which require cooling and dehumidifying air used in the ventilation process during four to five months each year. This report identifies documentary precedents for competent designs of future paint facilities and describes the preparation and issuance of a design-and-build contract for construction of this new facility at RAFB*."

…Consistent with the interpretations12, 14, and 16 above, OSHA inspectors did not cite L3 or Air Force facilities using ER ventilation to paint aircraft at Seymour Johnson Air Force Base (SJAFB), N.C., and at Mountain Home AFB (MHAFB), Idaho. SJAFB's facility design placed a vapor control system inside the ER loop, lowering17 both total emissions and the increase in exposure within the workplace. The concept earned a 1994 award by EPA for environmental excellence and has profound implications17 for source reduction strategies."

The OSHA database for available information and interpretations edited as follows:

"*Laws, Regulations and Interpretations provides a comprehensive and easy to use resource for current OSHA standards and enforcement-related information.*

Interpretations, enforcement guides, and other enforcement related information will be interlinked with regulatory requirements using hypertext links. Not all interpretations which have been issued by OSHA are included on "Laws, Regulations and Interpretations page". Ongoing maintenance is designed to provide the most up-to-date OSHA standards and interpretations of employee safety and health issues, while reducing the duplication of information and removing outdated guidance."

Attached is a list of known interpretations attempting to clarify the use of reduced and recirculating airflow by OSHA. Included in the interpretations are those annotated with an "*" are no longer available from the database but are included for supporting clarification, establishing the track record of acceptance by OSHA in industry for various allowances over the last 15-20 years. A copy is included at the end of this appendix or through imbedded file links. Interpretations published on the website may be accessed directly by imbedded hyperlink.(Control-enter key on the subject)

Clarification subject	29 CFR 1910.107
Spray Booth vs. Spray Area	11/04/1976 - Clarification Paint Spray Booth and Spray Areas http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=18571
Recirculation Airflow Allowed	*10/16/1987- A Clarification of requirements for recirculating air discharged from Spray Operations
Recirculation Airflow Allowed	*11/03/1989- Exhaust Air in Spray Operations
Recirculation Airflow Allowed and interpretations of de minimis violations policy	*Jan 16, 1990- From Directorate of Compliance Programs
Recirculation Airflow and the allowance of most concurrent census standards and de minimis violations	*08/27/9991-Spray Booth compliance with OSHA standards is determined at the workplace
De minimis violation Impact/Lack thereof	1995 - 08/03/1995 - Letter requesting a compliance determination of control device system used primarily in paint spray booth applications.
Reduced velocity in paint spray areas	1997 - 04/08/1997 - The airflow rate required for a spray painting area.
OSHA De minimis policy and compliance to NFPA-33 which allows recirculation	1996 - 03/15/1996 - Spray Finishing.
OSHA De minimis policy and compliance to NFPA-33 which allows recirculation	1996 - 05/14/1996 - Interpretation for questions related to compliance with NFPA 33 (1995 edition).
Corrosion Control Hangars treated as spray areas per OSHA because of larger volumes allowing reduced airflows with de minimis policy	1-JUL-1999 INDUSTRIAL VENTILATION RATES IN AIRCRAFT CORROSION CONTROL HANGARS (See Figure D-2) of this document)
Reduced Air Velocities Allowed in Spray booths	2001 - 10/22/2001 - Clarification of minimum face velocity requirements for spray booths.
Recirculation in compliance with NFPA 33, considered a de minimis violation and would not be cited. One of the main standards now	2001 - 09/17/2001 - Full compliance with NFPA 33-2000 may be considered a de minimis violation.

cited by the U.S. Air force for corrosion control hangars considered as Spray areas.	
(80%) Recirculated air and 20% fresh air) to protect employees in a spray booth from air contaminants. (This is basically the same interpretation the Air force is fully adopting) . One of the main standards now cited by the U.S. Air force for corrosion control hangars considered as Spray areas	2002 - 06/24/2002 - Hierarchy of controls for exposure to air contaminants.
Spray Booth Compliance	2004 - 08/12/2004 - Spray booth requirements including automatic sprinkler systems, relationship to NFPA 33 requirements, and paint storage.
	1910.94
Reduction of Airflow velocities in Paint Booths	2001 - 10/22/2001 - Clarification of minimum face velocity requirements for spray booths.
Reduction of Airflow velocities in Paint Booths	1997 - 04/08/1997 - The airflow rate required for a spray painting area.

LETTERS RELATED TO AIRFLOW REQUIREMENTS FOR CORROSION CONTROL HANGARS

The following Figure D-1 contains the NFESC Memorandum (less enclosures 1, 2, 3 and 4) requesting OSHA to interpret the ventilation rates for aircraft corrosion control hangars. This Appendix also contains OSHA's response to NFESC's request - See Figure D-2.

Figure D-1. NFESC Memorandum to OSHA

DATE: May 13, 1999

MEMORANDUM

To: Ron Cain, Office of Federal Agency Programs, Occupational Safety and Health Administration, Washington, DC 20210

Via: John Plummer, Director, Office of Federal Agency Programs, Occupational Safety and Health Administration, Washington, DC 20210

From: Kathleen M. Paulson, P.E.
Naval Facilities Engineering Service Center
Naval Occupational Safety and Health - Air (ESC 425),
1100 23rd Avenue
Port Hueneme, CA 93043-4370
Commercial:(805) 982-4984, DSN: 551-4984, FAX:(805) 982-1409
Internet: paulsonkm@nfesc.navy.mil
Web Page: http://www.nfesc.navy.mil/enviro/esc425/NoshArBr.htm

SUBJ: INDUSTRIAL VENTILATION FLOW RATES IN AIRCRAFT HANGARS

We appreciate your offer to revisit the OSHA standard interpretation you provided to the Department of the Navy, Office if the Assistant Secretary, (Installations and Environment) regarding spray painting in aircraft hangars. See Enclosures (1) and (2). When we tried to apply the interpretation that you provided to us dated April 8, 1997, we discovered discrepancies in our characterization of the processes performed in Navy Final Finish and Corrosion Control Hangars. Enclosure (3) defines the operations performed in each of the various level hangars.

Our questions are:

1. What is your definition of a production spray finishing operation?
2. How do you characterize the five operational levels of hangars discussed in Enclosure 3?
3. What airflow rate criteria is required for each of the five levels?
4. If 100 cubic feet per minute per square foot of cross-sectional area is required for any of the five operational levels, please define the term cross-sectional area. Is it:

    a) Area of the exhaust filter bank?
    b) Area of the exhaust filter bank?
    c) Air envelope around the plane, which excludes the "empty" area where there will be no aircraft parts?
    d) Full opening of the hangar, for instance the approximate side of the hangar door opening plus about 5 feet on the top and sides of the hangar reserved for maneuverability?
    e) Full opening of the hangar including open space for roof trusses?

Naval Facilities Engineering Command (NAVFAC) assigned the NAVOSH Air Branch of NFESC to revise Military Handbook 1003/17, Industrial Ventilation Systems. The handbook defines engineering design criteria for use by all components of the Department of Defense. We are adding a new chapter to the MIL-HDBK discussing the criteria for spray painting in aircraft hangars. We are having difficulties applying the interpretation to our criteria. To add to the urgency,

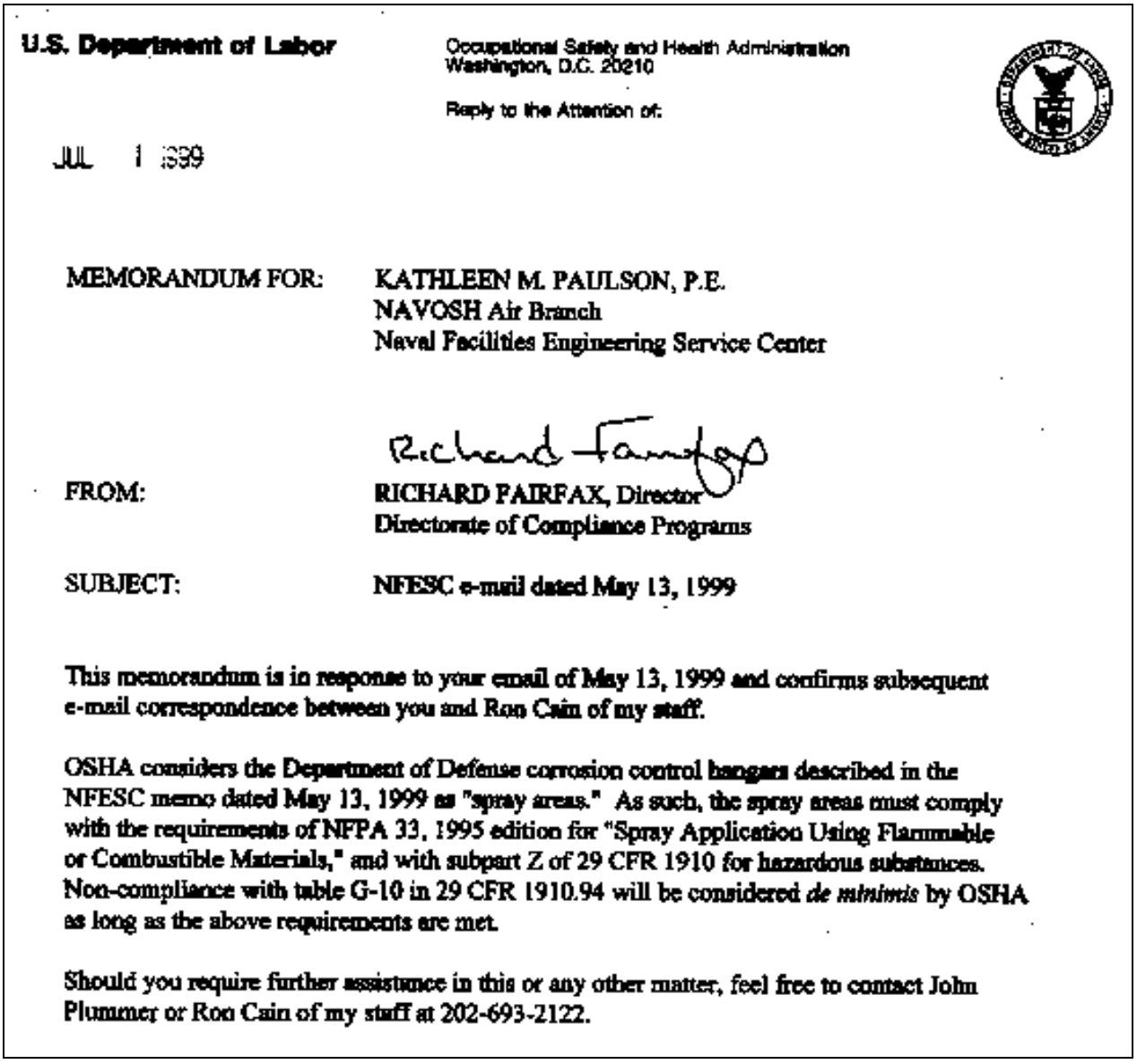
NAVFAC is also in the process of designing several new aircraft hangars. Reducing the flow rate from 100 cubic feet per minute per square foot of cross-sectional area will provide a significant reduction in equipment first costs and annual operating costs.

Our position is - Aircraft hangars should not be designed for 100 cubic feet per minute per square foot of cross-sectional area due to the size of the space and the dilution effect. Regardless of the flow rate, not all the paint overspray will reach the filters and we acknowledge some will drop to the floor. This is particularly true for the portion of the aircraft farthest from the exhaust filter bank. Paint spray criteria in the ACGIH Industrial Ventilation Manual permits airflow in large spaces as low as 50 cubic feet per minute per square foot of cross-sectional area. Both the NFPA 33 and the ANSI Z9.3 consensus standards require a sufficient ventilation rate to prevent vapor build-up by requiring airflow to keep the vapor less than 25% of the LEL. Airflow calculations based on LEL are typically 10-25% of the rates required for health protection. Enclosure (4) reiterates our understanding of the pertinent regulations.

Our experience shows that even in spray painting operations using flow rates of 100 cubic feet per minute per square foot of cross-sectional area, some employee's occupational exposure exceeds the PEL for certain paints and paint components. Therefore, our employees use respiratory protection when painting in hangars.

Thank you for continuing to consider our concern. Based on our phone conversation today, I understand that you are also working on this issue with the US Air Force. Could you direct us to their point of contact? Our contacts are Kappy Paulson and Trinh Do (805) 982-4984.

Figure D-2. OSHA interpretation.



U.S. Department of Labor

Occupational Safety and Health Administration
Washington, D.C. 20210

Reply to the Attention of:

JUL 1 1999

MEMORANDUM FOR: KATHLEEN M. PAULSON, P.E.
NAVOSH Air Branch
Naval Facilities Engineering Service Center

FROM: RICHARD FAIRFAX, Director
Directorate of Compliance Programs

SUBJECT: NFESC e-mail dated May 13, 1999

This memorandum is in response to your email of May 13, 1999 and confirms subsequent e-mail correspondence between you and Ron Cain of my staff.

OSHA considers the Department of Defense corrosion control hangars described in the NFESC memo dated May 13, 1999 as "spray areas." As such, the spray areas must comply with the requirements of NFPA 33, 1995 edition for "Spray Application Using Flammable or Combustible Materials," and with subpart Z of 29 CFR 1910 for hazardous substances. Non-compliance with table G-10 in 29 CFR 1910.94 will be considered *de minimis* by OSHA as long as the above requirements are met.

Should you require further assistance in this or any other matter, feel free to contact John Plummer or Ron Cain of my staff at 202-693-2122.

NOTE: De Minimis Violations. De minimis violations are violations of standards that have no direct or immediate relationship to safety or health. Whenever de minimis conditions are found during an inspection, they must be documented in the same way as any other violation but would not be included on the citation.

APPENDIX E GLOSSARY

3M	Maintenance and Material Management
ACCPF	Aircraft Corrosion Control and Paint Facilities
ACGIH	American Conference of Governmental Industrial Hygienists
AF	Air Force
AFCEE	Air Force Center for Engineering and the Environment
AFCESA	Air Force Civil Engineer Support Agency
AFCPCO	Air Force Corrosion Prevention and Control Office
AFFF	Aqueous film-forming foam
AFI	Air Force Instruction
AFIT	Air Force Institute of Technology,
AFM	Air Force Manual
AFRL	Air Force Research Laboratory
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
ATFP	Anti-terrorism/Force Protection
C	celsius
CCF	Corrosion Control Facilities
CATV	Cable Television
CCTV	Closed Circuit Television
CFD	Computational Fluid Dynamics
CFR	Code of Federal Regulations
CMU	Concrete Masonry Unit

cm	centimeter(s)
CONUS	Continental United States
dBA	decibels A weighted Scale
deg	degrees
DF	Depot Facilities
DMB	Dry Media Blast
DoD	Department of Defense
DODCE	Department of Defense Corrosion Exchange
DOE	Department of Energy
EIA	Electronic Industries Alliance
EM	Engineering Manual
EPA	U.S. Environmental Protection Agency
ETL	Engineering Technical Letter
FSP	Floor Supported Platform
F	fahrenheit
ft	feet
FC	Foot Candle
FP	Fire Protection
GPM	Gallons per minute
GSE	Ground Service Equipment
HAP	Hazardous Air Pollutants
HEF	High Expansion Foam
HVLP	High Volume Low Pressure
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HR	Humidity Ratio

HLL	Horizontal Life line
HVAC	Heating, Ventilation and Air Conditioning
HW	Hot Water
IBC	International Building Code
IESNA	Illuminating Engineering Society of North America
in	inches
IW	Industrial Waste
IWTF	Industrial Waste Treatment Facility
kPA	kiloPascals
kVA	kilovolt-amperes
LCC	Life Cycle Cost
LCCA	Life Cycle Cost Analysis
m	meter(s)
mm	millimeter(s)
max	maximum
min	minimum
MEH	Median of Exterme Highs
MEL	Media of Exterme Lows
MERV	Minimum Efficiency Reporting Value
MSDS	Material Safety Data Sheets
NADEP	Naval Aviation Depot
NAVFAC	Naval Facilities Engineering Command
NC	Noise Criteria
NESHAP	National Emission Standards for Aerospace Manufacturing and Rework Facilities
NFPA	National Fire Protection Association

NIOSH	The National Institute for Occupational Safety and Health
OCONUS	Outside the Continental United States
O/I	Organizational and Intermediate
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
PF	Paint Facilities
PFAS	Personal Fall Arrest System
PMB	Plastic Media Blasting
PPE	Personal Protective Equipment
psi	pounds per square inch
PVDF	Polyvinylidene fluoride
RH	Relative Humidity
SDI	Steel Door Institute
STC	Sound Transmission Class
TMP	Telescoping Man Lift Platform
UFC	Unified Facilities Criteria
V	Volt
VDC	Volts Direct Current
VFD	Variable Frequency Drive
VOC	Volatile organic compounds

FC 4-211-03F
3 MAY 2016

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

FOREWORD

Facilities Criteria (FC) provide functional requirements (i.e., defined by users and operational needs of a particular facility type) for specific DoD Component(s), and are intended for use with unified technical requirements published in DoD Unified Facilities Criteria (UFC). FC are applicable only to the DoD Component(s) indicated in the title, and do not represent unified DoD requirements. Differences in functional requirements between DoD Components may exist due to differences in policies and operational needs.

All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the FC, the SOFA, the HNFA, and the BIA, as applicable.

Because FC are coordinated with unified DoD technical requirements, they form an element of the DoD UFC system applicable to specific facility types. The UFC system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, applicable to the Military Departments, Defense Agencies, and the DoD Field Activities. The UFC System also includes technical requirements and functional requirements for specific facility types, both published as UFC documents and FC documents.

FC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office using the following electronic form: Criteria Change Request. The form is also accessible from the Internet site listed below.

FC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Refer to UFC 1-200-01, *General Building Requirements*, for implementation of new issuances on projects.

AUTHORIZED BY:



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FACILITIES CRITERIA (FC)
NEW SUMMARY SHEET

Document: FC 4-211-03F, *Fighter Engine Maintenance Facility*

Superseding: None.

Description: This FC provides requirements for evaluating, planning, programming, and designing fighter engine maintenance facilities. The information in this FC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental United States (CONUS) and outside the continental United States (OCONUS). It also applies to the procurement of design/build services for the above-noted projects. Alteration and renovation projects should update existing facilities to meet the guidance and criteria within budgetary constraints.

Reasons for Document: This FC is the initial release to establish requirements for a fighter engine maintenance facility. It defines the criteria for determining appropriately sized, flexible, cost optimized, durable, quality-designed facilities on a life cycle basis to support the mission.

Impact: This FC will facilitate and standardize the design of fighter engine maintenance facilities throughout the Air Force.

- It will provide more complete and consistent project requirements and will expedite the programming and design of facilities and reduce initial design cost.
- The improved performance-based criteria and coordination with the Air Force request-for-proposal (RFP) template will reduce design-build proposals.

Unification Issues: None.

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CHAPTER 1 INTRODUCTION

1-1 GENERAL INFORMATION.

The standard facility prototype design program defines consistent facility requirements across the Air Force enterprise to expedite delivery of a facility. The objective is to deliver appropriately-sized, flexible, cost-optimized, durable, quality-designed facilities on a life cycle basis to support the Air Force mission.

This FC was provides standard facility prototype design criteria to assist Air Force planners in preparing and validating requirements for DD 1391, “FY __ Military Construction Project Data,” and to assist A-E design professionals with the approved project-specific design requirements. It is a source of basic programming and functional information for fighter engine maintenance facilities. This FC is consistent with Air Force Corporate Facility Standards (AFCFS) and UFCs, and complies with Air Force Manual (AFMAN) 32-1084, *Facility Requirements*. Together with the AFCFS, this FC defines Air Force expectations for project programming and A-E design decisions.

A standard facility prototype represents a shift in Air Force facility design philosophy toward maximizing use of open office space and systems furniture. This design approach allows maximum flexibility to reconfigure the building space as mission needs change. Where offices require sound attenuation, or physical or visual separation, evaluate the use of systems furniture or demountable partition walls in lieu of full-height hard wall construction. Maximizing open office space may require more systems furniture; funding must be listed on the 1391 as an FF&E cost. Comply with the latest Air Force policy on centralized procurement of systems and other furniture.

1-2 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *General Building Requirement*s. UFC 1-200-01 defines applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this FC in addition to UFC 1-200-01 and the UFCs and government criteria referenced herein.

1-3 REFERENCES.

Appendix A contains a list of related documents and references to be used with this FC. The publication date of the code or standard is not included. Use the latest available issuance of the reference.

1-4 INSTRUCTIONS.

The standard facility prototype was developed by determining personnel counts, allowable/authorized space/room sizes, adjacency diagrams between the functional spaces, and the overall facility space requirements. It establishes Air Force criteria for the facility type. Use these criteria together with other Air Force requirement documents such as AFIs and UFCs when programming and designing this facility type.

Supplement this FC with thorough review by individual program managers and operations staff.

1-4.1 Standard Facility Prototype Tools.

This standard facility prototype consists of four parts to be used by programmers and designers:

1. Facilities Criteria for standard prototype (this FC).
2. Interactive programming sheet.
3. Facility Building Information Modeling (BIM) drawings.
4. Supplemental RFP data.

1-4.2 Facilities Criteria.

The facilities criteria consist of three primary components:

- Notional site.
- Composite facility adjacency diagram(s).
- Modules with associated room data sheets.

1-4.2.1 Notional Site.

The notional site plan diagram depicts key site development criteria. It is not a site-specific solution. The information represents the land requirements to construct this facility and includes associated antiterrorism standoff and parking. Use of existing or shared parking is allowable and may reduce the total acreage required for the facility. Adapt the requirements to the specific site and location and comply with the applicable Installation Development Plan (IDP) and Area Development Plan (ADP) for facility siting.

1-4.2.2 Composite Facility Adjacency Diagram(s).

The composite diagram(s) represent ways to conceptually assemble the functional areas (modules) into a cohesive whole. They demonstrate how the various functional components of the facility type can be successfully placed together into layout diagrams. Individual modules are represented by different colors. They are not intended to be definitive building designs.

1-4.2.3 Modules.

Spaces and rooms that are integrally related with a specific functional connection or operational flow are grouped into a module. Modules and the associated room data sheets identify specific criteria and additional detail for each functional area of the facility as outlined in the space program sheets located in Appendix D. Information is provided in a standard presentation and data sheet format. The required space adjacencies and modules are illustrated in figures.

The modules are a grouping of functional spaces and represent “Lego® blocks” to be used in a “kit-of-parts” design approach. Use the fixed modules as pre-assembled pieces of the facility “puzzle.” Assemble them to comply with the required adjacencies indicated in the diagrams and module plans. Arrange modules and create a configuration/composite building layout/plan responding to the constraints and opportunities of the specific site.

The resulting shape of the facility assembled from the standard facility prototype modules must provide construction efficiencies obtained from building proportions and overall configuration. The building footprint shall be organized and well composed. The building design must comply with the installation facility standards (architectural compatibility plan) and the AFCFS.

1-4.2.4 Module Flexibility/Adjustments.

Modules must be used as designed to the greatest extent possible, and must not be deconstructed or altered except as indicated herein. The intent of the standard facility prototype criteria is to avoid manipulation of the composition, functional relationships, adjacencies, and module sizes. Modules contain fixed attributes and must not be changed arbitrarily. Modules may be rotated, flipped, and reversed to accommodate an overall composition or site issue. When the fixed modules cannot be arranged to produce a constructible floor plan due to site constraints, it is permissible to slightly adjust a module proportion to create a constructible plan. Manipulating the module shape must not result in an overall increase in square feet or reduce the functionality of any module or the composite plan.

Some modules are linked to space requirements that increase or decrease in size based on the personnel count and equipment for a particular mission. In these cases, increase or decrease the size of the module to match the revised scope calculation. This may sometimes require minor adjustments in adjacent modules so that they properly fit together to create a constructible facility floor plan. Spaces must comply with any critical dimensions indicated on module plans. Manipulate as few modules as possible to create a constructible facility. The resulting composite plan must respect the established modules’ adjacencies and must not exceed the authorized project scope.

1-4.2.5 Room Data Sheets.

Specific requirements for each room, space, or area are provided on room data sheets that are located following their respective module. Information contained on the data sheets defines the functional and physical requirements for each of the spaces within the facility type.

1-4.3 Programming Sheet(s).

This tool is provided in two formats. The pdf programming sheet cited in Appendix B reflects the baseline standard facility program and is provided primarily as a reference. The additional interactive programming sheet provides a tool for planners and programmers. It allows the input of authorized personnel positions and special purpose spaces. Updated inputs are automatically calculated and provide new required square

footage for each space and the estimated overall facility size. Appendix C contains a link for direct access to the interactive tool.

1-4.4 Facility Drawings – BIM.

This component of the standard facility prototype tool includes both a pdf version and Revit version of the modules and rooms. The spaces, rooms, and modules shown reflect the baseline standard facility program spreadsheet located in Appendix B. Drawings in this FC are exact copies of the larger BIM drawings and comply with the program scope. The BIM drawings provide a starting point for the digitization of building data and a starting point in the design and construction of a facility. BIM and pdf documents are found at the link provided in Appendix C.

1-4.5 Additional and Alterations.

For additions and alterations to existing facilities, use the adjacencies, sizing/scope, and detailed requirements contained in the site diagrams, module drawings, and room data sheets to the maximum extent possible. The functionality and adjacency of the modules are still valid, but may require some manipulation to fit into existing spaces. This standard may be modified slightly to accommodate the existing structure. Move non-structural walls to the greatest extent possible to open up space in the existing facilities to make them more receptive to the placement of the modules. The planner and designer will determine the most efficient means to balance the placement of modules within existing spaces or as a facility addition.

CHAPTER 2 SITE AND OVERALL ADJACENCY

2-1 GENERAL FACILITY OVERVIEW.

A fighter engine maintenance facility is typically a one-story structure. It is a standalone facility that houses fifth-generation fighter engines and maintenance crews based upon four engine work bays – typical for fifth generation fighters. (Note: The F-35 does not require a separate engine maintenance facility). The engine maintenance facility will include the following modules: engine shop bay module, engine shop support module, flight chief/training administration module, break room module, toilet/shower/locker module, and building support module.

2-1.1 AFCFS.

Consult the AFCFS to determine quality standards for this facility group. This standard facility prototype is considered a Group 3 hierarchy.

2-1.2 Facility Users/Occupants.

This facility is operated by active duty, guard, and reserve military personnel, as well as contractor representatives from the selected engine provider. The number of occupants is approximately 25 personnel per shift (typically two shifts) used by both civilian and military personnel throughout the building

2-1.3 Operational Aspects.

Hours of operation for this facility type are user-driven and vary for different engine types. Amount of air traffic on base can also alter the hours of operation. Engines are delivered on flatbed trucks from offsite locations, delivered to engine bay for initial processing, and trailered to and from the flight line. An exterior wash bay is used before and/or after an engine is serviced.

2-2 NOTIONAL SITE.

The site diagram represents a notional layout to reflect site development requirements/criteria only. It is not an actual site design. Siting must comply with the Installation Development Plan (IDP) and Area Development Plan (ADP).

2-2.1 Site Location and Orientation.

Several factors must be analyzed to determine the most appropriate and cost-effective location for a facility, such as availability and capacity of required utilities, the mass/scale of the facility relative to adjacent structures, and noise issues. Emphasize operation, function, and safety when siting the facility. The preferred location for a fighter engine maintenance facility is immediately adjacent to the flight line, or in close proximity. Other facilities/functions sited in close proximity may include general purpose maintenance hangars and aircraft sunshades. Analyze and comply with airfield clearances, building setback restrictions, and line-of-sight restrictions from the adjacent flight line.

The preferred orientation allows direct access to flight-line operations and ease of access for flight line vehicles and equipment. The approximate project area required for a four-bay shop is 4.00 acres, which includes antiterrorism standoff and parking.

2-2.2 Vehicular and Pedestrian Circulation.

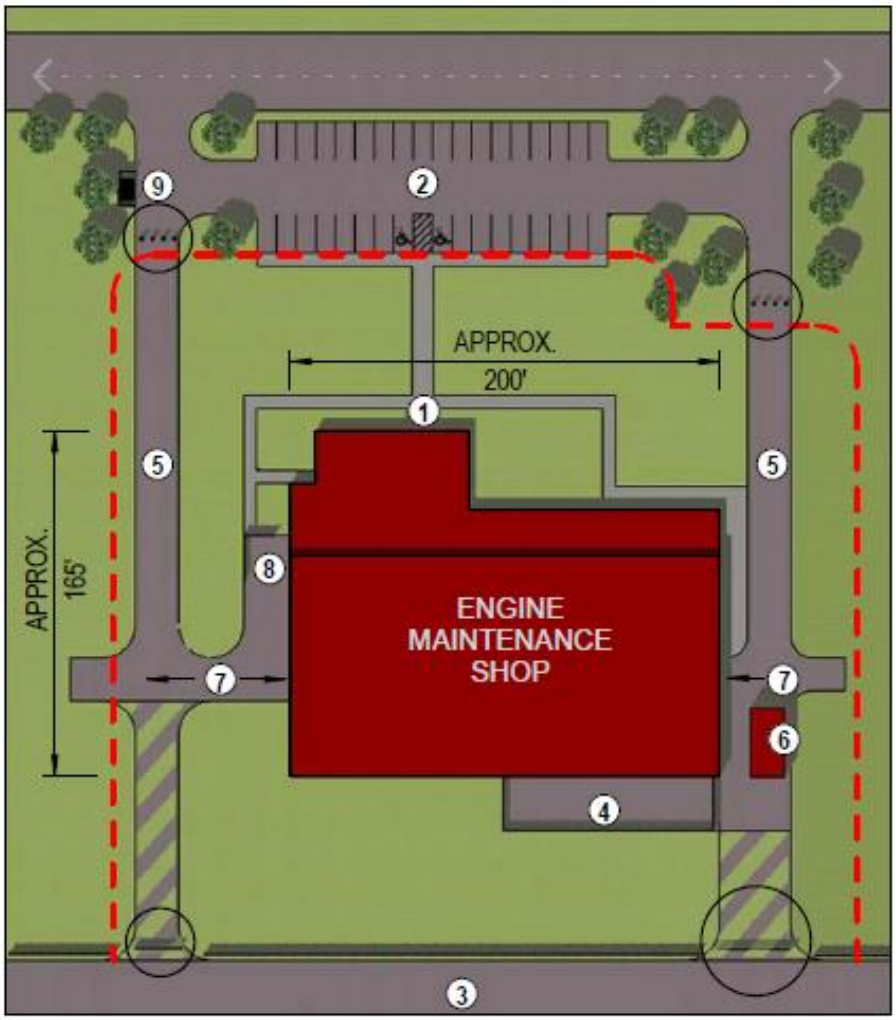
Ensure convenient, safe vehicular access and circulation for personal vehicles and essential services, including operations, maintenance, deliveries, trash and garbage collection, and emergency services. Provide parking to accommodate the largest shift size plus an additional 40 percent for shift overlap. Separate service drives to the facility from parking circulation areas.

Locate sidewalk networks to provide convenient and safe pedestrian circulation from existing circulation elements of the project site to the new parking areas and doors of the facility.

2-3 COMPOSITE FACILITY ADJACENCY (FIGURE 2-2).

This facility has a mixed use of occupants and many points of entry. A majority of administration and training personnel will enter through the main building entrance. Maintenance groups will be in/out of the engine shop bay throughout the day. If the facility is operational and occupied, spaces are left unlocked and accessible for transitioning engines to/from the flight line. Finalize any additional entrances when siting and orienting the building.

Figure 2-1 Notional Site Diagram



NOTES:

① PRIMARY BUILDING ENTRY
② POV PARKING LOT
③ FLIGHT LINE ACCESS (PREFERRED BUT NOT REQUIRED)
④ EXTERIOR ENGINE COMPONENT STORAGE
⑤ SERVICE DRIVE (ONE WAY)
⑥ EXTERIOR COVERED ENGINE WASH BAY
⑦ TRUCK ACCESS
⑧ MECHANICAL SERVICE YARD
⑨ DUMPSTER / SCREENED ENCLOSURE

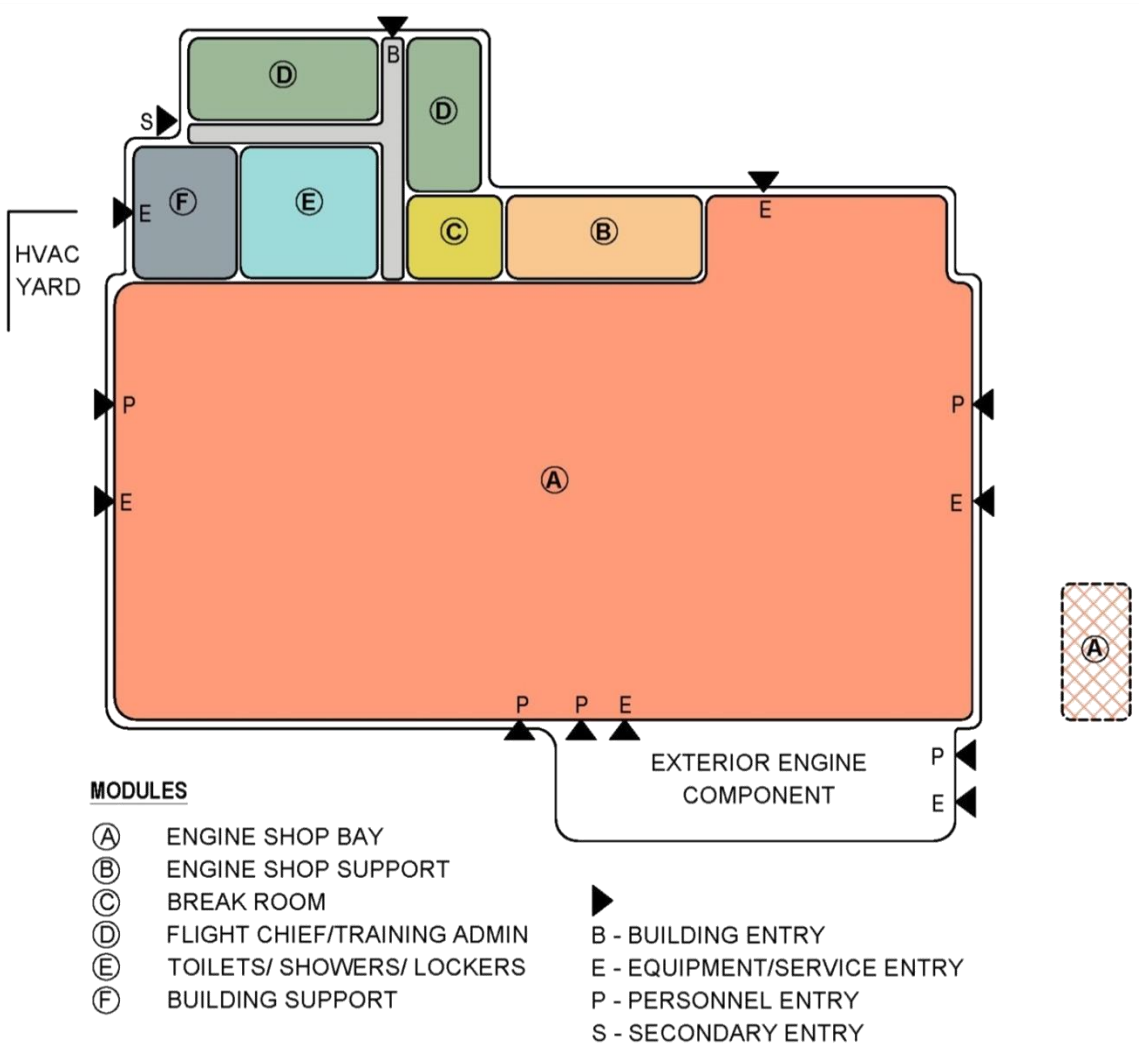
LEGEND:

CONCEPTUAL AT SETBACK (REFERENCE UFC 4-010-01)

ACCESS STREET

CONTROLLED VEHICLE ACCESS

Figure 2-2 Functional Adjacency Diagram



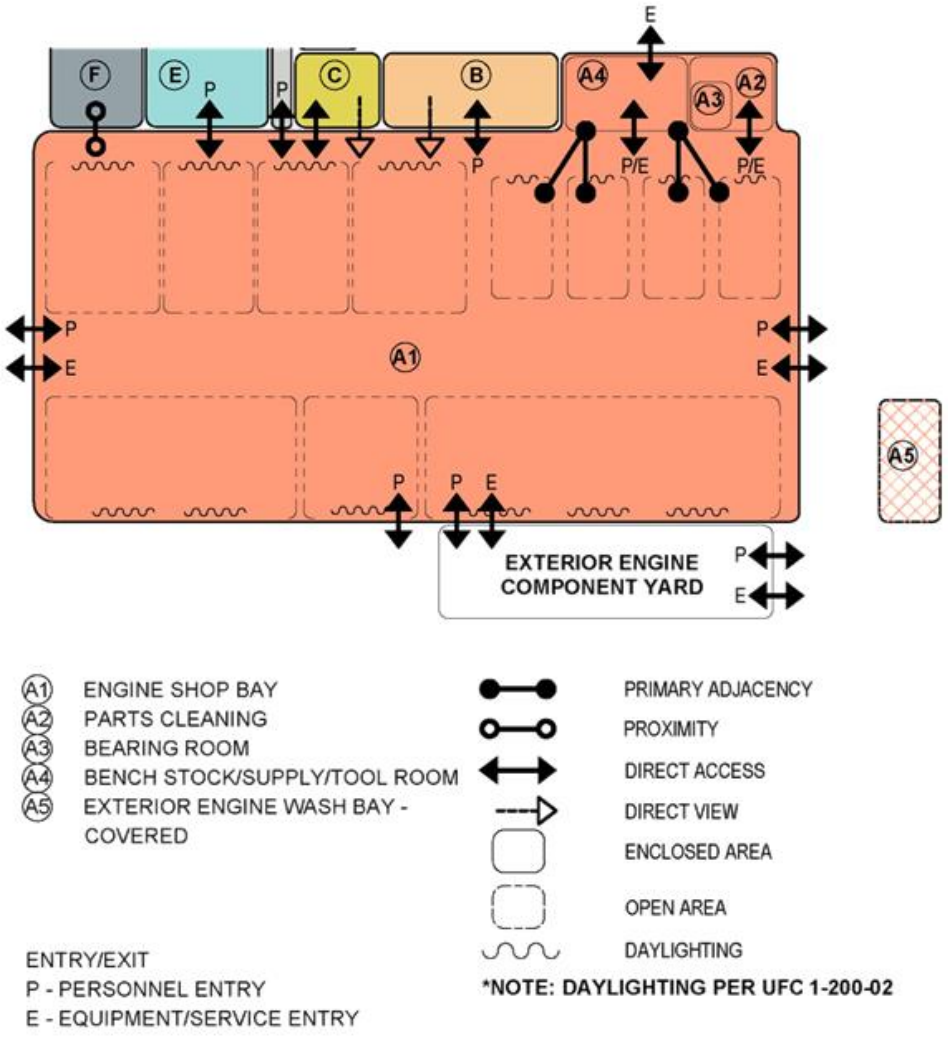
CHAPTER 3 FACILITY REQUIREMENTS AND CRITERIA

3-1 MODULE A - ENGINE SHOP BAY MODULE.

3-1.1 Function and Adjacency.

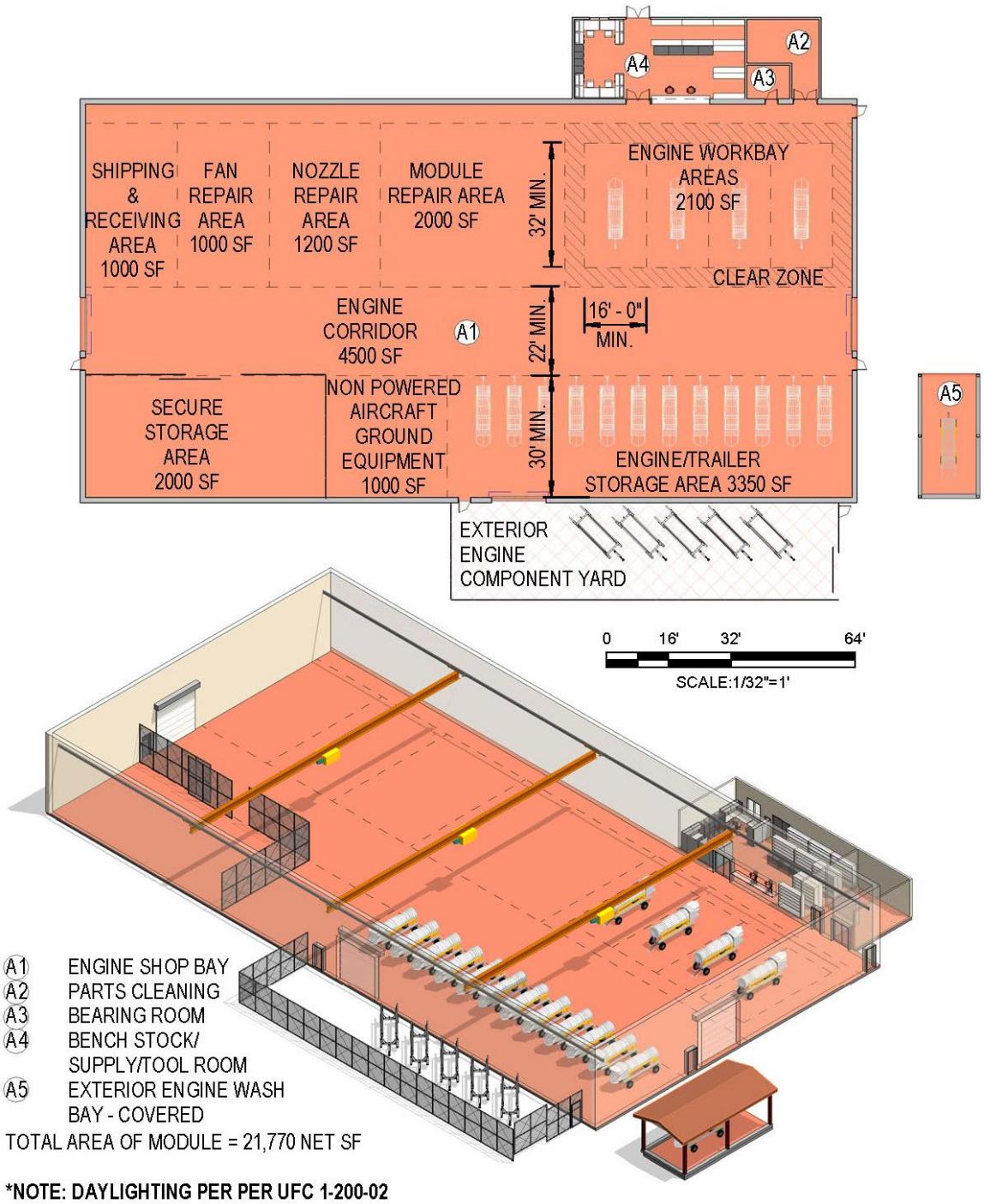
The engine shop bay supports the primary function of the maintenance facility. It is a high-bay, open-space module, with different sub-areas for different types of engine maintenance. Each area is delineated by paint or separated by an internal fence. Equipment and sub-areas are location- and engine-specific and must be verified for final layout. The engine shop bay must have overhead doors on both sides for shipping and receiving engines. An engine will travel in either direction depending upon its maintenance schedule. Trucks work with the bridge cranes to transition engines to and from the flight line or an off-site location. The width of the bay is determined by critical dimensions shown. The listed sub-areas, or a variation of these, are required. The size of these areas is based on the number of engine work bays, and can range proportionally.

Figure 3-1 Module A Adjacency Diagram



3-1.2 Engine Shop Bay Floor Plan (Figure 3-2).

Figure 3-2 Module A Floor Plan and Axonometric



3-1.3 Data Sheets.

Figure 3-3 A1 Engine Shop Bay Room Data Sheet

Description/Usage		General engine maintenance for F-15, F-16, F-22 aircraft engines. Areas include four engine work bays, secure storage area, non-powered aircraft ground equipment, work aisle, engine trailer storage for 14 trailers with a trailer work area, contractor module repair, nozzle, fan repair, and shipping/receiving.
Ceiling Height		20'-0" minimum or as required for 15' hook height clearance
Windows		Translucent wall panels or glazing for daylighting
Doors	**Type**	Hollow metal, 3'x7' Overhead insulated coiling door, 14'x14' power operated
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels 5"x20" at all exterior doors and bench stock room Kick plates both sides of all doors
Finishes	**Walls**	CMU - painted wainscot to 8', pre-finished metal wall or liner panels above to roof deck
	Floor	Epoxy - Non-slip (fuel resistant) or sealed concrete
	Base	No base
	Ceiling	Exposed structure – painted
Plumbing		No floor drains; eyewash shower/eyewash stations per UFC 3-420-01; compressed air drop every 25 feet; coordinate drop locations with users; hose bib
HVAC		Heated with overhead infrared heaters; ventilation with exhaust fans and intake louvers
Fire Protection		Wet pipe or dry pipe sprinkler system as required by UFC 3-600-01
Power		270Vdc/400hZ aircraft power, 480V RECEPT, and receptacles per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Determined by operations at location
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	Intrusion Detection System (IDS)
Acoustical		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Three 5-ton bridge cranes running the full length of the bay – 15' hook height A.F.F.
Special Requirements		Exterior engine component area 25' x 125' of fenced (7'-0" high w/3-strand barbed wire) storage space with concrete surface located adjacent engine shop bay

Figure 3-4 A2 Parts Cleaning Room Data Sheet

Description/Usage		Used to clean engine parts outside of the engine work bay areas. Parts cleaning uses manual solvent parts washers/ cleaners for light to moderate soil levels. Small parts are manually cleaned in the sink and the solvent drains into a 30-gallon reservoir below. Space will have localized exhaust hoods at a parts cleaner station. This space is occupied only by maintenance personnel when cleaning engine parts.
Ceiling Height		No ceiling, 9'-0" minimum clearance
Windows		N/A
Doors	**Type**	Hollow metal, pair 3'x7'
	Security/ Hardware	Keyed lock set Provide door seals for fume containment
	View Panels/ Kick Plates	View panels, 5"x20" at door to engine shop bay Kick plates both sides of each door
Finishes	**Walls**	CMU - painted
	Floor	Epoxy - non-slip or sealed concrete
	Base	No base
	Ceiling	Exposed to structure - painted
Plumbing		Industrial sink, emergency shower/eyewash stations per UFC 3-420-01
HVAC		Air conditioned; heated; localized exhaust over parts cleaning tanks
Fire Protection		Wet pipe sprinkler system
Power		Hazardous location Per UFC 3-520-01 and NEC
Lighting		Hazardous location Per UFC 3-530-01
Communication	**Tele.**	Determined by operations at location
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	IDS
Acoustical		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Parts cleaning equipment; work bench
Special Requirements		

Figure 3-5 A3 Bearing Room Data Sheet

Description/Usage		Used for cleaning, inspection, lubrication, and wrapping of the engine bearings. The room must be a clean, dust free, environmentally controlled area. This space is occupied by maintenance personnel only when accomplishing maintenance on engine bearings.
Ceiling Height		No ceiling, 9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 4'x7'
	Security/ Hardware	Keyed lock set Provide door seals for fume containment
	View Panels/ Kick Plates	View panels, 5"x20" at door to engine shop bay Kick plates on both sides of door
Finishes	**Walls**	CMU – painted
	Floor	Epoxy – non-slip or sealed concrete
	Base	No base
	Ceiling	Exposed to structure - painted
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation; single zone; localized exhaust
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01 and a 30A 240V power outlet. Hazardous areas per T.O. 44B-1-15.
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Determined by operations at location
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	IDS
Acoustical		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Bearing cleaning vats and equipment, work bench
Special Requirements		Electrical classification of the area around the cleaning vat and ventilation and filtering of the room air must comply with T.O. 44B-1-15. A tacky vinyl blotter/floor mat is required on both sides of the bearing room door entrance.

Figure 3-6 A4 Bench Stock/Supply/Tool Room Data Sheet

Description/Usage		Room for bench stock personnel, tool storage and tool distribution to maintenance personnel
Ceiling Height		9'-0" minimum clearance
Windows		Exterior insulated AT compliant
Doors	**Type**	Hollow metal, pair 3'x7', interior to engine shop bay and exterior 4'x8' coiling manual counter shutter to engine shop bay
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels, 5"x20" at door to engine shop bay Kick plates on both sides of doors
Finishes	**Walls**	CMU or impact resistant gypsum board - painted
	Floor	Epoxy – non-slip or sealed concrete
	Base	Resilient
	Ceiling	Exposed to structure - painted or acoustical ceiling tile
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation; single zone
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Determined by operations at location
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	IDS
Acoustical		N/A
Furnishings, Equipment and Casework		Four workstations in open office setting; storage racks; counter with coiling manual counter shutter from tool delivery area to engine shop bay
Special Requirements		

Figure 3-7 A5 Exterior Engine Wash Bay - Covered Room Data Sheet

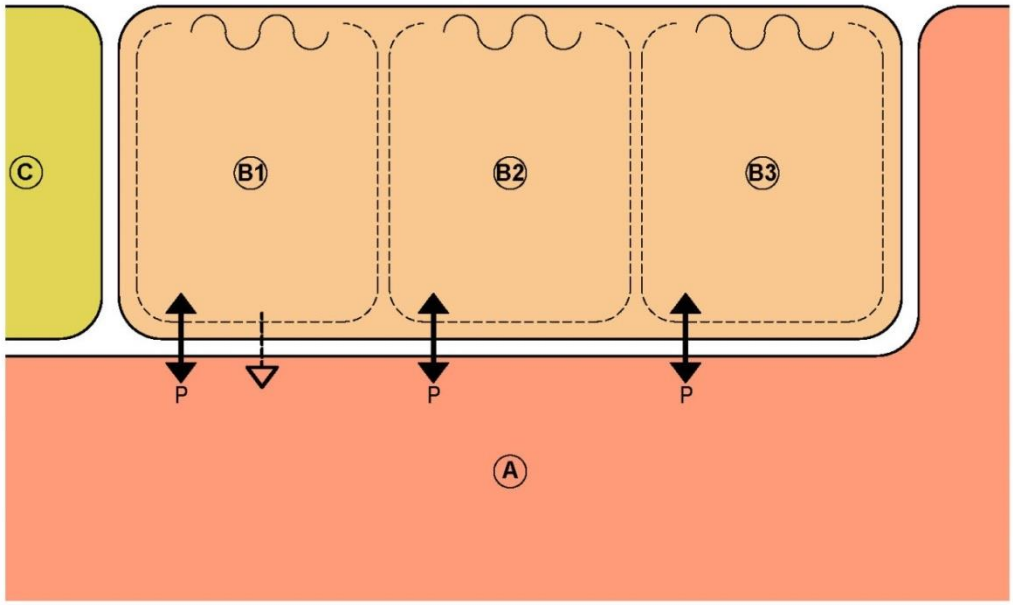
Description/Usage		An open wash bay to clean engines before or after being transported. Engines are backed in on trailers.
Ceiling Height		12’ minimum clear height to structure
Windows		N/A
Doors	**Type**	N/A
	Security/ Hardware	N/A
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	N/A
	Floor	Concrete or asphalt
	Base	N/A
	Ceiling	Exposed structure - painted
Plumbing		Freeze-proof hose stations; localized area drains
HVAC		N/A
Fire Protection		N/A
Power		N/A
Lighting		Flood lighting; per UFC 3-530-01
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		N/A
Furnishings, Equipment and Casework		N/A
Special Requirements		Provide hose stations in close proximity 16’ (w) x 32’(L) x 12’(H) clear of all obstructions; canopy sun shade for engines as required by mission and base constraints

3-2 MODULE B – ENGINE SHOP SUPPORT MODULE.

3-2.1 Function and Adjacency (Figure 3-8).

The engine shop support module is comprised of administration spaces that directly support the engine shop bay and is the only administration module placed directly adjacent to the engine shop bay. It is used by maintenance crews or personnel working directly with maintenance crews. Space requirements for personnel is the driving force in determining the net square footage needed in this module. These spaces can be separated by demountable partitions, systems furniture, or metal stud/gypsum board wall construction.

Figure 3-8 Module B Adjacency Diagram



B1 REPAIR SECTION CHIEFS
B2 READY ROOM
B3 JET ENGINE INTERMEDIATE MAINTENANCE (JEIM)

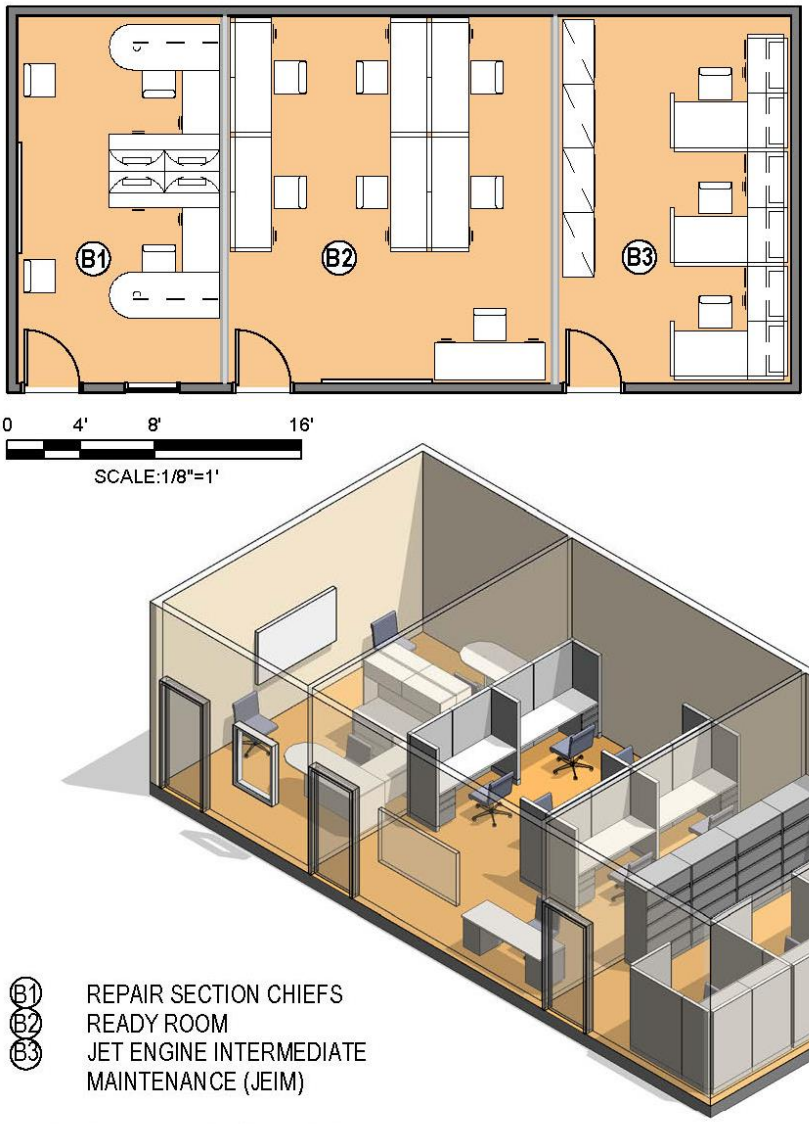
ENTRY/EXIT
P - PERSONNEL ENTRY
E - EQUIPMENT/SERVICE ENTRY

PRIMARY ADJACENCY
PROXIMITY
DIRECT ACCESS
DIRECT VIEW
ENCLOSED AREA
OPEN AREA
DAYLIGHTING

***NOTE: DAYLIGHTING PER UFC 01-200-02**

3-2.2 Engine Shop Support Floor Plan (Figure 3-9).

Figure 3-9 Module B Floor Plan and Axonometric



3-2.3 Data Sheets.

Figure 3-10 B1 Repair Section Chiefs Room Data Sheet

Description/Usage		Two Section Chiefs who oversee work in engine shop bay
Ceiling Height		9'-0" minimum
Windows		Exterior insulated AT compliant; interior (3'x4') with view to bay
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels, 5"x20" at door to engine shop bay Kick plates both sides all doors
Finishes	**Walls**	Systems furniture, demountable partitions or gyp. board - painted
	Floor	Sealed concrete, stained concrete or tile
	Base	Resilient or tile
	Ceiling	Acoustical ceiling tile or open to structure - painted
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation; single zone
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Determined by operations at location
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	IDS
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Two workstations and seats for visitors, whiteboard for instructional use
Special Requirements		

Figure 3-11 B2 Ready Room Data Sheet

Description/Usage		A transitional space between shifts and a training room for engine shop bay. For training, provide seating for each student and for instructors at ratio of one per six students. Provide space for hoteling, checking e-mails, etc.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated ATFP
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels, 5"x20" at door to engine shop bay Kick plates both sides of door
Finishes	**Walls**	Systems furniture, demountable partitions or gyp. board - painted
	Floor	Sealed concrete, stained concrete or tile
	Base	Resilient or tile
	Ceiling	Acoustical ceiling tile, or open to structure - painted
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation; single zone
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Determined by operations at location
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	IDS
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Seven desks with computer-based training and whiteboard on one wall; desks (and associated power/data) should be flexible in layout to accommodate different functions.
Special Requirements		

Figure 3-12 B3 Jet Engine Intermediate Maintenance (JEIM) Room Data Sheet

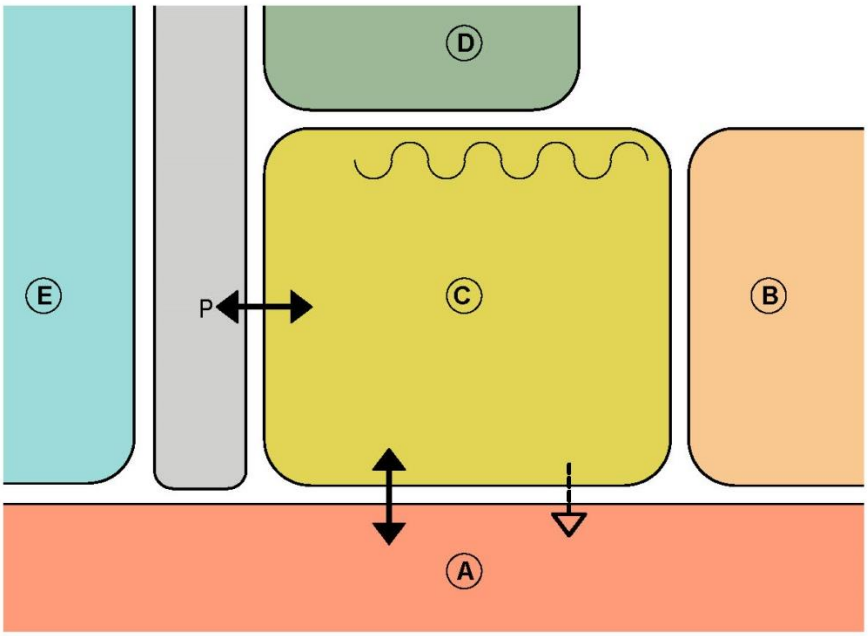
Description/Usage		Administration space for three occupants to log information regarding jet engine maintenance
Ceiling Height		9'-0" minimum
Windows		Exterior insulated ATFP
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels, 5"x20" at engine shop bay kick plates both sides of door
Finishes	**Walls**	Systems furniture, demountable partitions or gyp. board - painted
	Floor	Sealed concrete, stained concrete or tile
	Base	Resilient or tile
	Ceiling	Acoustical ceiling tile or open to structure - painted
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation; single zone
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Determined by operations at location
	Data	NIPR / SIPR
	CCTV	N/A
	CATV	N/A
	Security	IDS
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Three workstations and (4) 3 high 36" lateral files per occupant
Special Requirements		

3-3 MODULE C – BREAK ROOM MODULE.

3-3.1 Function and Adjacency (Figure 3-13).

The break room module is a stand-alone module, sized to accommodate 16-20 personnel. It will include a counter with sink and cabinets above, and areas for a microwave, refrigerator, and vending machines. This module supports the maintenance crews in the engine shop bay, as well as the administration personnel. It also functions as a team room for meetings. This module is centrally located for easy access from both groups.

Figure 3-13 Module C Adjacency Diagram



Ⓒ BREAK ROOM

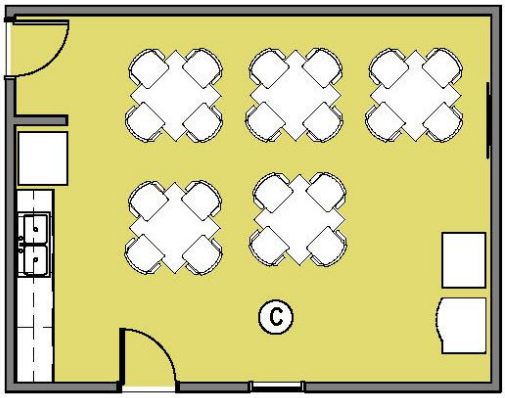
PRIMARY ADJACENCY
PROXIMITY
DIRECT ACCESS
DIRECT VIEW
ENCLOSED AREA
OPEN AREA
DAYLIGHTING

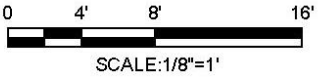
ENTRY/EXIT
P - PERSONNEL ENTRY
E - EQUIPMENT/SERVICE ENTRY

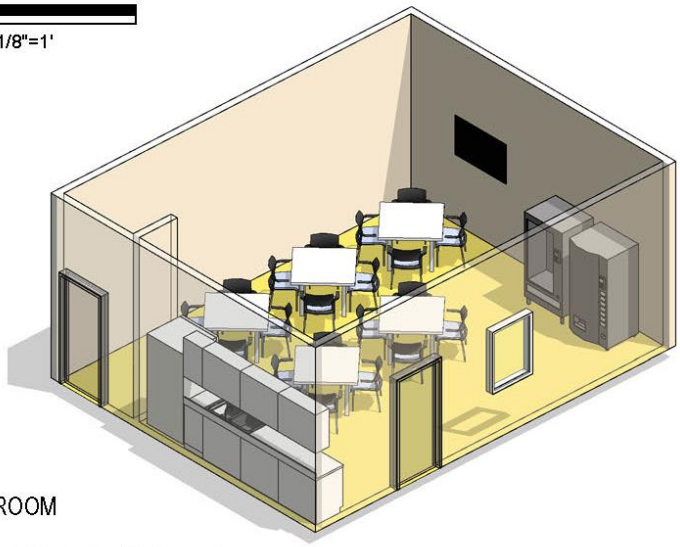
***NOTE: DAYLIGHTING PER UFC 01-200-02**

3-3.2 Break Room Floor Plan.

Figure 3-14 Module C Floor Plan and Axonometric







Ⓒ BREAK ROOM

TOTAL AREA OF MODULE = 520 NET SF

***NOTE: DAYLIGHTING PER UFC 1-200-02**

3-3.3 Data Sheets.

Figure 3-15 C Break Room Data Sheet

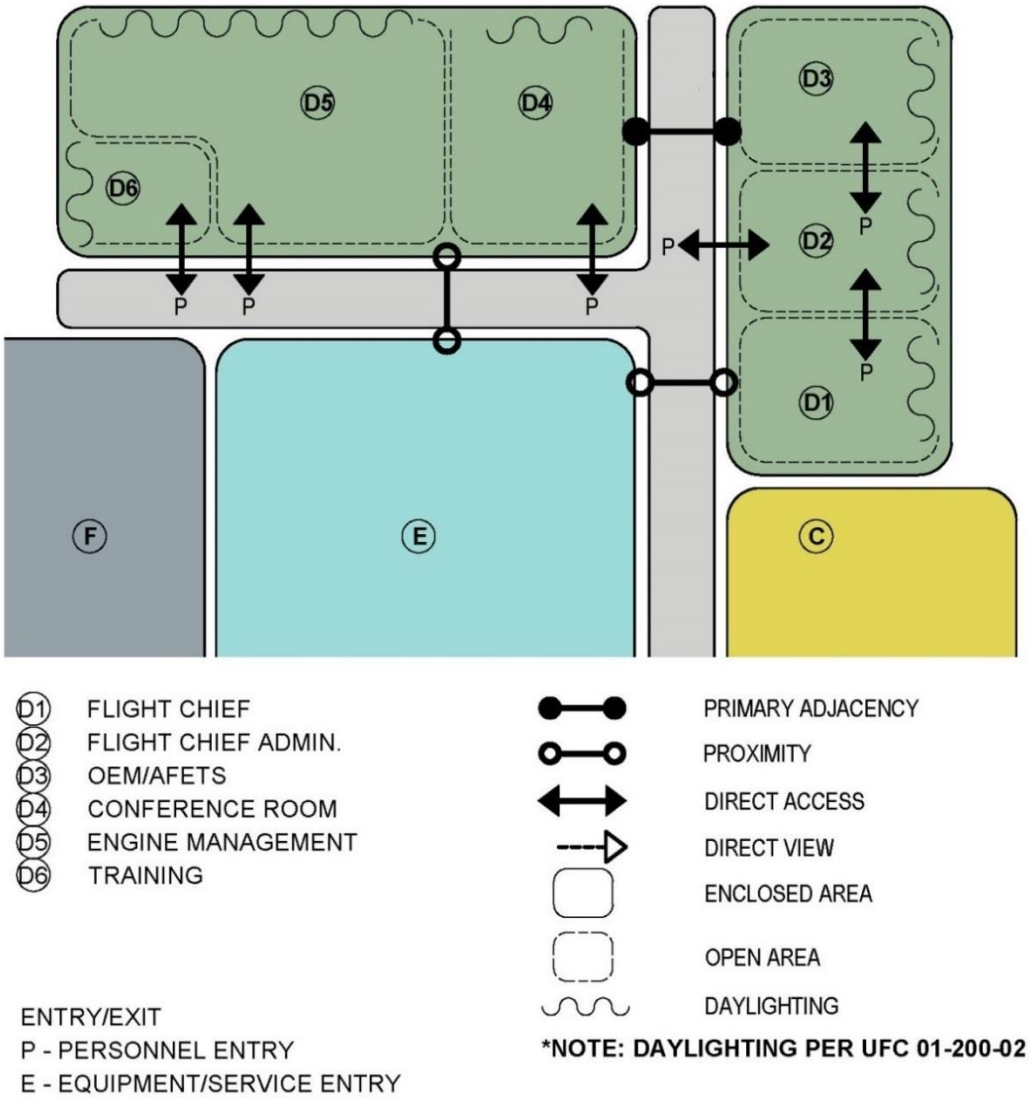
Description/Usage		An informal gathering space for personnel during lunch and breaks, and a transitional space before and after shifts; also used as a classroom and meeting room for up to 20 persons.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated AT compliant or clearstory; interior (3'x4') with view to engine shop bay
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels, 5"x20" for both interior doors kick plates both sides of doors
Finishes	**Walls**	Gypsum board – painted or CMU - painted
	Floor	Sealed concrete, stained concrete, quartz epoxy or tile
	Base	Resilient or quartz epoxy or tile
	Ceiling	Acoustical ceiling tile or open to structure – painted
Plumbing		Sink with disposal
HVAC		Air conditioned; heated; ventilation; single zone
Fire Protection		Wet pipe sprinkler system
Power		120V dedicated circuits for coffee maker, microwave, and refrigerator; 120V convenience outlets per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Determined by operations at location
	Data	NIPR
	CCTV	N/A
	CATV	Yes, see plans for locations
	Security	N/A
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Seating for 16-20 people; refrigerator, microwave, dishwasher, double sink with disposal; vending machines; wall-mounted video monitor and bulletin board.
Special Requirements		

3-4 MODULE D – FLIGHT CHIEF/TRAINING ADMINISTRATION MODULE.

3-4.1 Function and Adjacency (Figure 3-16).

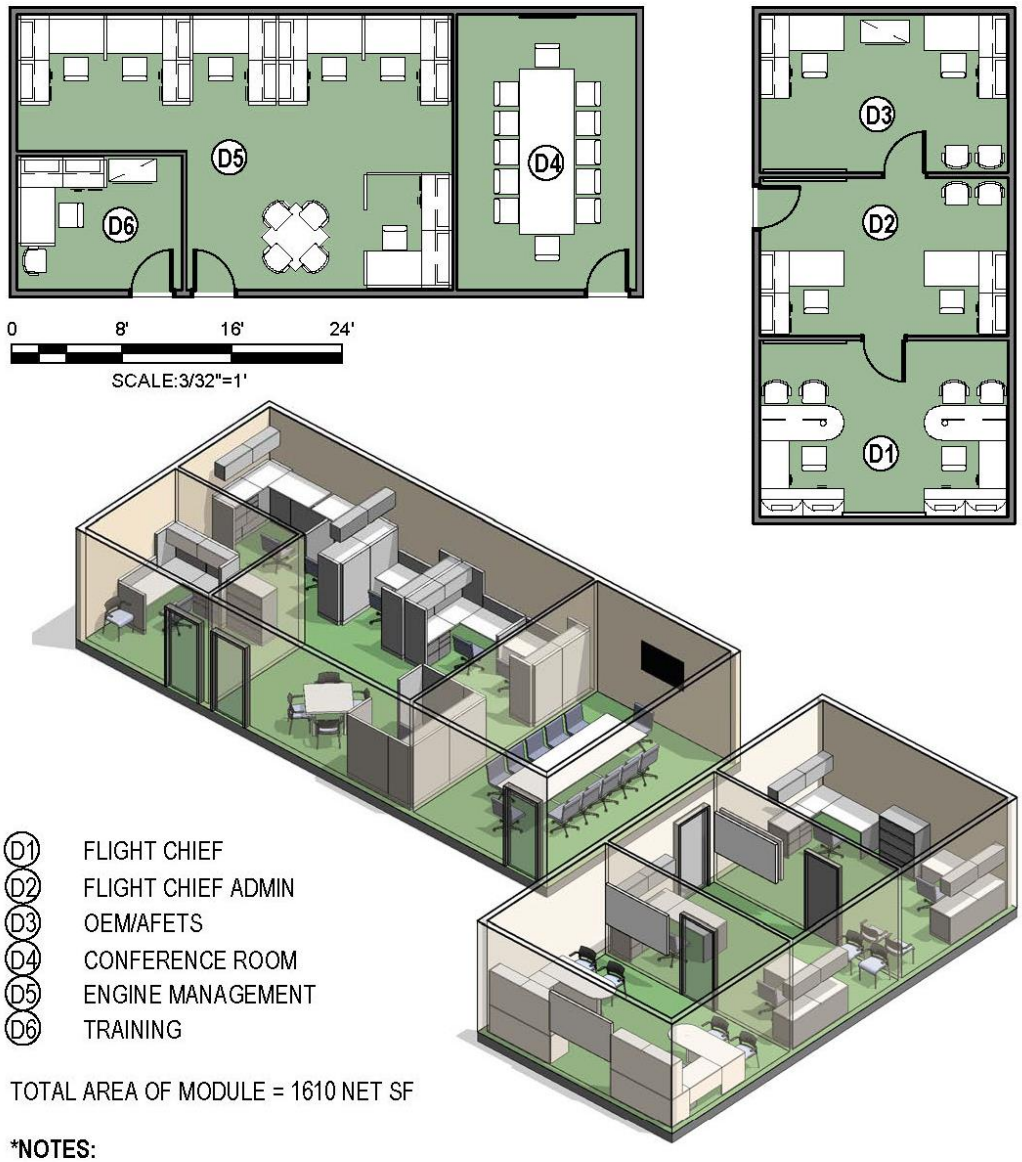
The Flight/Chief training administrative module comprises the following spaces: the Flight Chief office, with two workstation desks for the two Flight Chiefs; a Flight Chief administration area with two workstations, adjacent to the Flight Chief's office; an OEM/AFETS office with two workstations, located near the Flight Chief administration area; a conference room sized for 12 persons, centrally located near the Flight Chief's office; an engine management office with five open workstations and one small conference table; and a training office with one workstation. Locate this module directly adjacent to the building's main corridor, near the toilets/showers/lockers module and break room module. Interior spaces can be separated by demountable partitions, systems furniture, and/or gypsum board permanent construction.

Figure 3-16 Module D Adjacency Diagram



3-4.2 Flight Chief/Training Administration Floor Plan (Figure 3-17).

Figure 3-17 Module D Floor Plan and Axonometric



3-4.3 Data Sheets.

Figure 3-18 D1 Flight Chief Room Data Sheet

Description/Usage		An open office space that accommodates two Flight Chiefs for general administration, it must have space for up to four visitors during operational hours.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated AT compliant
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels, 5"X20" Kick plates both sides of door
Finishes	**Walls**	Systems furniture, demountable partitions or gyp. board - painted
	Floor	Sealed concrete, stained concrete, tile, or carpet tile
	Base	Resilient or tile
	Ceiling	Acoustical ceiling tile, or open to structure – painted
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation;
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Yes, one per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Two workstations with computer connection capabilities and whiteboard on one wall for instructional use
Special Requirements		

Figure 3-19 D2 Flight Chief Admin Room Data Sheet

Description/Usage		Supports the Flight Chiefs with daily tasks. Provide workspace for two occupants plus two visitors in a waiting area.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated AT compliant
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels, 5"x20" Kick plates both sides of door
Finishes	**Walls**	Systems furniture, demountable partitions or gyp. board - painted
	Floor	Sealed concrete, stained concrete, tile or carpet tile
	Base	Resilient or tile
	Ceiling	Acoustical ceiling tile, or open to structure – painted
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation;
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Yes, one per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Two workstations with computer connection capabilities & whiteboard on one wall for instructional use;
Special Requirements		

Figure 3-20 D3 OEM/AFETS Room Data Sheet

Description/Usage		Open office space that accommodates two general administration personnel; must have space for two visitors during operational hours.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated AT compliant
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels, 5"x20" Kick plates both sides of door
Finishes	**Walls**	Systems furniture, demountable partitions or gyp. board - painted
	Floor	Sealed concrete, stained concrete, tile or carpet tile
	Base	Resilient or tile
	Ceiling	Acoustical ceiling tile or open to structure - panted
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation;
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Yes, one per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Two workstations with computer connection capabilities and whiteboard on one wall for instructional use; shared lateral storage.
Special Requirements		

Figure 3-21 D4 Conference Room Data Sheet

Description/Usage		Serves all personnel in the facility (is available for use by all in the facility, but not at once). Both maintenance crews and administration personnel will use this space. Clearance around conference table is a requirement.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated AT compliant
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panel, 5"x20" on door to corridor Kick plates both sides of door
Finishes	**Walls**	Demountable partitions, gyp. board- painted
	Floor	Sealed concrete, stained concrete, tile or carpet tile
	Base	Resilient or tile
	Ceiling	Acoustical ceiling tile or open to structure - painted
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation;
Fire Protection		Wet pipe sprinkler system
Power		Per UFC3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Yes, one for the room
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Conference table with seating for 12; wall-mounted video monitor
Special Requirements		

Figure 3-22 D5 Engine Management Room Data Sheet

Description/Usage		Open office space that accommodates six general administration personnel. It must have enough space for two visitors during operational hours and a mini-conference area for collaboration.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated AT compliant
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels, 5"x20" for door to corridor Kick plates both sides of door
Finishes	**Walls**	Systems furniture, demountable partitions or gyp. board - painted
	Floor	Sealed concrete, stained concrete, tile or carpet tile
	Base	Resilient or tile
	Ceiling	Acoustical ceiling tile or open to structure - painted
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation; single zone
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Yes, one per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Six workstations; small conference table with seating for four to six personnel
Special Requirements		

Figure 3-23 D6 Training Room Data Sheet

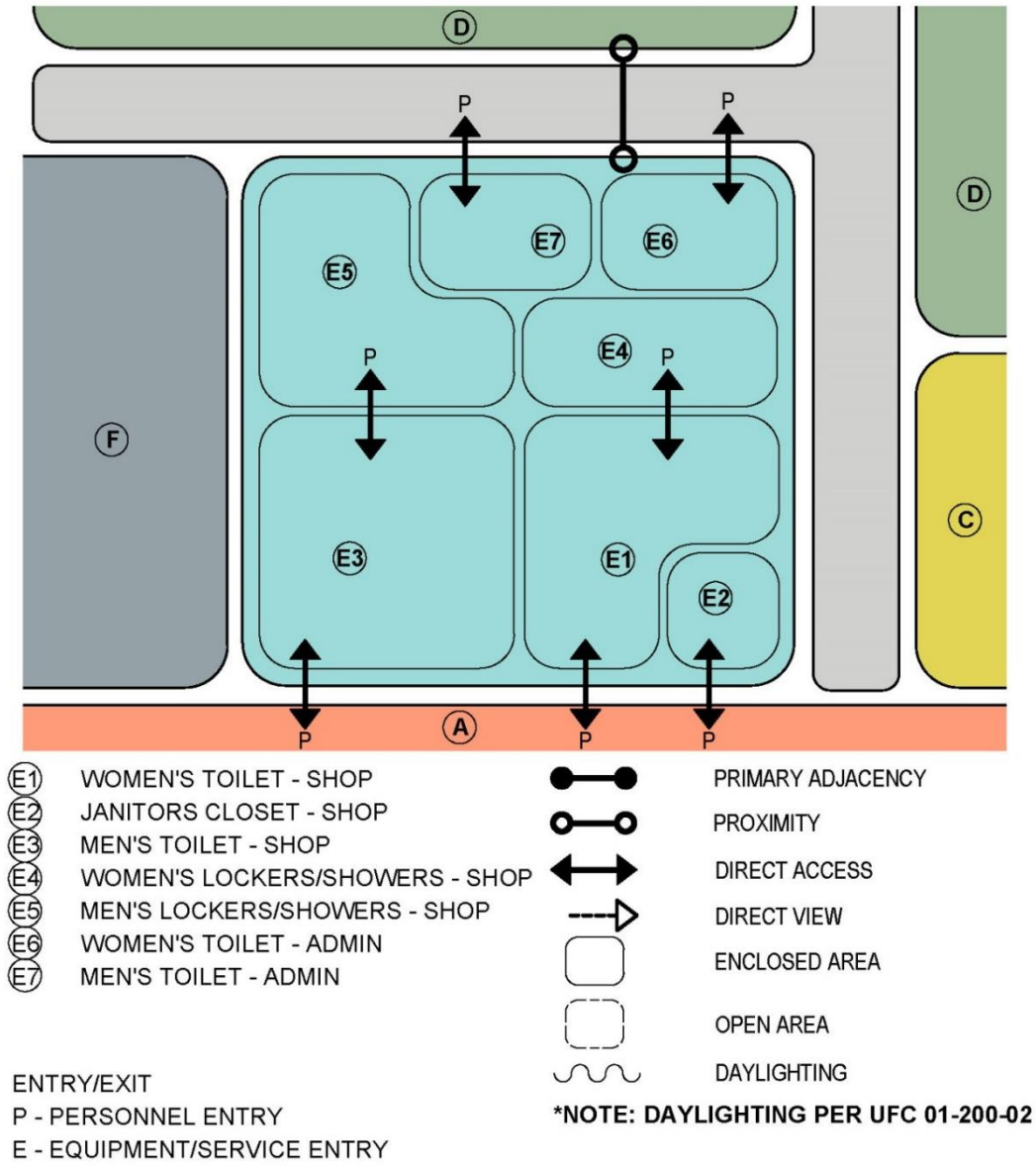
Description/Usage		An enclosed space for personalized training
Ceiling Height		9'-0" minimum
Windows		Exterior insulated AT compliant
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	View panels, 5"x20" on door to corridor Kick plates both sides of door
Finishes	**Walls**	Systems furniture, demountable partitions or gyp. board - painted
	Floor	Sealed concrete, stained concrete, tile or carpet tile
	Base	Resilient or tile
	Ceiling	Acoustical ceiling tile or open to structure - painted
Plumbing		N/A
HVAC		Air conditioned; heated; ventilation; single zone
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Yes, one per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		One workspace with space for visitors; lateral storage; whiteboard for instructional use.
Special Requirements		

3-5 MODULE E – TOILETS/SHOWERS/LOCKERS MODULE.

3-5.1 Function and Adjacency.

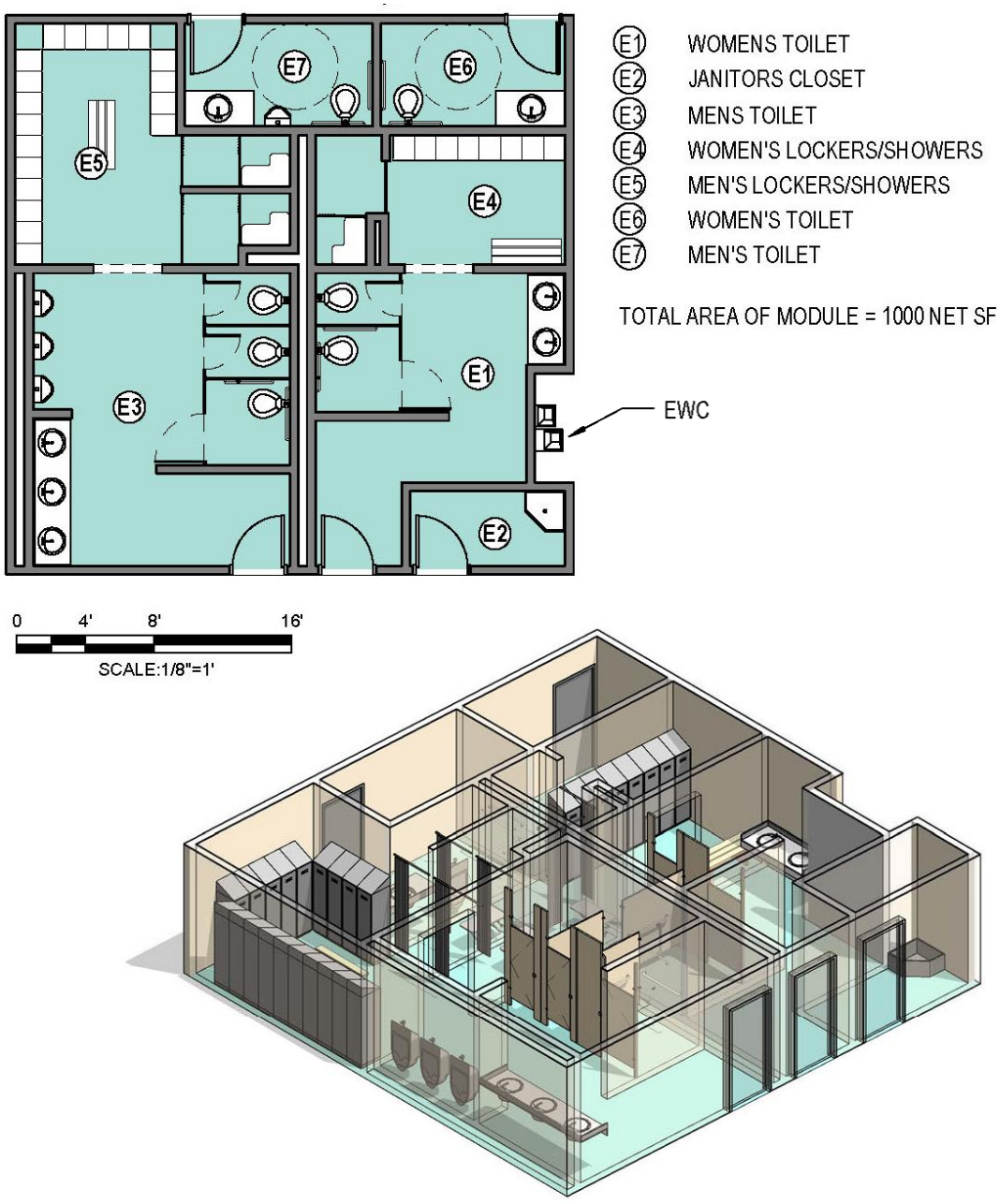
The toilets/showers/lockers module consists of men's and women's toilet/shower/locker rooms (sized for 25 total per shift, 75/25 male/female ratio) and a janitor's closet. It will be centrally located, with direct access to the engine shop bay area. The locker room module will have full-height lockers for two shifts (25-30 lockers). It will contain a single male toilet room and a single female toilet room, each with one water closet and an adjacent lavatory, and with access to the administrative module.

Figure 3-24 Module E Adjacency Diagram



3-5.2 Toilets/Showers/Lockers Floor Plan (Figure 3-25).

Figure 3-25 Module E Floor Plan and Axonometric



3-5.3 Data Sheet.

Figure 3-26 E1-E7 Toilets/Showers/Lockers Room Data Sheet

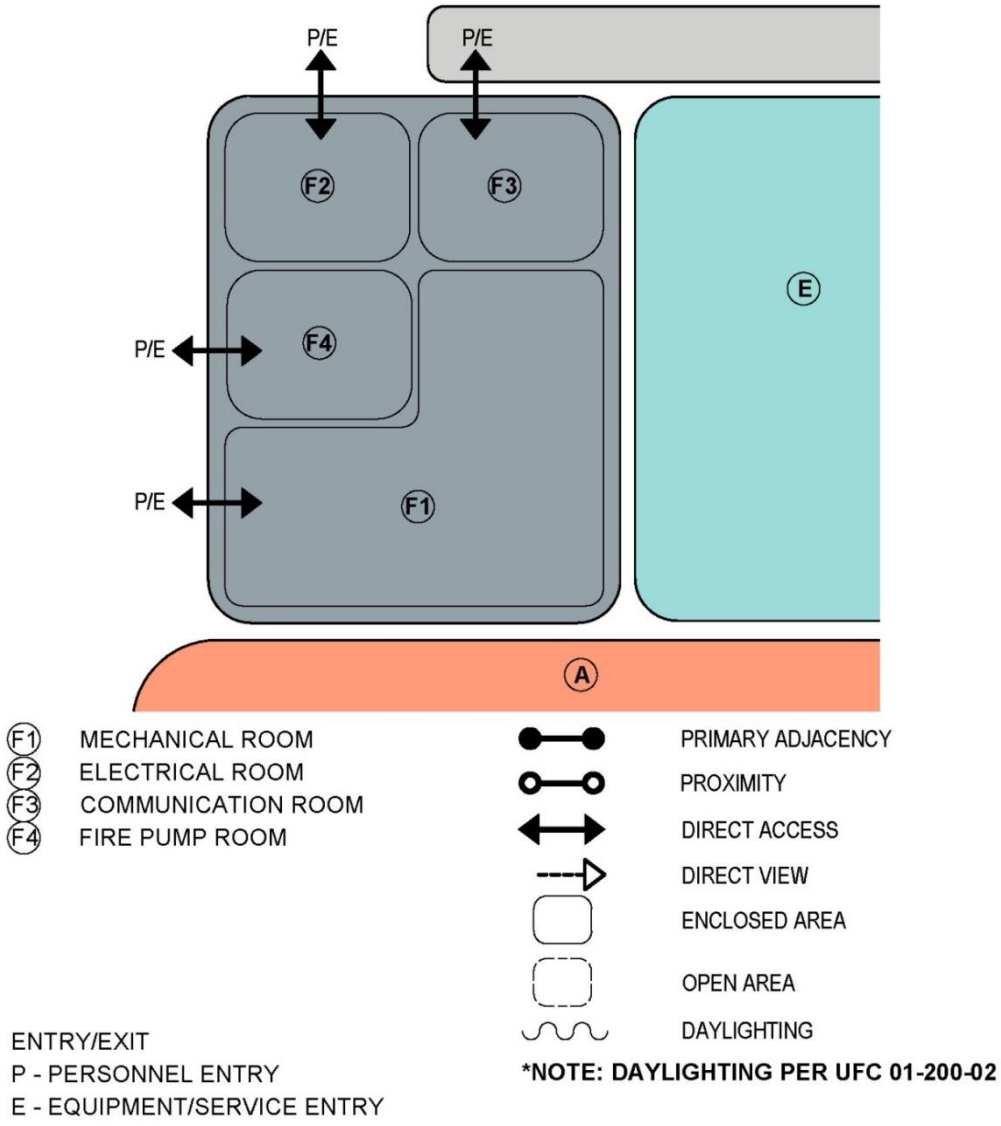
Description/Usage		Toilets/showers/showers serve all personnel in the facility. Toilet for maintenance crew use must be available from the engine shop bay.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3'x7'
	Security/ Hardware	Push-pull
	View Panels/ Kick Plates	No panels Kick plates both sides of doors
Finishes	**Walls**	Ceramic tile full height at wet walls, showers, gypsum board - painted
	Floor	Porcelain tile or quartz epoxy
	Base	Porcelain tile or quartz epoxy
	Ceiling	Gypsum board - painted
Plumbing		Sinks; toilets; urinals; floor drains in restroom areas, shower and locker areas; mop sink; EWC
HVAC		Air conditioned and heated restrooms, showers, lockers; ventilation; exhaust from restrooms, locker rooms, janitor's closet
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		Determine fixture count by number of building occupants at maximum load; wall hung urinals; lavatories in counter tops.
Special Requirements		Water-resistant gypsum board throughout. See RFP for accessories requirements.

3-6 MODULE F – BUILDING SUPPORT MODULE.

3-6.1 Function and Adjacency.

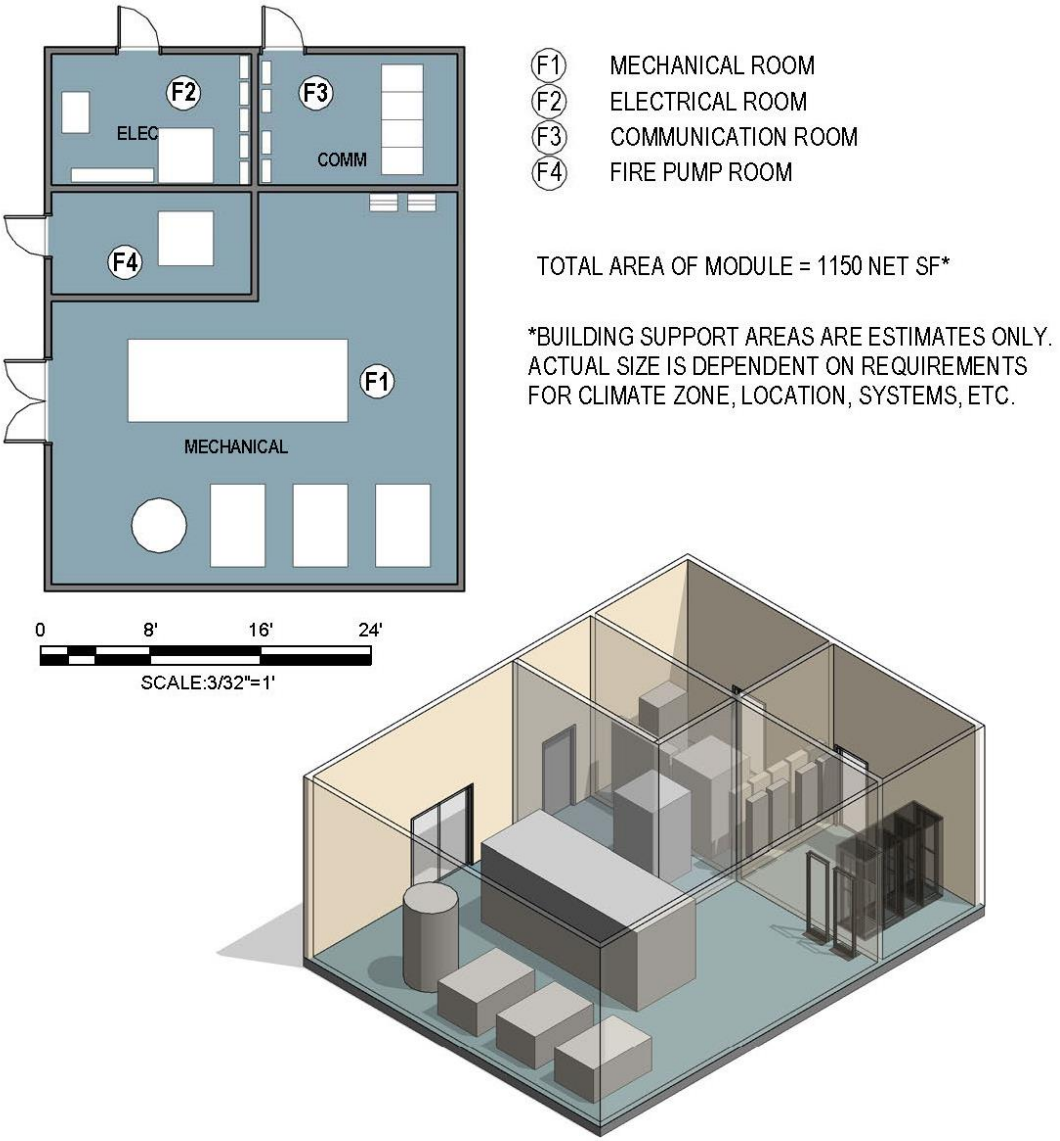
The building support module consists of a mechanical room, an electrical room, and a telecommunications room (fire protection room if not in mechanical room). All rooms must have exterior access (with exception of the communication room, which may have interior access). Building support modules must be located on an exterior wall adjacent to the utility courtyard and accessible for maintenance.

Figure 3-27 Module F Adjacency Diagram



3-6.2 Building Support Floor Plan (Figure 3-28).

Figure 3-28 Module F Floor Plan & Axonometric



3-6.3 Data Sheets.

Figure 3-29 F1 Mechanical Room Data Sheet

Description/Usage		Mechanical equipment and service
Ceiling Height		No ceiling
Windows		N/A
Doors	**Type**	Hollow metal, pair 3'x7', exterior access required
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	Kick plates
Finishes	**Walls**	CMU – painted to deck
	Floor	Sealer hardener
	Base	No base
	Ceiling	Open to structure - painted
Plumbing		Floor drains as required
HVAC		Heated and ventilated
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Yes, one per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		Per UFC 3-450-01 for noise control
Furnishings, Equipment and Casework		
Special Requirements		

Figure 3-30 F2 Electrical Room Data Sheet

Description/Usage		Electrical equipment and service
Ceiling Height		No ceiling
Windows		N/A
Doors	**Type**	Hollow metal, 3'x7', exterior access required
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	Kick plates
Finishes	**Walls**	CMU - painted
	Floor	Sealer hardener
	Base	No base
	Ceiling	Open to structure - painted
Plumbing		N/A
HVAC		Heated and ventilated
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	One per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/AB
Acoustical Requirements		N/A
Furnishings, Equipment and Casework		
Special Requirements		

Figure 3-31 F3 Communication Room Data Sheet

Description/Usage		Communication and UPS service
Ceiling Height		9'-0" minimum clearance
Windows		N/A
Doors	**Type**	Hollow metal, 3'x7', interior or exterior access is acceptable
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	Kick plates
Finishes	**Walls**	CMU - painted
	Floor	Sealer hardener
	Base	No base
	Ceiling	Open to structure - painted
Plumbing		N/A
HVAC		Heated and ventilated; dedicated cooling for comm.
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Yes, one per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		N/A
Furnishings, Equipment and Casework		
Special Requirements		

Figure 3-32 F4 Fire Pump Room Data Sheet

Description/Usage		Fire pump equipment
Ceiling Height		No ceiling
Windows		N/A
Doors	**Type**	Hollow metal, 3'x7', exterior access required
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	Kick plates
Finishes	**Walls**	CMU – painted to deck
	Floor	Sealer hardener
	Base	No base
	Ceiling	Open to structure - painted
Plumbing		N/A
HVAC		Heated and ventilated
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	One per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		N/A
Furnishings, Equipment and Casework		
Special Requirements		

Figure 3-33 Circulation Room Data Sheet

Description/Usage		Use this data sheet for circulation or corridor spaces. The corridor may become part of the Flight Chief/training administration module.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3'x7' (egress)
	Security/ Hardware	Keyed lock set
	View Panels/ Kick Plates	N/A Kick plates both sides of door
Finishes	**Walls**	Gypsum board - painted
	Floor	Sealed concrete, stained concrete or tile
	Base	Resilient or tile
	Ceiling	Acoustical ceiling tile or open to structure - painted
Plumbing		N/A
HVAC		Heated and air conditioned
Fire Protection		Wet pipe sprinkler system
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical Requirements		N/A
Furnishings, Equipment and Casework		
Special Requirements		

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APPENDIX A REFERENCES

AIR FORCE

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MISCELLANEOUS

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APPENDIX B BEST PRACTICES

B-1 ENGINE MAINTENANCE FACILITY PROGRAMMING SHEET.

MODULE NO.	AREA	NO. OCCUP	SF PER USER	NO. OF ROOMS REQUIRED	INDIVIDUAL ROOM RQRMNTS SF	NET USER REQUIREMENTS SF	NET USER REQUIREMENTS SM	COMMENTS
A	Engine Shop Bay							
A.1	Engine Shop Bay (4 Engine WorkBays)	20		1	20230	20230	1,879.37	1
A.2	Parts Cleaning	2		1	280	280	26.01	
A.3	Bearing Room	1		1	100	100	9.29	
A.4	Bench Stock/Supply & Tool Room	6		1	900	900	83.61	
A.5	Exterior Engine Wash Bay- Covered (1/2 Scope)	0		1	260	260	24.15	
	SUBTOTAL ENGINE BAY AREA					21770	2,022.43	
B	Engine Shop Support							
B.1	Repair Section Chiefs	2	80	1	250	250	23.23	3, 7
B.2	Ready Room	7	64	1	350	350	32.52	3
B.3	Jet Engine Intermediate Maintenance (JEIM)	3	64	1	250	250	23.23	3, 7
	SUBTOTAL ENGINE SHOP SUPPORT AREA					850	78.97	
C	Break Room							
C.1	Break Room	16-20	note 2	1	520	520	48.31	2
	SUBTOTAL BREAKROOM AREA					520	48.31	
D	Flight Chief /Training Administration							
D.1	Flight Chief	2	120	1	240	240	22.30	3, 7
D.2	Flight Chief Administration	2	100	1	200	200	18.58	3, 7,11
D.3	OEM/AFETS	2	100	1	200	200	18.58	3, 7
D.4	Conference Room	12	20	1	360	360	33.44	3,7
D.5	Engine Management	6	64	1	490	490	45.52	3, 7,10
D.6	Training	1	120	1	120	120	11.15	3
	SUBTOTAL TRAINING AREA					1610	149.57	
E	Toilets / Showers / Lockers							
E.1	Women's Toilet	2		1	200	200	18.58	8
E.2	Janitors Closet	0		1	60	60	5.57	8
E.3	Men's Toilet	6		1	250	250	23.23	8
E.4	Women's Lockers/Showers	12		1	150	150	13.94	8
E.5	Men's Lockers/Showers	19		1	200	200	18.58	8
E.6	Women's Toilet	1		1	70	70	6.50	
E.7	Men's Toilet	1		1	70	70	6.50	
	SUBTOTAL ADMINISTRATION AREA					1000	92.90	
F	Building Support							
F.1	Mechanical	0		1	740	740	68.75	6
F.2	Electrical	0		1	150	150	13.94	6
F.3	Telecommunications	0		1	150	150	13.94	6
F.4	Fire Pump	0		1	110	110	10.22	6
	SUBTOTAL BUILDING SUPPORT AREA					1150	106.84	
	Covered Entry (1/2 Scope)	0		1	50	50	4.65	
	TOTAL FACILITY NET FLOOR AREA					26,900.00	2,499.01	4,5
	NET TO GROSS	15%						
	TOTAL FACILITY GROSS AREA					30,935	2,874	
	Exterior Elements							
A.6	Engine Bay Support Yard			1	2500	2500	232	9
	SUBTOTAL EXTERIOR ELEMENTS					2,500	232	
	TOTAL FACILITY SITE SUPPORT					2,500	232	

COMMENTS:

1	Programming Matrix is based upon 4 engine workbays - typical for 5th Gen. Fighters (Note F-35 does not require a seperate engine maintenance facility)
2	Break Room also serves as Classroom, sized per Table 6.3 Break Rooms and Table 6.4 Classroom of Air Force Manual 32-1084 (Break Room 16% of 50 occupants mulitplied by 18 sf per occupant plus Classroom of 20 persons multiplied by 25 sf per person)
3	Reference Tables in Chapter 6 of Air Force Manual 32-1084 for additional information.
4	Includes all areas listed in Air Force Manual 32-1084, Chapter 1 and Chapter 6
5	Per AFM 32-1084 Chapter 1, net-to-gross multiplier of up to 25%, used 15% as large portion of area is in Engine Shop Bay.
6	Building Support areas are estimates only and actual size is dependent on requirements for climate zone, location, system, etc.
7	Administration Areas include circulation factor of 10% per Chapter 1 Air Force Manual 32-1084
8	Male/Female ratio of 75/25
9	Exterior Engine Component Yard is uncovered exterior space
10	Engine Management room has small Mini Conference area for up to 6 persons @ 15 sf per person
11	Waiting area in Flight Chief Admin. per AFM 32-1084 Table 6.3 - 20 sf per person, 2 people

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APPENDIX C BIM AND PDF DRAWINGS LINK

BIM & PDF versions of the drawings are available at:

http://www.wbdg.org/references/afbim_tools.php.

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APPENDIX D AIR FORCE MILCON SUSTAINABILITY REQUIREMENTS SCORESHEETS

Air Force MILCON Sustainability Requirements Scoresheet

version LEED® 2009 (Updated September 2013)

* required entry

General Information

Federal Requirements Complete

XXXX123456	Project ID (e.g. ABCD12345)
xxxxxxxxxxxxxxxxx	Real Property Unique ID (RPUID)
Fighter Engine Maintenance Facility (Prototype Design)	Building Name
New Building Construction	Project Type
Other	Installation
Other	City
Other	State
Other	CONUS
Air Combat Command	MAJCOM
TBD	PM Name
$0.00	PA ($k)
28,000	Building Size (SF)
2014	Program Year (FY####)
Initial Design Charrette	Project Phase
2014	Design Started (FY####)
10/9/2017	BOD (MM/DD/YY)
In Progress	Pursuing formal LEED® Certification
	Date Project Registered (MM/DD/YY)
	Date Project Certified by GBCI (MM/DD/YY)
	LEED Points Awarded by GBCI (e.g. 42)
	LEED Energy and Water Points Awarded by GBCI
[Select]	LEED Certification Level Awarded by GBCI
Fees ($) Registration: 900	Certification: 6512.15
LEED® 2009	LEED® Rating System
58	LEED® Points Status
Silver	LEED® Certification Level Status
29	LEED® Energy and Water Points Status
100%	HPSB Compliant
30%	Energy Efficiency Achieved (% below ANSI/ASHRAE/IESNA Standard 90.1-2010)
11/3/2014	Date Scoresheet Completed or Revised
2013_V0	Scoresheet version

Color Coding: See Instructions Tab for more detail

Drop-Down Box	Recommended (not required)
No Entry Required	Yes or N/A
Custom Entry	Maybe
LEED Prerequisite	No

* required entry

Federal Requirements for High Performance and Sustainable Buildings (HPSB) & UFC 1-200-02

HPSB I: Employ Integrated Design Principles (UFC 1-200-02 para 2-2)

Total Points	2		Possible Points	2
Yes	HPSB I.1	Integrated Design		1
Yes	HPSB I.2	Commissioning		1

UFC 1-200-02 para 2-3. Promote Sustainable Location and Site Development

Total Points	1		Possible Points (HPSB only)	1
Yes	UFC para 2-3.1	Site selection		1
Yes	UFC para 2-3.2	Mitigation of Heat Island Effect		1
Yes	UFC para 2-3.3	Reduction of Light Pollution		1
Yes	HPSB III.3-4	Stormwater Management		1

Air Force MILCON Sustainability Requirements Scoresheet

version LEED® 2009 (Updated September 2013)

* required entry

HPSB II: Optimize Energy Performance (UFC 1-200-02 para 2-4)				
Total Points	4		Possible Points	4
Yes	HPSB II.1	**Energy Efficiency**		1
		Yes	Reduce energy use 30% below ANSI/ASHRAE/IESNA Standard 90.1-2010 or if not - achieve maximum energy efficiency that is lifecycle cost effective	
		30.0%	Insert percentage below ANSI/ASHRAE/IESNA Standard 90.1-2010 in terms of energy use (e.g. 32)	
		0	Insert building energy intensity (kBtu/yr-sqft) calculated IAW 10 CFR 433	
Yes	HPSB II.2	**On-site Renewable Energy - Solar Hot Water Heater System**		1
		Yes	Installed solar hot water heater system or found installation not lifecycle cost effective	
		0.0	Insert generation capacity (MMBtu/yr)	
		0.0%	Insert percentage of demand	
Yes	HPSB II.3	**On-site Renewable Energy**		1
		Yes	Installed renewable energy elements or projects were not lifecycle cost effective	
		0	Renewable energy types (check below)	
		☐ Solar PV ☐ Geothermal ☐ Hydro ☐ Waste to Energy ☐ Solar CP ☐ GSHP ☐ Wind ☑ Renewables were not ☐ Solar Thermal Electric		
		0.0	Insert generation capacity (kW)	
		0.0%	Insert percentage of total building	
Yes	HPSB II.4	**Measurement and Verification**		1
		Yes	Water Metering: Select N/A if no service	
		Yes	Electric Metering: Select N/A if no service	
		Yes	Natural Gas Metering: Select N/A if no service	
		N/A	Steam Metering: Select N/A if no service	
HPSB III: Protect and Conserve Water (UFC 1-200-02 para 2-5)				
Total Points	3		Possible Points	3
Yes	HPSB III.1	**Indoor Water**		1
Yes	HPSB III.2	**Outdoor Water**		1
Yes	HPSB III.4	**Water used for heating and cooling**		1
		Yes	Water efficient measures were implemented with heating and cooling equipment when life cycle effective	
HPSB IV: Enhance Indoor Environmental Quality (UFC 1-200-02 para 2-6)				
Total Points	6		Possible Points	6
Yes	HPSB IV.1	**Thermal Comfort**		1
Yes	HPSB IV.2	**Ventilation**		1
Yes	HPSB IV.3	**Moisture Control**		1
Yes	HPSB IV.4	**Daylighting**		1
Yes	HPSB IV.5	**Low Emitting Materials**		1
Yes	HPSB IV.6	**Protect Indoor Air Quality during Construction**		1
Yes	HPSB IV.7	**Environmental Tobacco Smoke**		
HPSB V: Reduce Environmental Impact of Materials (UFC 1-200-02 para 2-6)				
Total Points	6		Possible Points	6
Yes	HPSB V.1	**Recycled Content**		1
Yes	HPSB V.2	**Biologically-based Products**		1
Yes	HPSB V.3	**Environmentally Preferable Products**		1
Yes	HPSB V.4	**Waste and Materials Management - Recycling**		1
Yes	HPSB V.5	**Waste and Materials Management - Divert 50% from Disposal**		1
		50.0%	Insert percentage diverted from landfill	
			Data element is not applicable	
Yes	HPSB V.6	**Ozone Depleting Substances**		1
HPSB Totals			Possible Points	22
22	Federal Requirements - Yes or N/A			
0	Federal Requirements - Maybe			
0	Federal Requirements - No			
100%	Percentage of Federal Requirements Met			

Air Force MILCON Sustainability Requirements Scoresheet

version LEED® 2009 (Updated September 2013) * required entry

LEED® 2009 Checklist

LEED® Credits and/or Prerequisites that meet HPSB/UFC Requirements
LEED® Credits and/or Prerequisites that align closely with HPSB/UFC Requirements
LEED® Credits that meet USAF Energy & Water Criteria (may depend on technologies & strategies)

Sustainable Sites				
Achievable Points	11	Sustainable Sites	Possible Points	26
Yes	Prereq 1	Construction Activity Pollution Prevention (HPSB GP3)		Required
Yes	Credit 1	Site Selection		1
Maybe	Credit 2	Development Density & Community Connectivity		5
Maybe	Credit 3	Brownfield Redevelopment		1
Maybe	Credit 4.1	Alternative Transportation - Public Transportation Access		6
Maybe	Credit 4.2	Alternative Transportation - Bicycle Storage & Changing Rooms		1
Yes	Credit 4.3	Alternative Transportation - Low-Emitting & Fuel Efficient Vehicles		3
Yes	Credit 4.4	Alternative Transportation - Parking Capacity		2
Maybe	Credit 5.1	Site Development - Protect or Restore Habitat		1
Maybe	Credit 5.2	Site Development - Maximize Open Space		1
Yes	Credit 6.1	Stormwater Design - Quantity Control (HPSB GP3)		1
Yes	Credit 6.2	Stormwater Design - Quality Control (HPSB GP3)		1
Yes	Credit 7.1	Heat Island Effect - Non-Roof (UFC)		1
Yes	Credit 7.2	Heat Island Effect - Roof (UFC)		1
Yes	Credit 8	Light Pollution Reduction		1
		Option 1	Select which LEED® Interior Lighting Option was used	

Water Efficiency				
Achievable Points	7		Possible Points	10
Yes	Prereq 1	Water Use Reduction - 20% Reduction (HPSB GP3)		Required
4	Credit 1	Water Efficient Landscaping (HPSB GP3)		2 to 4
		2	Reduce Potable Water Use by 50% (HPSB GP3)	2
		4	No Potable Use or Irrigation (HPSB GP3)	2
Maybe	Credit 2	Innovative Wastewater Technologies		2
3	Credit 3	Water Use Reduction (HPSB GP3)		2 to 4
		2	30% Reduction (HPSB GP3)	2
		3	35% Reduction (HPSB GP3)	1
		4	40% Reduction (HPSB GP3)	1

Energy & Atmosphere				
Achievable Points	17		Possible Points	35
Yes	Prereq 1	Fundamental Commissioning of the Building Energy Systems (HPSB GP1)		Required
Yes	Prereq 2	Minimum Energy Performance (HPSB GP2)		Required
Yes	Prereq 3	Fundamental Refrigerant Management (HPSB GP5)		Required
15	Credit 1	Optimize Energy Performance (HPSB GP2)		1 to 19
		1	12% for New Buildings/8% for Existing Building Renovations	1
		2	14% for New Buildings/10% for Existing Building Renovations	1
		3	16% for New Buildings/12% for Existing Building Renovations	1
		4	18% for New Buildings/14% for Existing Building Renovations	1
		5	20% for New Buildings/16% for Existing Building Renovations	1
		6	22% for New Buildings/18% for Existing Building Renovations	1
		7	24% for New Buildings/20% for Existing Building Renovations	1
		8	26% for New Buildings/22% for Existing Building Renovations	1
		9	28% for New Buildings/24% for Existing Building Renovations	1
		10	30% for New Buildings/26% for Existing Building Renovations	1
		11	32% for New Buildings/28% for Existing Building Renovations	1
		12	34% for New Buildings/30% for Existing Building Renovations	1
		13	36% for New Buildings/32% for Existing Building Renovations	1
		14	38% for New Buildings/34% for Existing Building Renovations	1
		15	40% for New Buildings/36% for Existing Building Renovations	1
		16	42% for New Buildings/38% for Existing Building Renovations	1
		17	44% for New Buildings/40% for Existing Building Renovations	1
		18	46% for New Buildings/42% for Existing Building Renovations	1
		19	48%+ for New Buildings/44%+ for Existing Building Renovations	1
0	Credit 2	On-Site Renewable Energy (HPSB GP2)		1 to 7
		1	On-site 1%	1
		2	On-site 3%	1
		3	On-site 5%	1
		4	On-site 7%	1
		5	On-site 9%	1
		6	On-site 11%	1
		7	On-site 13%	1
Yes	Credit 3	Enhanced Commissioning (HPSB GP1)		2
Maybe	Credit 4	Enhanced Refrigerant Management (HPSB GP5)		2
No	Credit 5	Measurement & Verification (HPSB GP2)		3
No	Credit 6	Green Power		2

Air Force MILCON Sustainability Requirements Scoresheet

version LEED® 2009 (Updated September 2013)

* required entry

Materials & Resources				
Achievable Points	7		Possible Points	14
Yes	Prereq 1	Storage & Collection of Recyclables (HPSB GP5)		Required
0	Credit 1.1	Building Reuse - Maintain Existing Walls Floors & Roof		1 to 3
		1	Maintain 55% of Existing Walls Floors & Roof	1
		2	Maintain 75% of Existing Walls Floors & Roof	1
		3	Maintain 95% of Existing Walls Floors & Roof	1
Maybe	Credit 1.2	Building Reuse - Maintain 50% of Interior Non-Structural Elements		1
2	Credit 2	Construction Waste Management (HPSB GP5)		1 to 2
		1	50% Recycled or Salvaged	1
		2	75% Recycled or Salvaged	1
0	Credit 3	Materials Reuse		1 to 2
		1	5% of value of material reused content	1
		2	10% of value of material reused content	1
2	Credit 4	Recycled Content (HPSB GP5)		1 to 2
		1	10% of value of material recycled content	1
		2	20% of value of material reused content	1
2	Credit 5	Regional Materials		1 to 2
		1	10% Extracted, Processed & Manufactured	1
		2	20% Extracted, Processed & Manufactured	1
Maybe	Credit 6	Rapidly Renewable Materials (HPSB GP5)		1
Yes	Credit 7	Certified Wood (HPSB GP5)		1
Indoor Environmental Quality				
Achievable Points	10		Possible Points	15
Yes	Prereq 1	Minimum IAQ Performance (HPSB GP4)		Required
Yes	Prereq 2	Environmental Tobacco Smoke (ETS) Control (HPSB GP4)		Required
Yes	Credit 1	Outside Air Delivery Monitoring		1
Maybe	Credit 2	Increased Ventilation		1
Yes	Credit 3.1	Construction IAQ Management Plan, During Construction (HPSB GP4)		1
Yes	Credit 3.2	Construction IAQ Management Plan, Before Occupancy (HPSB GP4)		1
Yes	Credit 4.1	Low Emitting Materials, Adhesives & Sealants (HPSB GP4)		1
Yes	Credit 4.2	Low Emitting Materials, Paints & Coatings (HPSB GP4)		1
Yes	Credit 4.3	Low Emitting Materials, Flooring Systems (HPSB GP4)		1
Yes	Credit 4.4	Low Emitting Materials, Composite Wood & Agrifiber Products (HPSB GP4)		1
Yes	Credit 5	Indoor Chemical & Pollutant Source Control		1
Yes	Credit 6.1	Controllability of Systems, Lighting (HPSB GP4)		1
Maybe	Credit 6.2	Controllability of Systems, Thermal Comfort		1
Yes	Credit 7.1	Thermal Comfort, Design (HPSB GP4)		1
Maybe	Credit 7.2	Thermal Comfort, Verification		1
Maybe	Credit 8.1	Daylight & Views - Daylight 75% of Spaces (HPSB GP4)		1
Maybe	Credit 8.2	Daylight & Views - Views for 90% of Spaces		1
Innovation & Design Process				
Achievable Points	4		Possible Points	6
Yes	Credit 1.1	Innovation in Design 1.1		1
			Select if ID 1.1 was for energy and/or water	
Yes	Credit 1.2	Innovation in Design 1.2		1
			Select if ID 1.2 was for energy and/or water	
Yes	Credit 1.3	Innovation in Design 1.3		1
			Select if ID 1.3 was for energy and/or water	
Maybe	Credit 1.4	Innovation in Design 1.4		1
		Energy & Water	Select if ID 1.4 was for energy and/or water	
Maybe	Credit 1.5	Innovation in Design 1.5		1
		Energy & Water	Select if ID 1.5 was for energy and/or water	
Yes	Credit 2	LEED® Accredited Professional		1
Regional Priority Credits				
Achievable Points	2		Possible Points	4
Yes	Credit 1.1	Regional Priority 1.1		1
			Select if RP 1.1 was for energy and/or water	
Yes	Credit 1.2	Regional Priority 1.2		1
		Water	Select if RP 1.2 was for energy and/or water	
Maybe	Credit 1.3	Regional Priority 1.3		1
		Water	Select if RP 1.3 was for energy and/or water	
Maybe	Credit 1.4	Regional Priority 1.4		1
			Select if RP 1.4 was for energy and/or water	
LEED Project Totals	**(pre-certification estimates)**		**Possible Points**	**110**
58	Total LEED® Yes Points			
19	Total LEED® Maybe Points			
2	Total LEED® No Points			
29	Total LEED® Energy and Water Related Points			
Silver	LEED® Certification Status			
N/A	LEED® Horizontal Benchmark Level			
N/A	LEED® Utility Benchmark Level			
N/A	LEED® Industrial Benchmark Level			

LEED®: Certified: 40-49 points, Silver: 50-59 points, Gold: 60-79 points, Platinum: 80-110

APPENDIX E GLOSSARY

E-1 ACRONYMS AND ABBREVIATIONS.

‘	foot
“	inch
A.F.F.	above finished floor
ABA	Architectural Barriers Ac
AC	Advisory Circular
ACI	American Concrete Institute
ADP	Area Development Plan
A-E	Architect-Engineer
AFCEC	Air Force Civil Engineer Center
AFCFS	Air Force Corporate Facility Standards
AFI	Air Force Instruction
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AFMAN	Air Force Manual
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineer
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
AT	antiterrorism
ATFP	antiterrorism force protection
AWS	American Welding Society
BIA	Bilateral Infrastructure Agreements
BIM	Building Information Modeling
CATV	community access television

CCTV	closed circuit television
CMU	cement masonry unit
CONUS	Continental United States
DoD	Department of Defense
EISA	Energy Independence and Security Act
EPA	Environmental Protection Agency
EPACT 2005	Energy Policy Act of 2005
FAA	Federal Aviation Administration
FC	Facility Criteria
FF&E	furniture, fixtures, and equipment
HNFA	Host Nation Funded Construction Agreements
HQ USACE	Headquarters United States Army Corps of Engineers
HVAC	heating, ventilation, and air conditioning
hZ	hertz
IBC	International Building Code
IDP	Installation Development Plan
IDS	intrusion detection system
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFC	International Fuel Gas code
IMC	International Mechanical Code
IPC	International Plumbing Code
JEIM	jet engine intermediate maintenance
MIL-HDBK	Military Handbook
MIL-STD	Military Standard
MUTCD	Manual on Uniform Traffic Control Devices

N/A	not applicable
NAVFAC	Naval Facilities Engineering Command
NEC	National Electrical Code
NFPA	National Fire Protection Association
NIPR	non-secure internet protocol router
OCONUS	outside continental United States
POV	personally-owned vehicle
RFP	Request for Proposal
SF	square foot
SOFA	Status of Forces Agreement
TI	Technical Instruction
T.O.	Technical Order
UFC	Unified Facilities Criteria
USGBC	U.S. Green Building Council
V	volt
Vdc	volts direct current

UFC 4-213-10
18 May 2020

UNIFIED FACILITIES CRITERIA (UFC)

GRAVING DRY DOCKS



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UNIFIED FACILITIES CRITERIA (UFC)

GRAVING DRY DOCKS

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes UFC 4-213-10 Change 1, dated September 2012

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD-3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

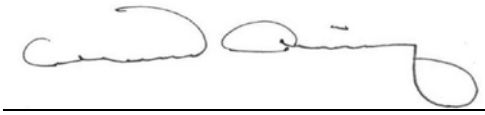
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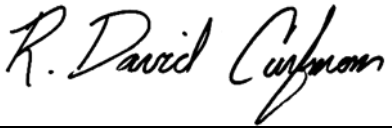
- Whole Building Design Guide web site https://www.wbdg.org/ffc/dod.

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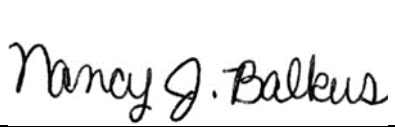
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UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Document: UFC 4-213-10, *Graving Dry Docks*

Superseding: UFC 4-213-10, *Design: Graving Dry Docks*, 1 September 2012, with Change 1

Description: This revised UFC serves as a specific guidance for planners, designers, contractors and maintenance technicians involved in the planning, designing, construction and maintenance of graving dry docks. The document is organized into chapters that address the various phases beneficial to the personnel involved in working with a dry dock. The document provides a unified approach to the formatting and content of Unified Facilities Criteria**.**

Reasons for Document:

- This UFC provides revised information that adheres to the format and content of the criteria documents.
- Revisions capture current changes in shipyard requirements and anticipated requirements of the Shipyard Industrial Optimization Program (SIOP). Revisions include: dry dock dimensions for new submarine classes, dry dock production needs, changes in flood elevation, fire safety standards, etc.

Impact:

- This revision does not have any cost impacts.

Unification Issues:

- This revision does not have any unification issues.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

The purpose of UFC 4-213-10 is to provide a uniform guidance for the planning, design, construction, renovation and maintenance of graving dry docks. This document has undergone many iterations over the decades. Much of the specific recommendations have been lifted from existing facility designs that have proven valuable.

Any dry dock construction or other work must be performed in concert with the NAVSEA Dry Dock Certification program, namely the requirements of MIL-STD-1625 and Naval Ship's Technical Manual (NSTM), Chapter 997, must be met.

1-2 APPLICABILITY.

UFC 4-213-10 applies to all facility planners, designers, contractors, and maintenance technicians involved in the planning, design, construction, and maintenance of Graving Dry Docks. It is assumed that the general vicinity, such as specific shipyard, has been selected, that the size of ship to be accommodated has been determined, and that the dry dock function, shipbuilding or repair has been decided. Consideration must be given to strategic site selection to meet present or future naval requirements, ease of defense, and general accessibility to and from the sea.

1-3 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-3.1 Anti-Terrorism and Security.

In some locations, consideration should be given to protective construction for the upper part of the pumpwell and the service tunnels. For waterfront security criteria, refer to UFC 4-025-01, *Waterfront Security Design*.

1-4 CYBERSECURITY.

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service Implementation Policy.

1-5 GLOSSARY.

APPENDIX B contains acronyms, abbreviations, and terms.

1-6 REFERENCES.

APPENDIX C contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

CHAPTER 2 SHIPYARD LAYOUT

2-1 SHOP FACILITIES.

Locate a dry dock near yard supporting industrial shops, or vice versa, from which material requiring fabrication or manufacture may be obtained.

2-2 LAYDOWN SPACE.

Provide ample space on both sides of a dry dock. If there are no restrictions, furnish a strip at least 250 ft (76.2 m) wide on each side of the dry dock coping and at the head end.

2-3 POWER AND UTILITIES.

Proximity to sources of power and utilities is desirable but seldom a determining factor. Electricity, fresh water, saltwater fire protection, compressed air, steam, oxygen, acetylene, and sewers are usually required as described in CHAPTER 8.

2-4 CRANE AND CRANE TRACKS.

Captive cranes should not be used if it can be avoided. Trackage should be interconnected for portal crane utilization elsewhere in the same yard.

2-5 SHIP APPROACHES.

Maneuvering a ship into a dry dock necessitates careful attention to the shape of the approach body of water, locations of ship channels, prevailing winds, currents, and relationship to other waterfront structures.

2-5.1 Turning Basins.

A ship must parallel the long axis of a dry dock before it enters; therefore, provide a turning basin of appropriate width, length, and depth of water outboard of a dry dock entrance. The length and depth of a dry dock are indicative of the maximum ship to be accommodated. The turning basin should have a width outboard of the dry dock at least two times the dock length and properly shaped for turning. The depth of water in the turning basin should be no less than that at the entrance sill of the dry dock. Where piers or other structures extend into a waterway and flank the approach to a dry dock entrance, the turning basin should be large enough to allow a ship to be turned before coming abreast of such flanking structures. A dry dock must not be located where flanking structures are too close to the path of a ship entering or leaving the dry dock. Leave room for tugs to operate beside a ship until it is clear of the dry dock entrance. The distance between such structures and the side of the ship path should not be less than 150 ft (45.7 m).

2-5.2 Dry Dock Orientation Effect.

In some cases, through necessity or choice, a dry dock may be oriented with the axis at an acute angle to the general shoreline.

This orientation is advantageous where, like a river, there is a current parallel to the shoreline, in which case the slanted position precludes the necessity of having a ship abreast of the current flow when entering or leaving the dry dock. Turning basin layouts are modified by such positioning, but the guidance for clearance of structures flanking the entrance must be observed.

2-6 FITTING OUT/REPAIR PIERS.

Fitting out or repair piers should be provided adjacent to dry docks.

2-6.1 Existing Piers.

In planning dry docks for existing shipyards, it may be that existing piers can serve this purpose for ships to be built or overhauled in the dock. The locations of such piers might influence positioning new dry docks reasonably near the piers, but the importance of this is not great since it involves only a single transfer of the ship after undocking.

2-6.2 New Piers.

When fitting out/repair pier capacity does not exist, new piers or wharves must be included in the project as essential support for dry docks. Refer to UFC 4-152-01, *Piers and Wharves*, for pier and wharf design.

2-7 SILTING AND SCOURING.

Ascertain the stability of the access waterway with regard to silting or scouring. A prospective site should be reconsidered if the possibilities of silting or scouring indicate excessive future dredging maintenance. Study historical characteristics of the waterway and possible effects on current flow due to planned new work or anticipated future structures.

2-8 TOPOGRAPHY, HYDROLOGY, AND METEOROLOGY.

2-8.1 Site Conditions.

Prior to the design of a dry dock, certain minimum information is required about conditions at the proposed site. Dry dock construction methods used are usually closely related to site conditions and to the type and shape of a dry dock.

2-8.2 Yard Grades.

The coping of a new dry dock must be compatible with general grades in a yard, or at least the grades in the vicinity of the dry dock and supporting facilities serviced by dry

dock cranes. Also, the elevation of the top of a dry dock must provide a certain minimum freeboard dependent on the highest anticipated tides, waves, and storm surge with consideration for sea level change.

2-8.3 Tide Range.

Ascertain the tidal range. Use this information as a basis to determine the final height of a dry dock, and also the height and strength of cofferdams or other temporary structures possibly involved in the dry dock construction. For predictions, which may be peculiar to the specific site, refer to records and predictions of *National Oceanic and Atmospheric Administration (NOAA)*, and to the local historical records.

2-8.4 Storm Potentialities.

Ascertain potentialities of a site. These data have a bearing on the determination of the freeboard height of a dry dock, and on the design of temporary construction work. Design for at least 1-percent annual exceedance probability storm event (100-year return period). In some areas, 0.2-percent annual exceedance probability storms (500-year-return period) and tides should be considered.

2-8.4.1 Wind Effects.

Include a study of prevailing winds and their velocities, fetch of water involved, and the length and height of waves. When these data are combined with tide records, they indicate the expected probable high-water conditions. The wind effects may influence the design of fenders or moorings contiguous to a dry dock. Refer to NOAA wind records for areas of the United States and possessions.

2-8.5 Water and Air Temperatures.

Approach body of water temperature ranges are important in designing heating and ventilating systems, coolers, cathodic protection systems, and any systems utilizing the water. Air temperature data are required for similar reasons. Obtain water and air temperature in the vicinity from NOAA and the local historical records.

2-8.6 Water Chemical Content.

The chemical content of water is subject to pollution when a dry dock is located on a river. When water is supplied by wells or well points from soil layers permeated by other than seawater, the chemical content is not known. The corrosiveness of the water must be determined for design of pipes, coolers, any equipment utilizing the water, pumping equipment, and dry dock pressure relief systems. Refer to UFC 3-230-01, *Water Storage and Distribution.*

2-9 FOUNDATION CONDITIONS.

2-9.1 Features.

Dry docks generally have diverse and varied types of foundation designs, which encompass the whole gamut of soil and foundation engineering. Designs are found in the complete range of such engineering, from the simplest spread footing to a complex elastic mat. Consequently, site specific soil investigations must be especially thorough and complete in the determination of a great variety of soil properties.

2-9.2 Borings.

Examine all available records of borings in the vicinity of a proposed site. The scope of previous borings will help determine the program extent for additional borings. For soil investigation procedures, refer to UFC 3-220-01, *Geotechnical Engineering*.

2-9.2.1 Depths of Borings.

Overall or mean soil pressures under dry docks are not great; therefore, for areas under the main body of a dock, borings need not be as deep as for other structures where load concentrations are severe. Where a dry dock is likely to be the relieved type, the depths of borings should be sufficient to allow proper analyses of percolation problems. Where piles, either the bearing or hold-down types, might be used, boring depths should adequately indicate the soils to be penetrated.

2-9.2.2 Usage.

Borings determine soil properties and ground water levels for establishing tip elevations for piles supporting special structures. Borings can also be used for conducting permeability and pumping tests, if necessary. Refer to UFC 3-220-01 for criteria for pumping and permeability field tests and laboratory permeability tests.

2-9.3 Pile Driving Records.

Consult previous pile driving records for applicable information. Supplement these records, if necessary, by new test pile data, especially in areas where appurtenant foundation structures may be used for track supports, capstan foundations, and similar facilities. Pile driving information and equipment is discussed in UFC 3-220-01.

2-9.4 Laboratory Tests and Soil Analyses.

Laboratory tests applicable to soils are generally necessary. For application and interpretation of such tests refer to UFC 3-220-01.

2-9.5 Bearing Capacities of Soils.

Make tests for bearing capacity appropriate to the types of applied loading in accordance with provisions of UFC 3-220-01. For designs of dry dock cross-sections,

especially those with thin floors, the soil modulus of subgrade reaction under a floor is important.

2-9.6 Foundation Materials.

Many types of foundation materials may be encountered in a site, and almost all may be utilized for supporting a dry dock. This material variability, however, results in a number of structural types from which a selection must be made. For selection of structural types affected by foundation conditions, refer to CHAPTER 4. Seismicity of the area should be considered.

2-9.6.1 Soils.

Types of soil which may be encountered, and upon which dry docks may be founded, include soft and hard rock, hardpans and shales, sand and/or gravel, soft and hard clay, marl, soft and hard mud, and certain types of coral. Extremely cavernous coral, through which water flows in quantities that precludes even grouting, cannot be used as a site support.

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CHAPTER 3 DETERMINATION OF GRAVING DOCK DIMENSIONS

3-1 MINIMUM DIMENSIONS.

This chapter presents design criteria on graving dock dimensions with particular reference to minimum inside length, width, depth, and configuration. The minimum inside dimensions of a graving dock depends on the classes of ships to be accommodated. However, the exact configuration of the inside of the walls and the resulting shape of the inside cross section will represent a compromise between several conflicting factors, the dominating one being the structural type that is finally selected. For designation of dry dock features, see Figure 3-1.

It is important to remember that all areas of the dry dock must be accessible for inspection. This includes all tunnels, chambers and ballast tanks. Inspection is performed by humans on a regular basis. Therefore, making tunnels tall enough to walk through and openings that allow for ladders is important for the design.

3-2 REPAIR AND SHIPBUILDING DRY DOCKS.

This type of double function dry dock is the only type constructed in naval shipyards. Ships needing routine maintenance and repair, or those coming into dry dock in a damaged condition, require a deeper dock than ships under construction that are generally removed to a fitting-out pier for completion. A damaged ship may have a severe list and/or trim requiring additional dry dock depth.

3-2.1 Basic Dimensions.

Lay out dry dock plans according to the applicable type of ship as shown in Table 3-1. The values listed in Table 3-1 are recommended for new dry dock layout and may not be applicable for existing dry docks. Guidance for minimum dimensional allowances to ease ship positioning and provide industrial space for shipbuilding or repair work are:

- Normal keel block height: 6 ft (1.8 m). Other size blocks are available and acceptable. Minimum recommended height of blocking is 4 ft (1.2 m). Consider taller blocking ships with sonar domes.
- Ships keel clearance over blocks: 2 ft (0.6 m). NSTM CH 997 requires 1 ft (0.31 m) clearance from hull or appendage during docking evolution.
- Ship to head end clearance: 10 ft (3.0 m)
- Ship to caisson end clearance: 40 ft (12.2 m)
- Ship to wall clearance, each side: 15 ft (4.6 m)

Figure 3-1 Designation of Dry Dock Features

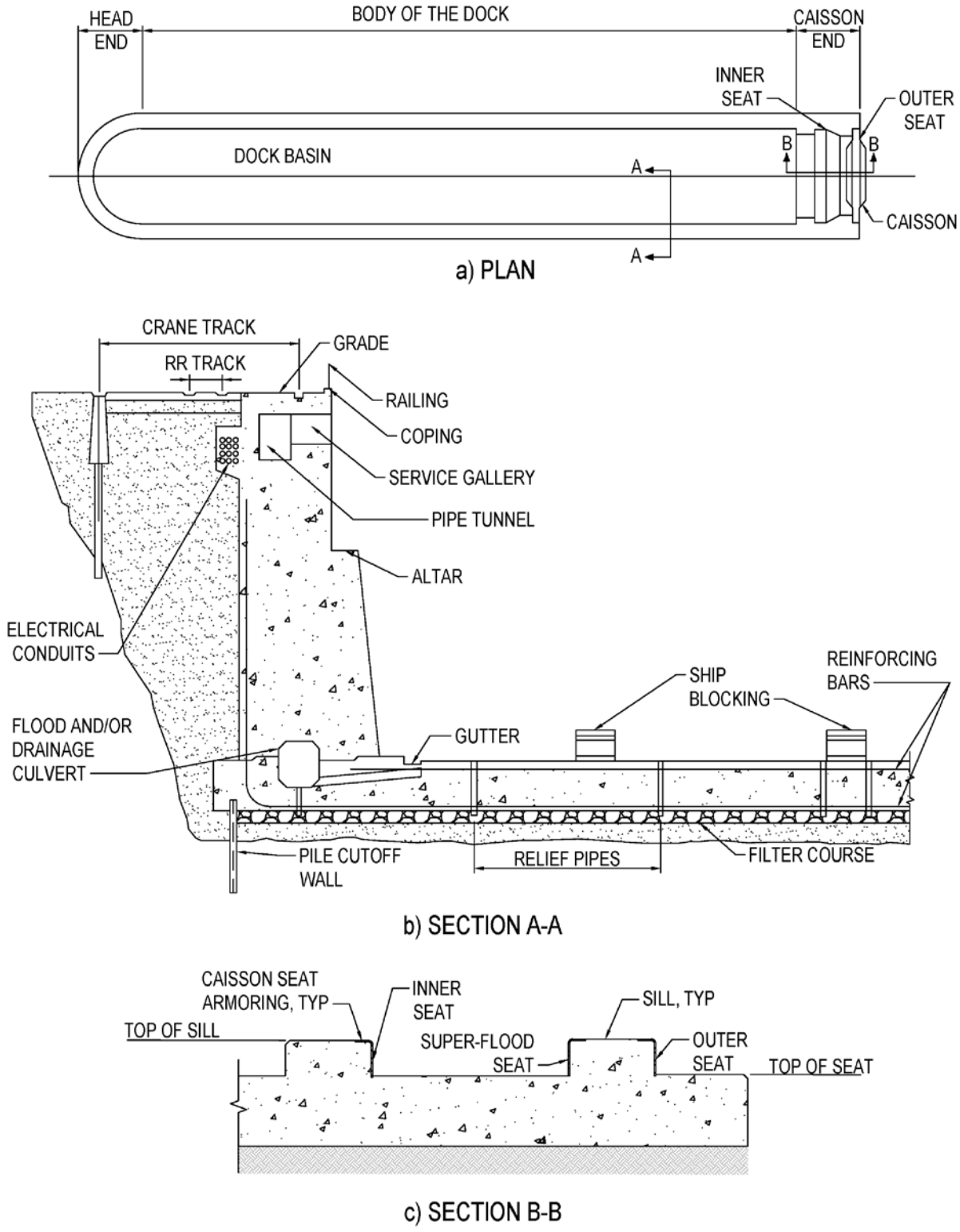


Table 3-1 Basic Dry Dock Dimensions [a]

Ship Type [b]	Width, Clear Inside Body ft (m)	Length, at coping from Head to Outer Caisson Seat ft (m)	Depth, from MHW to Dry Dock Floor ft (m)
SSN Submarine	90 (27.4)	630 (192.0) [c]	43 (13.1)
SSBN or SSGN	130 (39.6)	800 (243.8) [c, d]	48 (14.6)
Destroyer or Frigate	90 (27.4)	650 (198.1)	42 (12.8) [e]
Cruiser	115 (35.1)	800 (243.8)	38 (11.6)
Auxiliary	130 (39.6)	850 (259.1)	45 (13.7)
Carrier	Floor 210 (64.1) Coping 190 (58.0)	1,250 (381.0)	55 (16.8) [f]

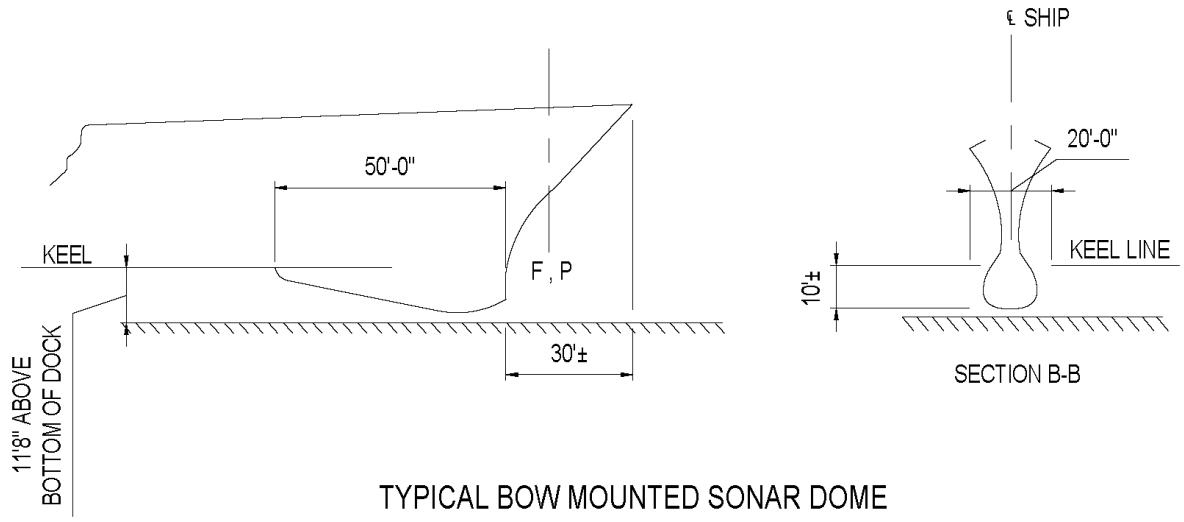
Note:

[a] Dimensions listed are basic planning guidance. Ship class, site-specific conditions, and anticipated industrial work to be performed will dictate final design dimensions.
[b] Refer to the following website for ship characteristics: https://www.nvr.navy.mil/SHIPS.html
[c] Allowance for shaft and dome removal included.
[d] Minimum floor work area. Does not include Caisson End shown in Figure 3-1 (a).
[e] Allowance for sonar domes below keel line included.
[f] Damaged condition.

3-2.2 Allowance for Sonar Domes.

Sonar domes are ordinarily located on the fore part of the ship keel. For a new dock to accommodate vessels so equipped, use the height of blocking required for removing domes with a sonar dolly. Sonar equipment is of various configurations and no set rules can be given (see Figure 3-2). Specific criteria must be outlined in project requirements. Sonar dome pits have been installed in some dry docks to reduce the required height of blocks.

Figure 3-2 Sonar Dome



3-2.3 Caisson Seats.

Provide an inner and an outer caisson seat at the entrance to graving docks. The outer seat is required to permit repairs to be made on the inner seat. For seat dimensions, refer to CHAPTER 9. A double-faced seat is required if a super-flooding feature is installed. For new construction, the inclusion of the superflood seat is negligible design and construction cost, therefore always provide an inner, outer and superflood caisson seats.

3-3 DRY DOCKS FOR SHIPBUILDING ONLY.

These dry docks, although sometimes built under the auspices of the Navy, are generally built in private shipyards and usually for a particular class or classes of ships. This type of dry dock is usually semi-permanent for economic reasons. The overall design, layout, pumping systems and utilities will be similar to repair dry docks. However main dewatering pump capacity can be reduced considerably as dewatering is only necessary prior to start of construction and not for docking existing ships.

Other considerations may be made to reduce cost if the life span of the dry dock will be 20 years or less. Determination of the dock lifespan and compromises weighed should be carefully considered. Experience has shown that docks built as semi-permanent have now been reclassified, and the associated life-extension project costs and risk have been considerable.

3-3.1 Height of Floor.

The draft at the time of undocking is predicated on the degree of vessel completion to be attained in the dry dock before removal to fitting-out pier. The weight and displacement will determine the elevation of the floor below mean high water.

3-3.2 Width.

Shipbuilding docks may be made narrower than repair dry docks for the same class of ships. Provide sufficient clearance to accommodate the required construction equipment between the hull and walls.

3-4 INSIDE CONFIGURATION.

3-4.1 Head End Shape.

The head end of the dry dock may be square, semicircular, trapezoidal, or ship shape as shown in Figure 3-3. One shape may best fit the pattern of adjacent structures. Additionally, there are other advantages and disadvantages which are directly associated with the construction and operation of the dry dock itself. A tabulation of these for each shape of head end is shown in Table 3-2, and is to be used as follows:

3-4.1.1 Square.

Use the square end for multiple docking, or for docks that are likely to have future extensions.

3-4.1.2 Semicircle.

Use the semicircular end for medium sized docks that cannot readily be lengthened at the head end.

3-4.1.3 Trapezoid.

Use the trapezoidal shape for small docks that are not likely to be lengthened at the head end.

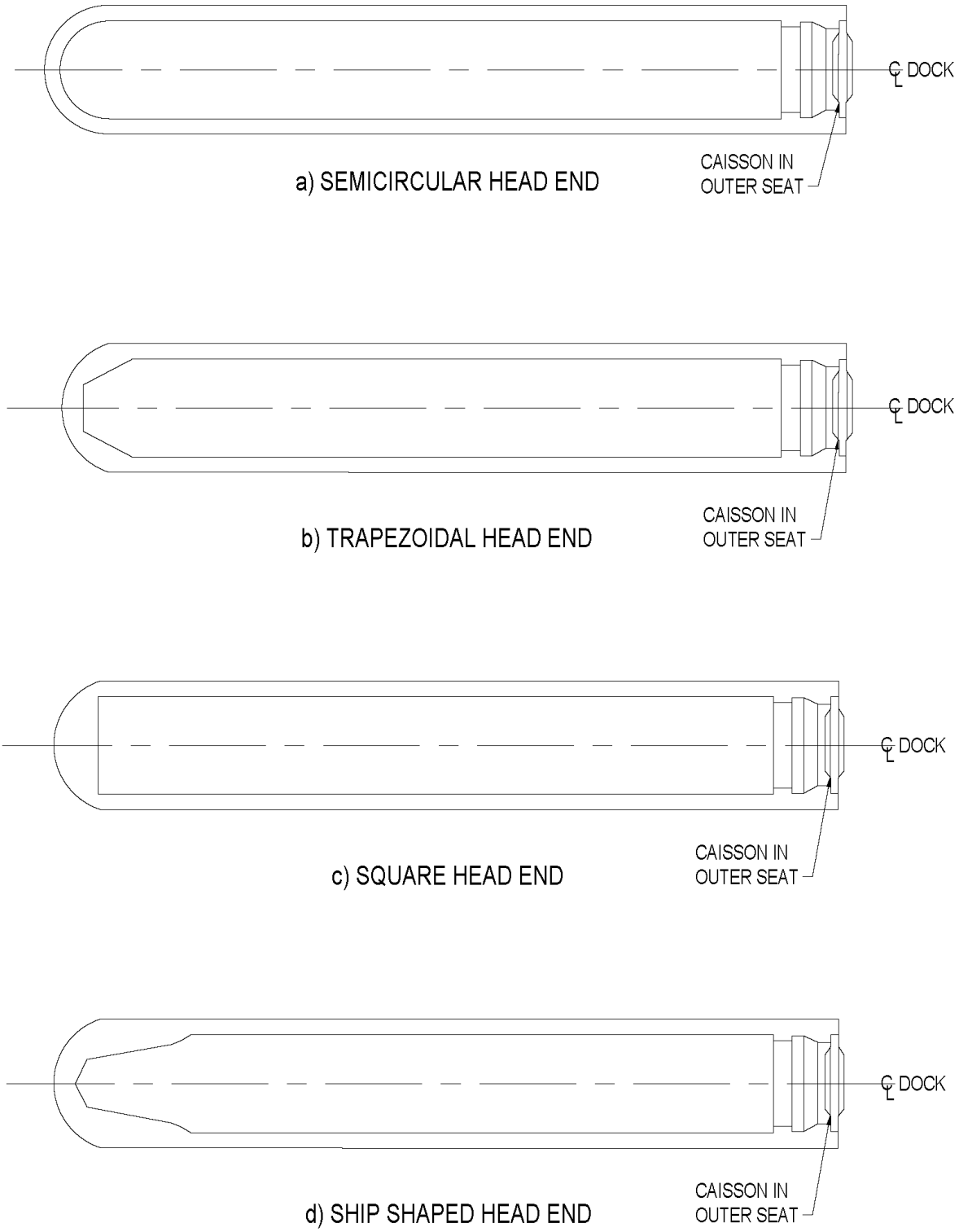
3-4.1.4 Ship Shaped.

Ship shaped dry docks are not versatile and are obsolete.

Table 3-2 Design Considerations for Various Head End Shapes

Design Considerations	Square	Semicircle	Trapezoid
Economy of formwork	Poor	Fair	Best
Economy of concrete	Poor	Best	Good
Simplicity of crane tracks	Poor	Best	Good
Simplicity of installation of service facilities	Best	Poor	Good
Fit into yard	Poor	Good	Good
Adaptability for future extensions	Best	Poor	Fair
Providing access to dock floor:			
for Carriers	Best	Fair	Poor
for Other Ships	Good	Good	Good
Suitability for multiple docking	Best	Fair	Poor

Figure 3-3 Head End Shapes



3-4.2 Entrance End.

At the entrance end of a dock, the walls may be vertical or sloped outward. Refer to CHAPTER 9 for caisson dimensioning and details of the seats.

3-4.2.1 Clearances.

Ship clearances are not as large at the entrance as in the body of the dock where working space is necessary. For docks having vertical walls, allow 5 ft (1.5 m) minimum clearance from the ship hull on each side.

3-4.2.2 Roadway.

Where an entrance caisson is to be used as a roadway for vehicular traffic, the dock coping in the way of the caisson must be designed and detailed to suit.

3-4.3 Cross Section.

The most important influence of the inside as well as the outside shape of a dry dock cross section is the structural type (and construction methods) adopted. For relation of shape to these factors, refer to CHAPTER 4.

3-4.3.1 Floor and Wall Coping Elevation.

Design the coping of the dry dock wall high enough so that it will not be overtopped by severe waves which could possibly occur at extreme high water (storm surge) level, or at the grade of the surrounding yard, whichever is higher. See Section 3-5. Establish floor elevation per Section 3-2; Floors should provide drainage to prevent standing water via crown, slope or trenches.

3-4.3.2 Service Tunnels and Galleries.

In order to bring utilities and services from the shipyard to the docked ship it is convenient to have either service tunnels, galleries or both along the top of the dry dock wall. Attention should be paid to the location of these wall features and the anticipated water level in a flooded dock. Flooding service tunnels and galleries is not desired.

3-4.3.2.1 Service Tunnels.

Service tunnels are located in and near the top of walls. The tunnel is utilized to route large size salt and fresh water piping from the yard to the dry dock. Smaller piping such as for compressed gases, electrical and data cabling can also be run in these tunnels. The tunnel must be designed for intermittent human occupancy. Openings from the service tunnel to galleries allow service to pass through. Service tunnels and galleries should be designed and constructed such that they are always kept dry. Sump pumps, isolation valves and tunnel drains should be installed if necessary. Tunnels should be wide enough to accommodate all the required piping plus clearance for people to walk and to effect repairs. The height should provide 6.5 ft (2 m) headroom even where pipe

crossovers exist. Refer to Section 3-4.3.5 entitled “Crane Rails” for the relation of shape and location of tunnels to crane tracks.

3-4.3.2.2 Galleries.

Galleries can be set into the wall or cantilevered out from the wall surface. Their design should consider ship clearances during docking evolutions. The purpose of the gallery is to allow that final length of hose connection from the services in the tunnel to the ship. Gallery size should use the same parameters as service tunnels.

3-4.3.3 Steps or Altars.

The number of setbacks or altar platforms in the inboard faces of the dock walls should be kept to a minimum. Modern reinforced concrete design practically eliminates the necessity of any altars.

For full hydrostatic dry docks, gravity walls, a single step back may be made, part way up on the inboard face, to reduce concrete thickness in the upper part of the wall and to improve the stability of the wall.

3-4.3.4 Flooding and Drainage Tunnels.

Flooding and drainage tunnels are usually provided in the walls of dry docks. In order to create the most favorable stress conditions- See CHAPTER 6 and CHAPTER 7 for design considerations for these systems. Any tunnel should be designed for periodic human inspection but made as small as is compatible with hydraulic requirements. Large tunnels should never be less than 6 ft (1.8 m) high. Except for pure gravity walls, drainage tunnels present structural problems and result in increased cost.

3-4.3.5 Crane Rails.

Place one crane rail on top of the wall as close to the centerline of the dry dock as possible and compatible with other wall and tunnel design considerations. Never place the inboard rail nearer than 5 ft (1.5 m) to the edge of the coping. Rails should be set with the top flush with the concrete surface. The companion rail is generally located off the wall structure and supported independently. For additional criteria regarding location of crane rails, refer to CHAPTER 8.

3-5 FLOOD ELEVATION AND SEA LEVEL CHANGE.

A design flood elevation (DFE) must be determined in order to set the coping elevation, protect a dry dock and supporting infrastructure from flooding, and calculate the buoyancy factor of safety (FS). DFE is based on expected flood levels, additional water levels from extreme events, and future sea levels. Integrating shipyard and supporting infrastructure at new and retrofitting existing dry docks is both cost and time prohibitive. Therefore, a risk-based, adaptive approach is recommended in order to design for future extreme water events. Unless other guidance superseding this UFC is released, the following methodology is recommended.

1) First, calculate a design flood elevation using each of the three methods described below.
2) Second, rank the three elevations from lowest to highest. Begin a design that meets all structural requirements for the lowest elevation and formulate strategies to adapt to the higher elevations.
3) Finally, perform an analysis of alternatives (AOA) for future adaptive mitigations. This can be done by assigning relative cost and risk values to each of the three elevations relative to buoyancy FS, over-toping the dock, and the shipyard flood mitigation plans.

3-5.1 Flood Elevation Determination Methods.

3-5.1.1 UFC 3-201-01 Method.

This method follows UFC 3-201-01 using Table 2-1 for ASCE Flood Design Class 4. The coping is set to the minimum Design Flood Elevation (DFE) using the Base Flood Elevation (BFE). The BFE is the elevation of flooding, including wave height, having a 1% chance of being equal or exceeded in any given year.

Equation 3-1 Computation of Flooding Rate

$$DFE = BFE + 3\ ft\ (0.91\ m)$$

3-5.1.2 Extreme Event Method.

Compute the Extreme Flood Elevation (EFE) by using the FEMA value for elevation of flooding, including wave height, having a 0.2% chance of being equal or exceeded in any given year + 1 foot to coping.

Equation 3-2 Computation of Flooding Rate

$$EFE = FEMA\ 0.2\% + 1\ ft\ (0.31\ m)$$

3-5.1.3 Sea Level Change Approach.

Sea Level Change (SLC) affects the future storm surge and extreme tides. Global and local SLC shall be considered on any new construction or major dry dock renovation project. The science of SLC and application to design is an area under rapid development. All SLC values shall use the projections for at least the year 2100. Compute the extreme sea level elevations (ELSE) by:

Equation 3-3 Computation of Flooding Rate

$$ESLE = Local\ SLC + MHHW\ + Extreme\ Water\ Level$$

Where:

Local SLC = Global Scenario + Site Specific Adjustments

3-5.2 Minimum Values for New Construction.

The coping elevation shall be at or above the ELSE when using the medium global scenario and compared to the high and highest scenario for purposes of the AoA. Buoyancy FS shall be satisfied at ELSE for at least the high global scenario. If the FS is below 1.0, iterate on the design by adding mass or additional hold down elements. Check and report the FS for the highest global scenario.

3-5.3 Adaptive Strategies for Existing Docks.

For existing docks, the prediction and analysis should follow the same methodology minimum values. The mitigation for buoyancy is limited to adding hold down elements via tension piles through the floor to engage the rock or earth below the dry dock. Mitigating the potential for high water events that over-top the dry dock coping and caisson weather deck include permanent or semi-permanent floodwalls, adding a weir to the caisson, and raising the elevation of the immediate surrounding area. For any approach, the increased hydrostatic loads and resilience must be analyzed.

3-5.4 Shipyard Area Planning.

Recognizing that the dry dock does not stand alone and its mission requires the resources of the entire shipyard. Mitigating strategies for flooding the surrounding shipyard can only be addressed at the installation level. Dry Dock construction projects shall consult the area development plan and the Shipyard Infrastructure Optimization Planning (SIOP) office PMS 555 in order to maximize the dock’s operational days per year.

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CHAPTER 4 STRUCTURAL TYPES OF DRY DOCKS

4-1 DESIGN AND CONSTRUCTION.

This section deals with the influence of foundation requirements on shape and the reasoning leading up to specific type selection.

4-1.1 Basis of Type Designation.

Type designations are determined by the structural requirements necessary to neutralize the pressure of the water that surrounds it.

4-1.1.1 Hydraulic Pressure.

Hydraulic pressure can be resisted by the employment of sufficient weight and strength to resist the full pressure potential or can be diminished by absorbing the flow so as to lower the hydraulic gradient under the dry dock. The degree to which the water pressure is relieved determines the type terminology: (1) full hydrostatic; (2) fully relieved; and (3) partially relieved.

4-1.1.2 Piles.

Each of the three types of dry docks may be built with or without piles. For the full hydrostatic type, piles may be used to engage soil beneath the dry dock to contribute to the hold-down weight. For the fully and partially relieved types, piles may be used to improve the elastic modulus of the foundation or to reinforce the soil at locations of excessive soil pressure; for example, beneath the toes of walls or under ship blocking.

4-1.2 Methods of Construction.

Since a dry dock is constructed on the shore or extending into water, there is always the problem of excluding water from the construction site. To define completely the structural type of a dry dock, it is generally necessary to state its method of construction.

4-1.2.1 Water Exclusion.

On sites where water exclusion is feasible, a cofferdam, should be used. Since it must be deeper and wider than the finished dry dock, a cofferdam often presents technical and engineering problems more difficult than for the structural design of a dry dock itself. The structural type and shape of the dry dock may be influenced by the method used to solve the cofferdam problem. On sites where water exclusion is not feasible, a dry dock must be constructed by underwater methods, in which case the method used also influences the structural type and shape.

4-2 TYPES DICTATED BY FOUNDATION CONDITIONS.

4-2.1 Full Hydrostatic.

A dry dock is classed as full hydrostatic unless there is a relief drainage system that lowers the natural hydraulic head on the walls or floor. No material, even rock, can be considered impervious in the sense that it will prevent or decrease the hydraulic pressure on the structure. The full buoyancy of the dry dock must be resisted by one or more of the following factors: (1) weight of concrete; (2) weight of soil below the dock engaged by hold-down devices; or, (3) weight of earth resting on a ledge formed by the projection of the floor slab beyond the sidewalls or friction of the earth on the sidewalls.

4-2.1.1 Selection of Type.

Theoretically, a full hydrostatic dry dock can be built under almost any site or foundation condition. However, for large and deep docks, where the pressure on the floor and sidewalls is great, and especially where it is not feasible to secure a satisfactory hold-down system to the material beneath the dock, economic considerations may force the choice of another type.

4-2.1.1.1 Dry.

A full hydrostatic type of dock does not require relief pumping and, therefore, has the least cost of power and maintenance. If possible and where all other local conditions are suitable, it should be constructed in the dry.

4-2.1.1.2 Wet.

All dry docks constructed in the wet are of the full hydrostatic type because conditions preclude installing reliable relief systems underwater. Docks of this type can be constructed with or without pile hold-downs. See (a.) of Figure 4-1 for the cross section of a full hydrostatic dock constructed in the dry and (b.) of Figure 4-1 for a dock constructed by tremie methods.

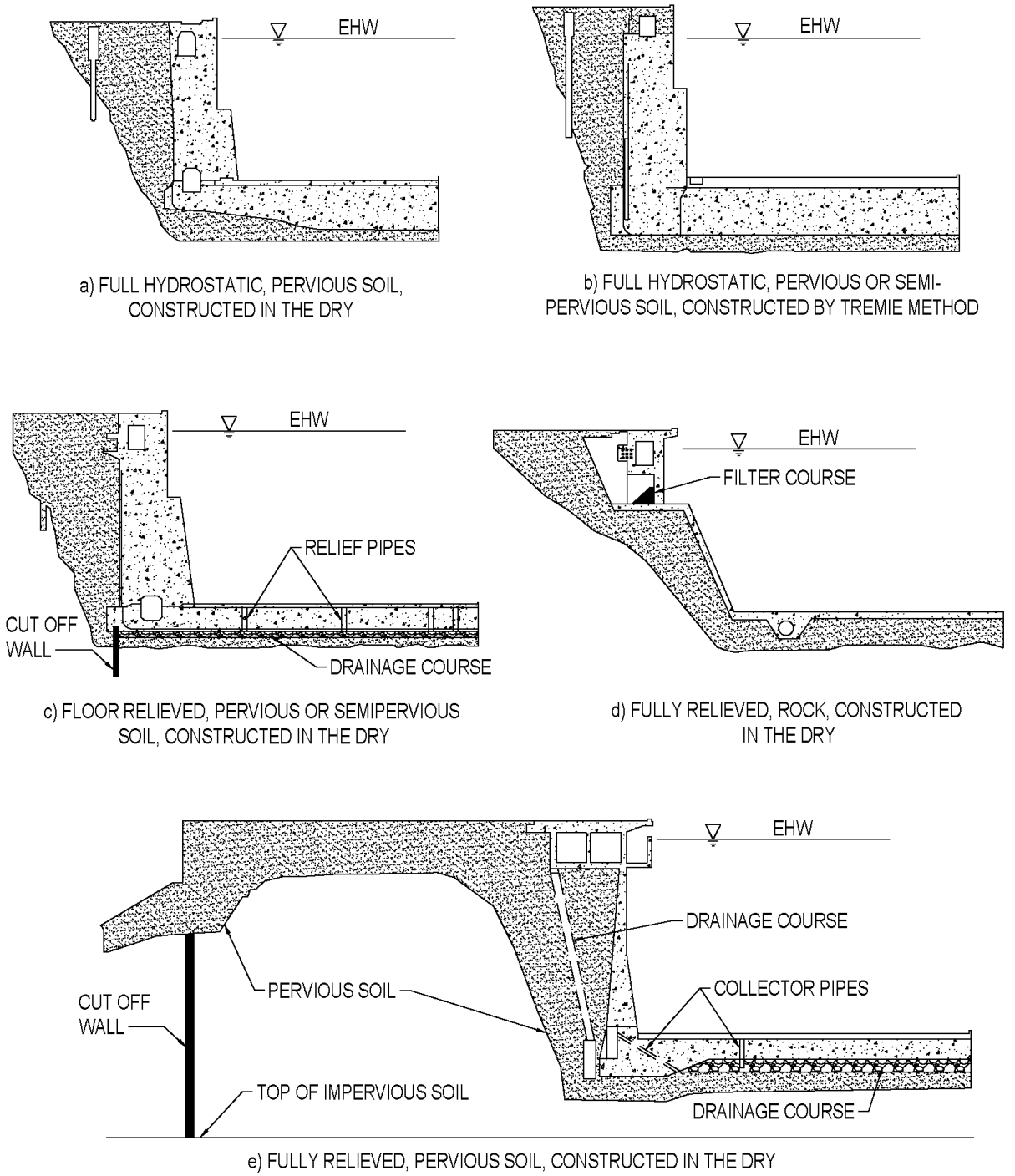
4-2.2 Fully Relieved.

A fully relieved dry dock requires a drainage system to eliminate or reduce the pressure on the floor and walls so that these elements may be of minimum size. Lower original cost will be offset to some degree by higher pumping costs throughout the life of the structure. The pressure relief type may be built for all types of foundation conditions if the flow of water is naturally cut off by not too pervious soil, or by natural or manmade means. The exception is for dry docks constructed in the wet.

4-2.2.1 Dry Dock in Rock.

For this type, it is necessary to line the rock excavation with concrete and provide weep holes through the floor and sidewall concrete lining. For an example of this type, see (d.) of Figure 4-1.

Figure 4-1 Graving Dock Sections by Structural Type and Construction Method



4-2.2.2 Dry Dock in Impervious Soil.

Where the soil is impervious, or nearly so, and the volume of seepage water to be handled is small, provide for this water to be drawn off through drainage courses placed under the floor and against the walls. This drainage course may or may not be supplemented by a pipe system to carry the seepage water into the dry dock chamber for disposal by pumping. The volume of seepage water that must be pumped during the life of a dry dock will depend on the degree of perviousness of the soil.

4-2.2.3 Dry Dock in Pervious Soil.

For a fully relieved dry dock to be built in pervious surrounding soil, provide a suitable cutoff outside the dry dock to stop the greater part of the general flow.

4-2.2.3.1 Sheet Pile Cutoff.

A dry dock may have an immediate surrounding of granular material underlain by an impervious stratum. A sheet pile cutoff, perhaps originally a part of the construction cofferdam and located at a distance from the dry dock, when driven to the impervious layer, can provide the necessary obstruction for cutting off the large volume of seepage flow which would otherwise reach the dry dock. For an example of this type, see (e.) of Figure 4-1.

4-2.2.3.2 Granular Material Filter.

Granular materials generally found at these dry dock sites must be excluded from the relief system flow. This requires the use of carefully designed filter courses and a system of drainage pipes adjacent to the walls and under the floor. The amount of pumping for this type will depend on the efficiency of the cutoff and the permeability of the soil.

4-2.3 Partially Relieved.

A partially relieved dry dock has relief provided for the floor only. Its use reduces the amount of floor concrete and minimizes difficulty in construction of the cofferdam. Provide the following:

4-2.3.1 Cutoff Wall.

Generally, a cutoff wall to surround the floor area only.

4-2.3.2 Filter Course.

A filter course under the floor. A system of collector pipes in the filter course may be used to carry the seepage water into the dry dock collecting tunnel.

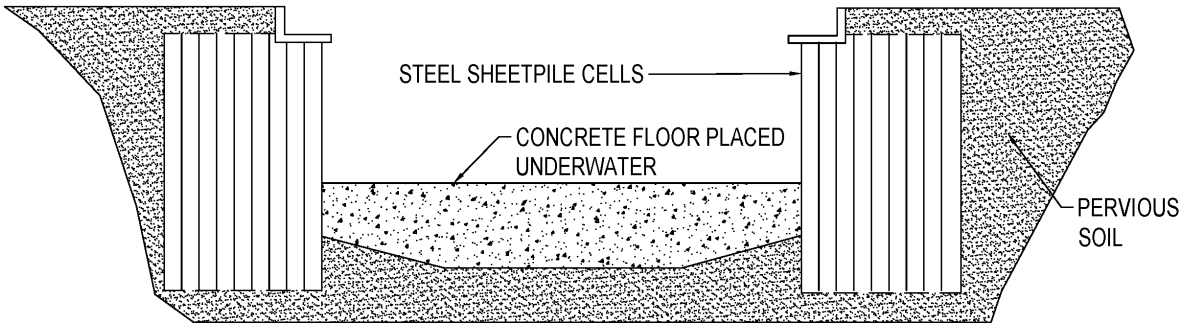
4-2.3.3 Alternate.

As an alternative to a collector system, provide holes through the floor for the seepage water to flow into the dry dock chamber then through trenches and scuppers to the collecting tunnel. See (c.) of Figure 4-1.

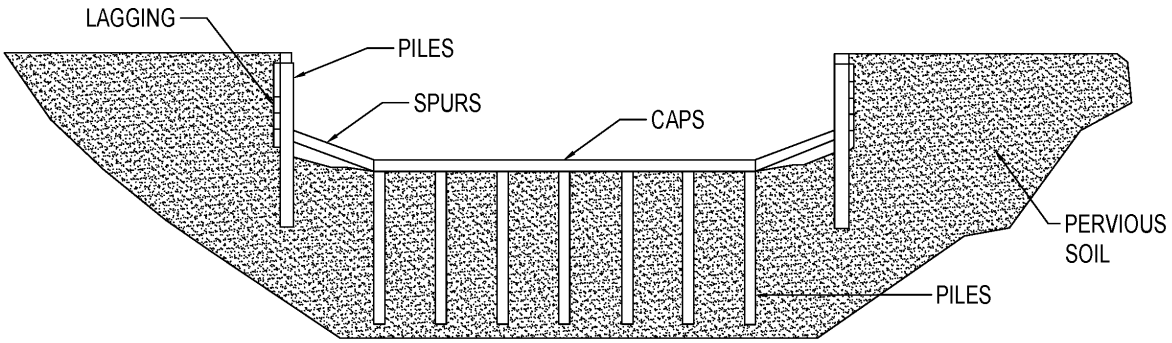
4-2.4 Miscellaneous Types.

For dry docks of temporary or semi-permanent nature, a great variety of types may be used. These types are so much different in general character from the conventional naval dry dock that classification in accordance with the method of solving the water pressure problem is not entirely definitive. These dry docks are generally for shipbuilding or for building other types of floating structures and take a great variety of shapes and forms (see Figure 4-2). For these dry docks, provide the simplest drainage systems. Either the floor or walls, or both, may not be watertight, and the water may seep through them into the dock chamber and run off the floor into trenches or pump sumps for disposal by pumping.

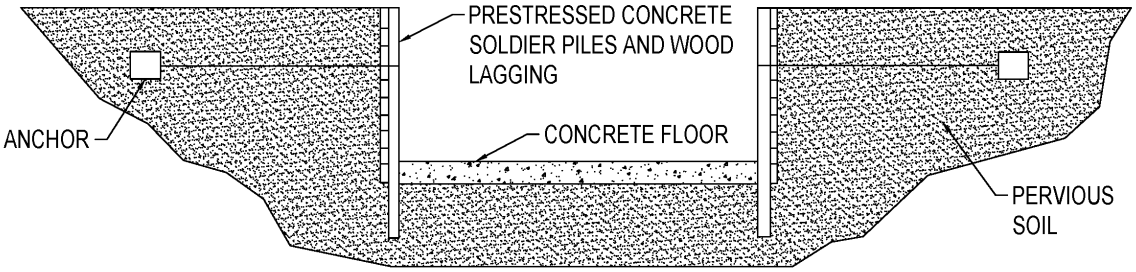
Figure 4-2 Miscellaneous Types of Dry Docks



a) SEMI-PERMANENT SHIPBUILDING DRY DOCK



b) TEMPORARY, ALL TIMBER DRY DOCK, CONSTRUCTED IN OPEN CUT FOR BUILDING FLOATING STRUCTURES



c) TEMPORARY DRY DOCK, CONSTRUCTED IN OPEN CUT FOR BUILDING TUNNEL SECTIONS

CHAPTER 5 STRUCTURAL DESIGN

5-1 SCOPE.

This section presents criteria on structural design of dry docks, with particular reference to dead loads, hydrostatic pressure, earth pressure, live loads, special conditions of loading, materials and design stresses, and methods of analysis.

5-1.1 Design Life.

Half the graving dry docks in the Navy's inventory are over 100 years old. It is incumbent on the design agent and end user to consider both the current mission and the future environment.

5-2 DEAD LOADS.

Dead loads are of special significance because the deadweight of the structure, including all mobilized earth weight plus friction and tension piles, must be greater than the maximum buoyancy.

5-2.1 Weight of Concrete Structure.

For design purposes, compute the weight of reinforced concrete structures on the basis of 150 lb/ft^3 (23.56 kN/m^3) weight in air. For plain or mildly reinforced concrete, assume it to be 145 lb/ft^3 (22.78 kN/m^3), unless higher value is justified by testing.

5-2.2 Weight of Earth.

In computing the total resistance to uplift, include the weight of earth engaged by any extension of the slab beyond the outside of the wall. Earth below the dry dock floor, when engaged by hold-down piles or other devices, is included in the computation of the total weight.

5-2.2.1 Weight of Earth on Floor Slab Projections.

5-2.2.1.1 Specific Weights.

Unless special, lightweight soils are encountered, use 60 lb/ft^3 (9.42 kN/m^3) for submerged soils and 100 lb/ft^3 (15.71 kN/m^3) for soils above water levels. The use of alternate values estimated based on geotechnical testing, is permitted.

5-2.2.1.2 Computation of Volume.

To compute volume with a dock empty and with mean high water, use the soil weight above the slab projection between a vertical plane at the outer edge of the projection and the back of the wall. With a dock empty and extreme high water, add the weight of earth wedge between the vertical plane and an intersecting plane sloping 15 degrees outward from the vertical plane.

5-2.2.2 Weight of Earth Engaged by Floor Slab Hold-downs.

5-2.2.2.1 Specific Weights.

This earth is always submerged. For ordinary soils, use 60 lb/ft^3 (9.5 kN/m^3). Since this weight is usually very important, determine the correct weight by geotechnical testing if there is any indication that the soil may be of a greater or lesser weight.

5-2.2.2.2 Computation of Total Weight.

The hold-down capacity of individual piles may be computed by methods given in UFC 3-220-01. The total hold-down capacity is not necessarily the sum of the individual capacities of a pile group.

- Weight: In computing the weight of this block, assume its plan dimensions to extend beyond the outer rows of piles by one-half the typical pile spacing.
- Depth: For the depth of block, assume the block bottom is above the pile tips by a distance of one-half the typical pile spacing. Where spacings are different in each direction, use the larger of the spacings.

5-3 HYDROSTATIC PRESSURE.

5-3.1 Weight of Water.

In computing pressures, use 64 lb/ft^3 (10.05 kN/m^3) for seawater and 62.4 lb/ft^3 (9.80 kN/m^3) for fresh water. For brackish water, the specific weight should be adjusted based on the water salinity content.

5-3.2 Buoyancy Computations.

Minimum factor of safety (FS) for buoyancy is 1.0 under all conditions and at all stages of the dry dock's life. This includes construction and through the end of the dry dock's expected operational life. Make all buoyancy computations for four water levels, as follows:

5-3.2.1 Extreme High Water (EHW).

To check safety against uplift with the maximum (15-degree) earth wedge mobilized. A FS shall be no less than 1.1 for this condition.

5-3.2.2 Mean High Water (MHW).

To check safety against uplift with the minimum earth block and friction mobilized. Refer to Section 5-2 entitled "Dead Loads" and Section 5-4 entitled "Earth Pressure".

5-3.2.3 Extreme Low Water (ELW).

With a ship in dock to determine maximum downward load on foundation soil or piles.

5-3.2.4 Flood Elevation.

Current and future flood elevations must be considered. After determining the design flood elevation (DFE), see Section 3-5, check the dry dock stability at this extreme event. For dry docks with a safety wall or flooding barrier the water above the yard grade may provide additional mass to counter act this increased buoyant force.

5-4 EARTH PRESSURE.

5-4.1 Variations.

Acting against a dock structure, the resultant outside earth pressure will vary considerably according to pressure and weight conditions inside the dock. Resultant earth pressures will be different when a dock is full of water, when a dock is dry but contains a vessel, and when a dock is empty. See UFC 3-220-01 for determination of earth pressures.

5-4.2 Water or Ship in Dock.

Active pressure is to be used because the rotation of the wall with respect to the floor is negligible. Do not use surcharge for computing pressure on dry dock walls except where railroad rails on ballast are near the wall.

5-4.3 Dock Empty.

Assume partial passive pressure to be operative where there is structural continuity at the juncture between sidewalls and floor because, with the dock empty, sidewalls of full hydrostatic docks tend to rotate outward against the backfill. The amount of passive resistance must be determined by assuming a uniform increase in resistance to occur throughout the sidewall height, starting from zero value at the top to an ascertained maximum bottom value. The rate of increase is based on the condition that the total internal work of the bending stresses throughout the dock cross section has a minimum value.

5-4.3.1 Inconsistency in Partial Passive Pressure Assumption.

The earth pressure at floor level should be no greater than active pressure, because the horizontal displacement of sidewalls is zero at about floor level, which is the approximate center of rotation for the sidewalls. Nevertheless, the method of approximating the total passive resistance for the condition of dock empty, as described previously, has proved satisfactory for existing structures so designed.

5-4.3.2 Upward Pressure.

5-4.3.2.1 Full Hydrostatic Dock.

The distribution of upward pressure beneath a dock designed to resist full hydrostatic pressure is known when the dock is empty, because the dock weight is nearly equal to total buoyancy.

5-4.3.2.2 Relieved Floors.

For relieved floors, earth pressures are not uniform because they are dependent on slab deflections induced by concentrated ship loads and moments at the wall bases. For the solution of elastic foundation problems and associated soil pressures, refer to any of the industry accepted foundation analysis books.

5-4.3.2.3 Friction on Sides.

In addition to the dock deadweight, friction piles, and earth weight over projections, the frictional resistance between backfill and sidewalls also is effective in preventing uplift.

- Mean High Water (MHW): To determine the frictional resistance for an empty dock at mean high water, the lateral force acting against the sidewalls (that is, the force corresponding to the active pressure of submerged earth) is multiplied by the coefficient of friction for the earth material on the sidewall material.
- Extreme High Water (EHW): Stability against uplift at extreme high water is computed using a deadweight of the earth wedges as described in Section 5-2 entitled “Dead Loads”, instead of frictional resistance.

5-5 LIVE LOADS.

For design purposes, conditions comprising live loads are:

- Shiploads applied to dock floors through blocking.
- Wheel loads from crane wheels, railroad tracks, and trucks applied to local beam and slab supports.
- Local static and moving loads on roofs and floors or pumpwells.
- Railroad track loadings, as a surcharge of earth pressure, from tracks carried on ties and ballast adjacent to sidewalls of docks and walls of pumpwells.
- An impact allowance of 15-percent is made for moving loads for structural members forming the primary support for the moving loads.

5-5.1 Shiploads.

Determine shiploads on the floor for the specific class ship. Shiploads on the floor must be determined in accordance with the guidance provided in MIL-STD-1625, and NSTM Chapter 997.

5-5.1.1 Thin Floors.

For thin floors, investigate the effect of these extra heavy loads, and reinforce the floor locally as necessary.

5-5.1.2 Positioning.

Base the blocking arrangement for design of the floor on any likely positioning of ships in the dock. Larger ships may be docked only on the centerline of the graving dock. For docks wide enough to permit multiple docking of ships abreast, or long enough to permit various placement fore and aft, apply the load pattern for such smaller ships multiple docked in odd positions to the floor as well as the load pattern of larger ships docked on the centerline.

5-5.2 Wheel Loads.

The typical wheel loadings for a 40 ST (36.3 t) locomotive crane, 25 ST (22.6 t), 35 ST (31.7 t), and 50 ST (45.4 t) portal cranes are given in UFC 4-152-01.

5-5.2.1 Full Hydrostatic Graving Docks.

Crane wheel loads do not normally influence the design of the main wall of graving docks designed to resist full hydrostatic pressure, because of the extensive longitudinal distribution of the wheel loads by the walls. Wheel loads from cranes operating around full hydrostatic graving docks, therefore, usually are significant only in the design of local beam supports under rails crossing the overhead of service tunnels, pumpwells, and other auxiliary structures.

5-5.2.2 Relieved and Partially Relieved Graving Docks.

For relieved and partially relieved graving docks, crane wheel load may influence the design of main dock walls as well as the design of local beam supports.

5-5.2.3 Mobile Crane Loads.

Mobile cranes are to some extent replacing locomotive cranes. Use truck crane wheel loads as given in UFC 4-152-01 or the crane manufacturers wheel load specifications (covering many of the larger ~ 220 ST (199.6 t) mobile cranes used by PWDs/Shipyards/Private Contractors) for beams, slabs, and the overhead structure of the pumpwell, where crane track loading does not govern.

5-5.3 Loads on Pumpwell Overhead and Floors.

Pumpwell overhead should be designed for a uniform load of 600 lb/ft^2 (28.8 kN/m^2) and for truck crane wheel loading when it is at ground level. The critical load for floors supporting main pumps usually corresponds to the maximum upward pressure. Use a uniform load of 300 lb/ft^2 (14.4 kN/m^2) for floors not subject to upward hydrostatic pressure; also these floors are to sustain loads from operating machinery placed thereon either in a permanent operating position or in a temporary overhaul position. Include vibrations induced by reciprocating and rotating equipment in the design.

5-5.4 Anti-Terrorism, Bomb and Blast Resistance and Security.

Dry docks are not usually designed to resist bombing or blast effects because of the massive size of the structure involved. In some locations, consideration should be given to protective construction for the upper part of the pumpwell and the service tunnels. For waterfront security and anti-terrorism/force protection criteria, refer to UFC 4-025-01, *Waterfront Security Design*.

5-6 EARTHQUAKE LOADS.

Seismic analysis of the dry dock must be performed in accordance with MIL-STD-1625. Seismic forces should be considered as an “extreme” load and are to be combined with the additional forces that are present during regular operations, with appropriate load factors in accordance with UFC 4-152-01. Site specific geotechnical studies must address seismic and soil-structure interaction based on the hazard levels addressed in MIL-STD-1625, consider Chapter 4 of ASCE 61.

5-7 SPECIAL CONDITIONS OF LOADING.

5-7.1 Full Hydrostatic Dry Docks.

Although there are many special loading conditions to be considered in the design of a graving dock (for example, nonsymmetrical loads, wave action on exposed walls, earthquake, and unusual water differentials), the design of full hydrostatic pressure docks generally is concerned with four especially critical conditions.

- **Case I**. Dock under construction.
- **Case II**. Dock empty. Maximum hydrostatic uplift.
- **Case III**. Maximum ship load. Minimum hydrostatic uplift.
- **Case IV**. Dock full of water. Include superflooding, if applicable.

5-7.2 Partially and Fully Relieved Dry Docks.

Critical conditions for partially and fully relieved designs are similar to those for full hydrostatic dry docks, except for appropriate allowance for decreased upward and lateral water pressures in accordance with the degree of lowering of hydraulic gradients.

5-7.3 Dry Docks Built by Underwater Methods.

When completed, these dry docks are always of the full hydrostatic type. In some cases, however, this method of construction involves loadings not encountered with construction in the dry. These cases occur when walls are built entirely in the dry in cofferdams set on slabs previously constructed underwater. Under these conditions, when wall cofferdams are dewatered, the partially completed structure does not have the benefits of wall and finish floor slab weight to overcome the buoyancy of the cofferdams, or the full sidewall thrust to overcome the tension in the slab. For examples of two such conditions, see Figure 5-1.

These dry docks are frequently associated with the use of hold-down piles, necessary if the weight of the floor slab is insufficient to overcome the total buoyancy including that of the empty cofferdam or cofferdams. Note in (a.) of Figure 5-1 there is a tendency to develop tension in the slab bottom without benefit of axial compression from a sidewall thrust. In (b.) of Figure 5-1, there is a tendency to develop tension in the slab top with a side thrust that is much smaller than will be developed against the walls of the completed dock.

5-8 MATERIALS AND DESIGN.

This section contains special provisions applying to concrete for dry dock walls, floors, and general cross section.

5-8.1 Concrete.

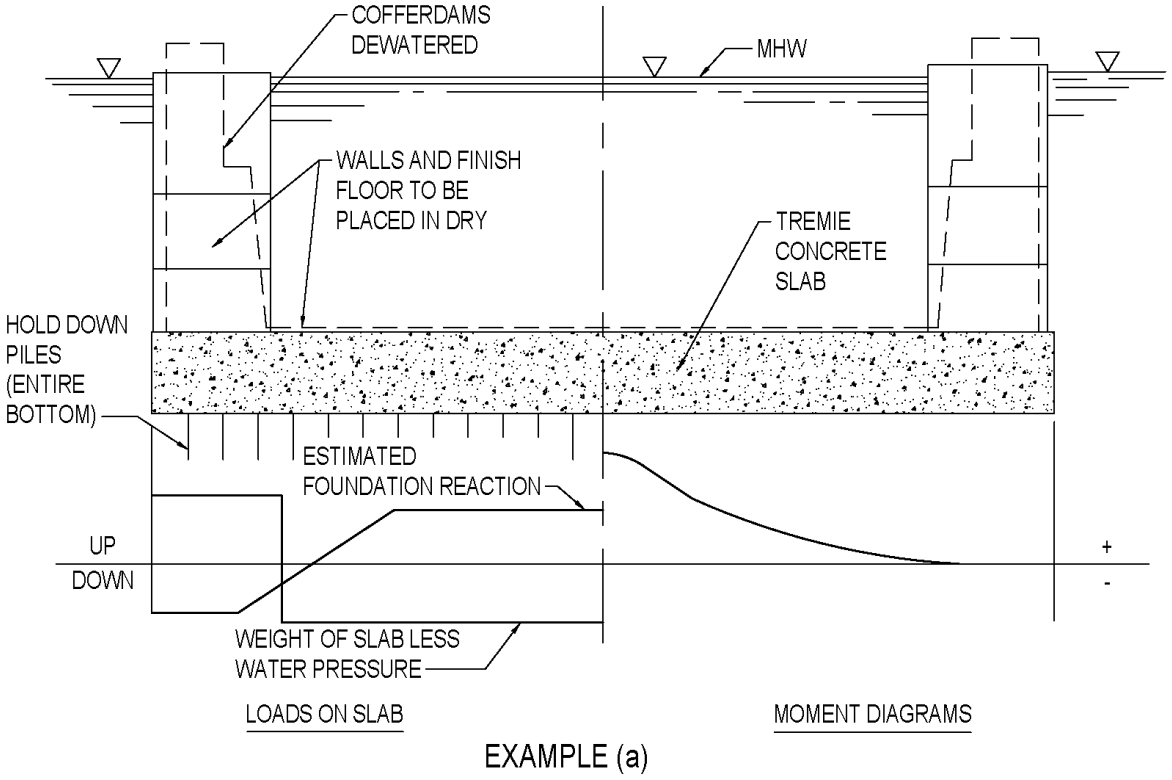
5-8.1.1 Classes of Concrete.

Recommend using concrete as specified in UFGS 03 31 29 or UFGS 03 31 30 *Marine Concrete* as appropriate. Use minimum 3,500 psi (24.12 MPa) estimated 28 days compressive strength cast-in-place concrete for the main body of the dock. Classes of greater strength may be used in accordance with structural requirements. Do not specify mortar intrusion concrete (see APPENDIX B, Glossary) for permanent dry docks.

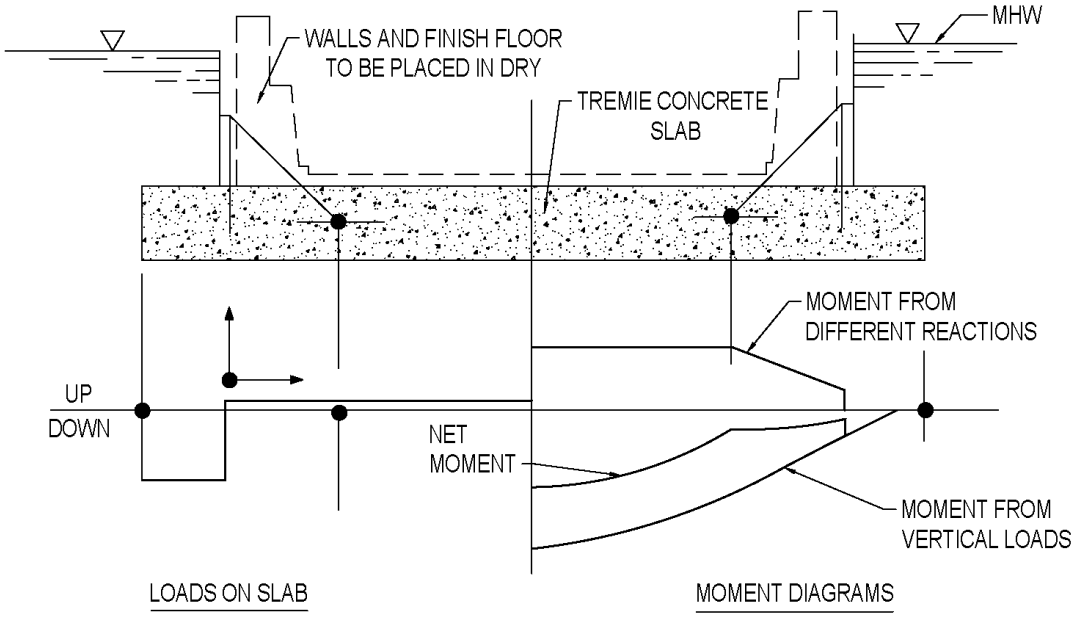
5-8.1.2 Admixtures.

Admixtures may be used to produce air entrainment, higher strength, greater durability and better workability, up to maximum percentages detailed in the project specifications.

Figure 5-1 Dry Docks with Slabs Constructed Underwater, Walls and Finish Floor Constructed in Dry



EXAMPLE (a)



EXAMPLE (b)

5-8.1.3 Mass Concrete.

The designer must follow the guidance in UFGS 03 31 29, UFGS 03 31 30, ACI 207.1R, ACI 207.2R, and ACI 207.4R to prevent undesirable cracking in mass concrete used to construct the dry dock. A thermal study must be conducted as a part of the design effort when mass concrete will be used in construction of the dry dock. The designer must specify the methods of crack control to be used including mix design, pour size and sequencing, and temperature control during placement and curing. Consideration must be given to the following during design to minimize cracking:

- Maximizing aggregate size.
- Limiting monolith widths to 50 ft (15.5 m).
- Increasing temperature and shrinkage reinforcement above the minimum requirements of ACI 318 up #9 (#29) bars at 12 in. (305 mm) in each face.
- Requiring the contractor to conduct a mass concrete simulation test (mock up) prior to construction to validate the adequacy of crack control measures.
- Mass concrete temperature control plans.

5-8.2 Reinforcing Steel.

5-8.2.1 Cover.

Minimum concrete protection for reinforcement is as follows:

- 6 in. (152 mm) where face of concrete will be in contact with soil, and surfaces subject to cavitation or abrasion erosion.
- 3 in. (76 mm) for formed or finished surfaces not in contact with soil.
- 2 in. (51 mm) over bearing pile butts.
- At piles intended as tension piles and having a considerable length of embedment in the concrete, place the reinforcement as in the first bullet above.

5-8.2.2 Reinforcing Bars.

Reinforcement should have a minimum yield strength of 60,000 psi (413.7 MPa), and conform to either of ASTM A706/A706M, *Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement* or ASTM A615/A615M*, Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement*, Grade 60. High strength or special large size reinforcement should conform to Grade 75 or Grade 80. Consider use of galvanized, coated or corrosion resistant reinforcement such as fusion bonded or purple bar coating. To control cracking, the maximum center-to-center spacing should not exceed 12 in.

5-8.3 Foundations.

Evaluate safe soil bearing capacity by methods set forth in UFC 3-220-01. Where the safe capacity of the soil is exceeded, provide structural support. Types of structural supports applicable to the foundation of dry dock proper and to supplemental structures are: timber piles, concrete piles, steel H-piles, pipe piles with open or closed ends, and caissons. For pile capacities, analytical treatment, information on range of capacities for various types of piles, and capacity of caissons, refer to UFC 3-220-01.

5-8.4 Cellular Cofferdam Wall.

The dock wall consisting of cellular sheet pile structure should be designed based on USACE EM 1110-2-2503 *Design of Sheet Pile Cellular Structures Cofferdams and Retaining Structures.*

5-8.5 Design.

5-8.5.1 Reinforced Concrete.

5-8.5.1.1 Load and Strength Reduction Factors.

In design of reinforced concrete structures, proportion members for adequate strength in accordance with provisions of the latest edition of ACI 318, *Building Code Requirements for Reinforced Concrete*, using load factors and strength reduction factors (Φ) specified.

5-8.5.1.2 Service Load Stresses.

Alternatively, non-prestressed reinforced concrete members may be designed using service loads and permissible service load stresses in accordance with provisions of ACI 318-99, Appendix A, Alternate Design Method.

5-8.5.1.3 Buoyant Condition Increases.

For a buoyant condition of a continuous U cross section, which might be produced in a relieved or partially relieved dock resulting from failure of the pressure relief system, or for construction stages, the ordinary working design criteria may be increased 50 percent.

5-8.5.2 Steel and Other Materials.

For appurtenant structures of concrete, steel, wood, and other structural materials, design must be in accordance with UFC 1-200-01.

5-8.5.2.1 Allowance for Corrosion of Steel Structures.

Steel structures must be designed with a corrosion allowance such that allowable stresses will not be exceeded when corrosion has reduced structural component cross sectional areas by the amount of the corrosion allowance. Corrosion allowances should be tailored to suit the environment of each steel structure. All pressure or flooding boundaries must be considered. This includes such examples as the caisson hull, watertight hatches and sluice gate thimble plates.

5-9 METHODS OF ANALYSIS.

5-9.1 Full Hydrostatic.

For analysis of four basic conditions of loading, refer to *American Civil Engineering Practice, Volume II*.

5-9.2 Fully or Partially Relieved.

Where these dry docks have relatively thin floors, concentrated ship blocking loads and wall reaction produce deflections resulting in variations in foundation pressures and requiring methods of elastic foundation analysis. The problem is to be treated as two-dimensional. The elastic foundation method may be used to assist in estimating foundation pressures for the special loading conditions discussed in Section 5-6 entitled “Special Conditions of Loading”.

5-9.3 Seismic Analysis.

Simple method of analysis such as Seismic Coefficient Method and Equivalent Lateral Method should be implemented in the initial stage of analysis and later progressing to increasing complexity by implementing linear elastic response spectrum, time-history modal-analysis and non-linear time history-direct integration procedure, if necessary. Refer to EM 1110-2-6053, Earthquake Design and Evaluation of Concrete Hydraulic Structures for general approach for the seismic analysis.

5-9.4 Computer Analysis.

The dock structure may be analyzed using structural finite element analysis (FEA) and/ or soil-structure interaction (SSI) analysis codes, depending on the complexity of the structure and loading. The analysis may initially be performed on two-dimensional (2D) sections and later progressing to three dimensional (3D) analysis, if necessary.

5-10 SAFETY CONSIDERATIONS.

5-10.1 Basic Safety Standards.

For general safety standards see OSHA Part 1915, *Occupational Safety and Health Standards for Shipyard Employment*, and Part 1910.29 *Fall protection systems and falling object protection-criteria and practices*. Local shipyard safety instructions or

other current U.S. Navy safety requirements may take precedence. Consult representatives from the local safety office and the appropriate subject matter experts before finalizing the design of safety features.

5-10.2 Safety Features Peculiar to Dry Docks.

Observe the safety features described in the sections below.

5-10.2.1 Coping Railing.

It is necessary for coping railings to be removable to avoid fouling lines when docking and undocking ships. The removal and replacement must be accomplished with as little hazard as possible because of the seriousness of the accident should a person fall into an empty dock. Chain rail with removable stanchions were used in the past, but maintaining adequate chain tension is a common problem. Solid metal pipe or fiberglass railing, provided in 6 to 10 ft (1.8 to 3 m) sections for ease of removal/reinstallation, is preferred. The design and locations of the top rail, mid rail, and toeboard must meet fall protection requirements. Refer to the shipyard safety office or current U.S. Navy safety guidelines for specific requirements.

5-10.2.2 Stairways.

Use open mesh treads on all framed stairways. Use non-slip treads for concrete stairways. At the top of steep, infrequently used stairways provide a guard. Closing chains may be used however; self-closing gates are preferred because they do not rely upon personnel to reattach the chains after each use. Open stairways must have top rail and mid-rail. If the top rail is used to guard an opening then the top of the rail as measured from the stair nosing is between 36 in. and 38 in. (914 mm and 965 mm).

5-10.2.3 Toeboards.

Provide toeboards in accordance with fall protection requirements at all rails where falling object protection is required. At the coping edge, a curb may serve as a toeboard.

5-10.2.4 Obstructions to Mooring Lines.

Keep the top of coping clear between the edge of the coping and the line of capstans and bollards.

5-10.2.5 Stepdowns in Tunnels and Culverts.

Avoid unprotected stepdowns in all unlighted tunnels and culverts. Use guardrails, or an arrangement of rails and gratings, to protect personnel while still retaining the water carrying capabilities of the tunnel or culvert.

5-10.2.6 Spillways.

Provide replaceable corrosion resistant (type 316 Stainless Steel or Composite) ladder rungs or guardrails, depending on steepness, up flooding and discharge spillways, to aid in access for inspection of sluice gates and stoplogs.

5-10.2.7 Dock Floor Irregularities.

Graving dock floors should present an unbroken surface. Cover drainage conduits with gratings that do not protrude above the floor level. Run service pipes near the sidewalls and bridge them at stairways. Floor finish should be sufficiently rough to prevent slipping, but not so rough as to injure blocks.

5-10.2.8 Painting.

Paint obstructions with a striped pattern composed on contrasting colors as outlined in UFC 3-190-06.

- Service pipes are customarily painted according to established color codes, but those below headroom or otherwise forming obstructions should be painted with contrasting colors in stripes.
- Channel pedestrian traffic through safety zones by marking the borders of pedestrian passageways with traffic zone paint.

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CHAPTER 6 FLOODING

6-1 DESIGN FACTORS.

This chapter contains criteria and information on flooding of dry docks, particularly methods of flooding and the design of hydraulic structures.

6-1.1 Requirements.

Flooding of dry docks is done entirely by gravity; superflooding feature installations require a pumping system to raise the water inside basin to water levels to higher elevations than the tide range allows. Design and arrange all flooding systems to operate with a minimum of disturbance to ship blocking, no intake of silt or floating objects, a minimum of required special gate control, and no vacuum or cavitation effects in the water channels. Gates and gate operating mechanisms must be reliable and durable.

6-1.2 Flooding Periods.

The average time for flooding Navy Dry Docks of the five types may be used as a design guide. Flood times are for empty docks. Actual flood time will depend on many factors. New docks or renovations shall set flooding time requirements based upon operational, environmental and functional needs of the shipyard. The times for flooding the docks should be, for the main classifications:

- SSN Submarine and destroyer docks, 90 minutes.
- Cruiser docks, 135 minutes.
- Carrier and Auxiliary docks, 135 minutes.

6-2 FLOODING METHODS.

There are three general methods used for flooding graving dock basins.

1. From flooding intakes on one or both sides of the entrance through culverts built into the lower parts of sidewalls and connected to floor openings spaced along the dock length at the floor.
2. From flooding intakes on one or both sides of the entrance through culverts passing transversely under the floor near the entrance with openings leading upward into the floor.
3. Through ducts or tubes in the caisson or entrance closure gate. This is referred to as a flood through caisson.

6-2.1 Common Intake Features.

Except under special conditions, place one intake opening on each side of an entrance. For very large docks requiring large culverts, two openings on each side may be used to reduce sluice gate sizes. Opening edges should be rounded to reduce eddying and contraction of the stream.

6-2.1.1 Opening Elevations.

No standardization can be established for opening elevations since these depend on tidal ranges, stem rises of gate valves, and proximity and character of entrance approach bottoms. In general, depths below mean low water, where opening soffits are placed, should not be less than opening heights. When an entrance approach bottom is near the invert or openings, protect the bottom area in front of and adjacent to the openings from erosion by heavy rip-rap or other means.

6-2.1.2 Trash Racks.

Place trash racks over openings to prevent intake of solid matter. Trash racks must be removable for maintenance and replacement.

6-2.1.3 Stoplogs.

Between trash racks and sluice gates, provide vertical slots in culvert sides to accommodate stoplogs furnished to shut off the water for sluice gate maintenance with double valve protection.

6-2.1.4 Sluice Gates.

Control graving dock flooding with sluice gates. Provide two sluice gates per flooding opening or a sluice gate plus a stoplog to assure “double valve protection” against inadvertent flooding as required by MIL-STD-1625.

6-2.1.4.1 Minimum Design.

When under heavy hydrostatic pressures occurring during high tide levels with wave action, design must be adequate to prevent operating and maintenance troubles caused by distortion, warping, and excessive friction.

6-2.1.4.2 Maximum Design.

Design maximum sluice gate sizes to allow flooding a dock within the specified time.

6-2.1.4.3 Design for Two-Way Pressure.

When sluice gates are subjected to two-way pressure, they must be specifically designed for such service.

6-2.1.4.4 Specific Requirements.

- Minimum design life of 30 years.
- Maximum leakage of 0.05 gpm/ft (0.6 lpm/m) of the seal perimeter at the design seating and unseating head.
- Limit the largest dimension to 96 in. (2.44 m).
- Provide local mechanical gate position indicators at gate stands, and remote electrically operated indicators at pumpwell control boards.
- Design structural supports for gate lifting mechanisms to carry a load two times the manufacturer rated lifting force (Factor of Safety = 2.0).
- Sluice gates used in dock flooding, dewatering, or drainage systems must be oriented such that the greatest pressure they will experience will seat the gate leaf against the gate frame. Sluice gates that will experience pressure from both sides (dock flooding gates for superflooding docks, gates in interconnecting tunnels between dry docks, etc.) must be specifically designed to accommodate expected unseating heads.
- Suitable corrosion resistant thimbles should be embedded in concrete for attachment of sluice gate frames.
- For all wedges and seating surfaces where sliding occurs, the use of a metal sliding against a metal of the same alloy composition may create galling problems. Use metals of different alloy composition or the same metals with different hardness and anchor these seating surfaces with dovetail grooves. For specific wearing problems, consult a metallurgist.

6-2.1.5 Draft Boards and Dock Marks.

Draft Boards or water level indicators must be placed on dry dock walls near the entrance on each side and on dry dock walls near the head end on each side. The indicators must be clearly visible from the opposite side at the top of a dry dock. Mark gauges with numerals 6 in. (152 mm) high, 3 in. (76.2 mm) clear space above and below and with the bottoms of numerals corresponding to multiples of 1 ft (305 mm) of draft.

The gauges may be cast as recesses in wall concrete and painted, colored tile cemented into a wall, noncorrosive metal anchored into the wall or plastic composite also anchored to the wall. The zero level may be referenced to the dock floor elevation, sill height or the top of the standard docking blocks used. Refer to NSTM Chapter 997, and MIL-STD-1625 for additional requirements.

Dock marks are longitudinal markings along the dock length. They are helpful in referencing utility locations, work orders for maintenance requests and progress during dock evolutions. They should be placed along the upper wall or top-level coping facing inward so that they are visible from the opposite sides of the dock and from the floor

when the dock is empty. Zero should be the inner caisson seat face. Maximum increments must not exceed 100 ft (31 m) center to center.

6-2.1.6 Vents.

Vents must be provided behind each gate, leading from water duct soffits to the free atmosphere on the coping where the vent openings must be covered by grating. A vent must be located at the highest point of a soffit before it curves down into the flooding culverts proper.

6-2.2 Flooding Culverts.

One of the two following types of culverts may be used to conduct flooding water from entrance works into a dry dock chamber.

6-2.2.1 Sidewall Type.

Sidewall culverts are located in the lower parts of sidewalls, connected to the sea through the entrance works. Floor openings and one or two large sidewall openings are connected to them.

6-2.2.1.1 Advantages.

This arrangement achieves filling without dangerous currents. A flooding culvert often serves in part as a drainage and/or dewatering culvert. The use of floor openings for filling provides a blanket of water to cushion the force of water from the outlets and also flushes the floor drains.

6-2.2.1.2 Flooding Design.

In a flooding culvert, maximum velocity occurs during early flooding stages and is gradually reduced by loss of head resulting from the rising water level inside a dock. The flooding time is greatly affected by the flow rate at reduced heads when a dock is nearly full. Therefore, large culverts and openings are desirable. It is important to reduce friction, eddy currents, and turbulence, by making interior surfaces of culverts smooth and all changes of direction by means of gradual curves.

6-2.2.1.3 Tunnels.

This system is efficient if hydraulic requirements do not result in tunnels of such size as to produce complex and high stress concentrations in the walls. This is especially true of thin walls with stressed reinforcing steel and less true in gravity walls. Even for the latter case, formwork is expensive. Long stretches of tunnel increase cleaning and maintenance work. From experience long stretches of tunnels that wrap around the dock floor or deliver water to the head end of dock are unnecessary. For existing docks, these tunnels should be filled, after checking for structural concerns, during renovations of the dock.

6-2.2.2 Transverse Floor Type.

Transverse floor culverts comprise a number of openings, spaced across a dock floor above a wide culvert located parallel to, and from 10 to 18 ft (3.1 to 5.6 m) inboard of, the inner caisson seat; the inboard distance depending on the dock size. The culvert ends rise in the sidewalls and terminate in the entrance works.

6-2.2.2.1 Flooding Factor.

In operation, the method of flooding through openings of transverse culverts necessitates partial opening of the sluice gates for a sufficient time to attain adequate water depth on the floor, so the flow velocity toward the head end will not dislodge or damage the blocking.

6-2.2.2.2 Cost Factor.

A properly designed system of this type will comply with specified flooding times at lesser cost than the system of flooding through sidewall culverts.

6-2.3 Flood Through Caisson.

Dry docks can be flooded through ducts or tubes in an entrance closure caisson or gate. This method for flooding the dry dock can be used exclusively, or it can be used in combination with flooding intakes in the dock walls. This is the preferred method because it provides greater redundancy and is more cost effective than the other two methods for both initial construction costs and O&M costs. Conversion of existing docks from using culverts to caisson flood through tubes is recommended when repair of flooding sources is studied.

For this method of dry dock flooding, multiple round tubes or ducts penetrate the caisson shell plating through the caisson ballast tank. Tube diameter is normally 30 in. (762 mm) and should not be larger than 36 in. (914.4 mm). The number of flooding tubes is dictated by the desired flooding time and hydraulic characteristics. However, utilize at least two flooding tubes for redundancy if the dock is to be flooded exclusively through the caisson. Each flooding tube must meet the requirements of double valve protection per MIL-STD-1625. This can be accomplished by having two valves installed in series or with one valve and flanges on the exterior of the caisson for steel blanks. Additional requirements are contained in CHAPTER 9.

6-2.4 Super-flooding.

Super-flooding is a system to raise the inside water levels to higher elevation than that of the normal tides. A super-flooding system has been used in several graving dry docks with inadequate water depth to enable them to dry dock sonar equipped ships and ships of newer deep draft design. Ideally a dry dock would be designed without the need for such a system. However, increased ship docking capability may be obtained by installing a super-flooding system that lifts ships by flotation. The operation consists of off-center vessel entry into the dock chamber, placing entrance caisson in seat,

pumping water into the dock chamber thus raising the ship, breasting the ship over preset keel blocks, and then dewatering the dock chamber.

It also requires that the dry dock have an inboard faced caisson seat or securing devices for the entrance closure to resist the outward hydrostatic pressures caused by the raised interior water level. Super-flooding is most cost effectively accomplished by installing the super flooding pumps in the caisson. At least two super flooding pumps should be used. The system should be piped to allow suction to be taken from the outside face of the caisson and discharged into the dry dock. Super-flooding can also be accomplished by using the main dewatering pumps thorough a specifically designed arrangement of sluice gate and dewatering valves. This design requires that the main dewatering pumps take suction from the flooding source and discharging into the dock.

6-3 HYDRAULIC DESIGN.

6-3.1 Overall Factors.

In hydraulic design of flooding systems, consider the factors of waterheads, required flooding times, optimum configuration of culverts, permissible flow velocities, and limiting sizes of sluice gates.

6-3.1.1 Heads.

Hydrostatic head causing flow varies from a maximum when a dock chamber is empty, to zero when a dock chamber is full. Mean high water (MHW) or mean higher high water (MHHW) is used as the reference elevation for determining maximum head.

6-3.1.2 Required Flooding Time.

Refer to Section 6-1 entitled “Design Factors”.

6-3.1.3 Flow Velocities.

The maximum desired flooding flow velocity should be 25 ft/s (7.6 m/s). This velocity may not conform to an available head that could produce higher velocities. In such cases, either provide built-in head losses in the system or reduce the intake area by sluice gate throttling.

6-3.2 Evaluation of Flooding Time.

The many factors affecting flow in flooding systems make it practically impossible to compute accurately the time required for the flooding. Such factors include:

- Variations in Hydrostatic Head. These conditions exist because of water rise in the dock, and the difference in actual tidal conditions from those assumed in the design.
- Transitions in culvert cross sections in many cases are necessarily abrupt; for example, at dock floor openings.

- Changes in elevation and direction of the main culvert alignment.
- Head losses in trash racks and gratings.
- Roughness condition of culvert walls.
- Entrance and discharge head losses.
- Size of ship in dock.

6-3.3 Computation of Flooding Time.

Because of the difficulty in combining the various factors influencing flow, the entire system is treated as an entity with a single overall flooding coefficient applied in the basic formulas as in Equation 6-1.

Equation 6-1 Computation of Flooding Rate

$$Q = aC_f\sqrt{2gh}$$

Where:

Q = *flooding rate, ft³/s (m³/s)*

C_f = *overall flooding coefficient (dimensionless)*

a = *cross section area of main culvert, ft² (m²)*

g = *acceleration of gravity, ft/s² (m/s²)*

h = *difference in elevation between water in dry dock and outside water, ft (m)*

To determine the relationship between a varying head, as the water rises in the dry dock, and an interval of elapsed time, take the expression in Equation 6-2.

Equation 6-2 Computation of Flooding Velocity

$$\frac{Q}{A} = -\frac{dh}{dt}$$

Where:

A = *average plan area of the water pond in a dry dock, ft² (m²)*

t = *interval of elapsed time, sec*

Then substituting the value of Q from Equation 6-1,

Equation 6-3 Time Rate of Change

$$dt = \frac{-Adh}{a \cdot C_f\sqrt{2 \cdot g \cdot h}}$$

Or for definite time intervals (integrating Equation 6-3 between limits h_2 and h_1)

Equation 6-4 Time rate of change for definite interval

$$t_2 - t_1 = \frac{2 \cdot A \cdot \left(\sqrt{h_1} - \sqrt{h_2}\right)}{a \cdot C_f \sqrt{2 \cdot g}}$$

The total time T, for the dock to reach the outside water level (h_2 = 0) with an initial difference h_1:

Equation 6-5 Total flooding time

$$T = \frac{2 \cdot A \sqrt{h_1}}{a \cdot C_f \sqrt{2 \cdot g}}$$

The value of C_f may be obtained from tests on dry docks or other structures such as ship locks with comparable flooding systems. For proposed flooding systems of unusual character, or for dry docks of unprecedented size, model tests should be considered.

CHAPTER 7 DEWATERING

7-1 DEWATERING SYSTEMS.

This section deals with criteria, data, and information on dewatering, with particular attention to basic components, basic requirements, and pumping systems.

7-1.1 Main Dewatering System.

This system is used to remove water from the dry dock basin during docking operations. Large grating covered culverts in the dry dock floor adjacent to the main pump suction chamber are normally used to facilitate flow into this system.

7-1.2 Drainage System.

A drainage system collects the last few inches (centimeters) of water blanketing the graving dock floor, as well as rainwater, flushing water. The floor should be sloped or crowned so that water will make its way to longitudinal floor trenches that lead to culvert adjacent to the main pump suction chamber. The trenches should be covered by securely anchored strong gratings.

7-1.3 Environmental Systems.

Environmental requirements in most locations now require that potentially contaminated water be treated prior to discharge. If potentially contaminated and uncontaminated waters are allowed to mix, the mixture must be handled as contaminated water. For this reason, it is usually necessary to segregate potentially contaminated water sources in the dry dock from uncontaminated sources that can be pumped directly into the harbor. Potentially contaminated sources can include water that contacts the dry dock floor where industrial activities are occurring. Uncontaminated sources include water pumped from the dry dock during docking/undocking operations, water that leaks past the caisson seat, ship’s cooling water, and water that leaks through dock walls or enters the dock through pressure relief pipes. Segregation is typically done by designating a location just beyond the sill beyond which all water is handled by the environmental discharge systems, and any water between this location and the caisson is discharged by the drainage system.

Design environmental systems so that system failure does not result in flooding of the dry dock floor. Environmental systems should overflow into the normal floor drainage system before the water reaches dry dock floor level.

Environmental system requirements vary by location and can be subjective. For this reason it is critical that environmental system planning and design be closely coordinated with the regulatory authorities to ensure compliance with environmental requirements.

7-2 DEWATERING SYSTEM COMPONENTS.

7-2.1 Floor Trenches.

The floor trench should be narrow and short grating covered leading to the pump suction chamber, collector channel, a wide, deep, grating covered open culvert leading to the pump suction chamber, handles the greater portion of water pumped out of the flooded graving dock by the main dewatering system.

7-2.2 Sand Sumps.

Abrasive materials harmful to pumps and pump fittings are continuously washed off a graving dock floor in sufficient quantities to justify the installation of a settling basin. Provide settling basins to retain most of these harmful suspended particles. Locate these basins in an accessible part of the collector channel to permit easy removal of collected sediment and sand. Other methods of containing this material may be used as an alternate, such as floor barriers around the ship.

7-2.3 Suction Chamber.

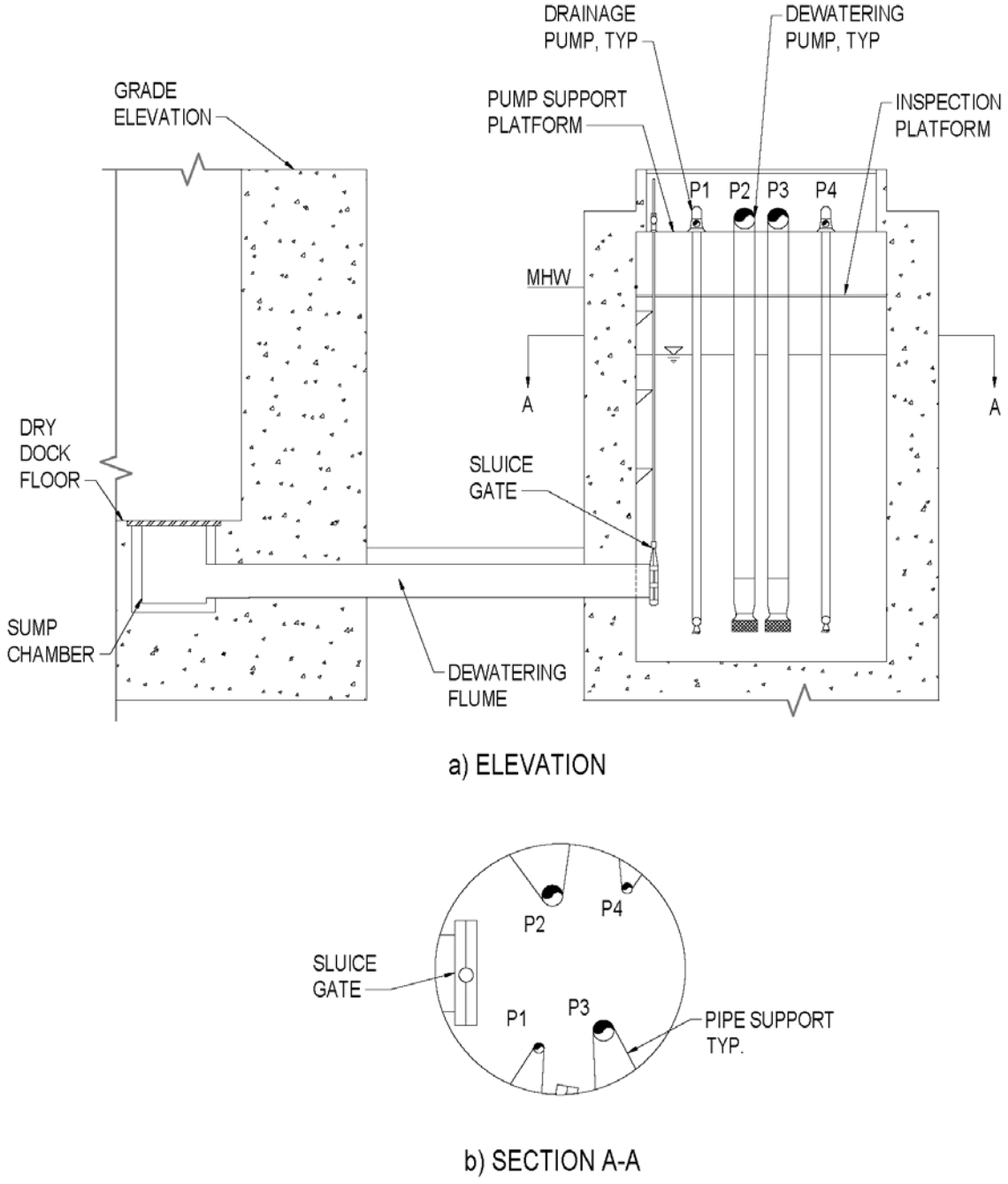
Provide a suction chamber (large enclosed space) for the suction bells of the dewatering pumps next to or in dock sidewalls, preferably near the dock entrance. Specific design requirements are:

- Locate the chamber floor below the graving dock floor approximately 10 ft (3.1 m); shape it to conform to flow lines of water entering pump suction bells, if necessary.
- Provide access to the main suction chamber from the dock floor culvert.

7-2.4 Pumpwell or Pumphouse.

Provide a pumpwell or pumphouses of reinforced concrete for housing the pumps, motors, valves, gates, controls, and other equipment. Pump suction chambers constitute the lower part of a pumpwell. A design, known as a wetwell (see Figure 7-1), can significantly reduce the amount of mechanical equipment and flooding risk compared to traditional Navy dry dock pumpwells. This design combines the suction chamber and pumpwell areas with an open, flooded center that equalizes with the dock. Wetwells also make use of more commercial off the shelf equipment vice custom manufacturing. Contact the NAVFAC EXWC Dry Dock SME for more information.

Figure 7-1 Elevation View of Wetwell Operations Level



7-2.4.1 Pumps and Motors.

Several functional types of pumps with motors may be housed in a pumpwell; main dewatering units predominate. Other pump and motor units are:

- Drainage pumps.
- Sump pumps.
- Sewage pumps.
- Salt water pumps (fire protection and flushing).
- Vacuum pumps (if required for priming).

7-2.4.2 Valves and Gates.

Include the following valves and sluice gates in a pumping plant:

- Gate valves in discharge line from each main pump.
- Check valves in discharge line from each main pump.
- Miscellaneous valves and sluice gates for operation of the drainage system.
- As an alternative, dewatering systems may discharge above sea level or be looped above sea level (with a suitable siphon breaker). In this case discharge gate valves and check valves are not required. The system must be designed to prevent back-flooding into the dry dock with outside water levels up to the caisson overtopping level if the valves will be omitted.

7-2.4.3 Double Valve Protection.

Dry docks must be protected from sources of potential flooding through normal flooding and dewatering sources. Therefore, dewatering and drainage systems must have two valves or a valve and a stoplog. In situation where an adjacent dock shares a pumphouse or suction chamber, each dock must be isolated. Combinations of valves and sluice gates may be used.

7-2.4.4 Amenities within Pumphouse.

Depending on the occupancy category and expected duration of docking evolutions, the pumphouse may require facilities to be provided for the staff. This may include one or more toilets, lockers, kitchenettes, even offices and tool rooms. With modern remote operations, communication equipment and more efficient equipment, the trend has been to reduce the size of pumphouses and suction chambers. Therefore, less space will be necessary for staff to continually occupy these areas.

7-2.4.5 Heating and Ventilating.

Refer to UFC 3-410-01 for heating and ventilating criteria for pumping stations.

7-2.5 Pump Discharge Tunnel.

Design the pump discharge tunnel in the form of a variable section header, or header tunnel, connecting the various pump discharge lines to carry water into the discharge tunnel outer portions. The tunnel should be designed for occasional human inspection.

7-2.5.1 Auxiliaries.

Install gate valves and check valves in all pump discharge lines, except in unusual cases where discharge is above high water.

7-2.5.2 Discharge Stoplog.

Provide a stoplog or hinged stoplog in the discharge tunnel to allow inspection and maintenance of discharge valves.

7-2.6 Gratings.

Gratings must have small openings to prevent small tools and other objects from going through the pumps. During work around a docked vessel, some dock floor drainage grates may be temporarily removed. As an added precaution to prevent damage to the pumps, it may be advisable to place a grating over pump suction boots or bells.

7-2.7 Salt Water Intake Screen.

Where salt water is to be pumped for fire protection or other purposes, provide a screen at the intake to catch solids of sizes that would interfere with pump operation. If large quantities of salt water are to be handled, moving mechanical screens may be required. Refer to UFC 3-230-01 for screen design.

7-2.8 High Water Sensing Systems.

Provide two independent water level sensing systems. The primary sensing system, which must operate from station power, must be designed to activate both the pumps and the alarm. A backup or secondary sensing system must have an independent power source and operate the alarm only. Both systems must announce locally and at a central location that is continuously manned. Refer to MIL-STD-1625 for additional system performance requirements.

7-3 BASIC REQUIREMENTS OF DESIGN FACTORS.

Three basic design factors enter into the design of a pumping system: (1) desired pumping time, (2) initial cost of pumps, motors, pumpwell structure, and appurtenances,

and (3) power supply. Also consider the relatively small percent of time that pumps are in operation.

7-3.1 Pumping Time.

The average time for dewatering Navy Dry Docks of the five types may be used as a design guide. Pumping times are for empty docks. Actual dewatering time may depend on many factors. New docks or renovations shall set dewatering time requirements based upon operational, environmental and functional needs of the shipyard.

- Submarine docks, 135 minutes.
- Destroyer docks, 150 minutes.
- Cruiser and Auxiliary docks, 165 minutes.
- Carrier docks, 240 minutes.

7-3.2 Initial Cost of Installation.

For comparative studies, obtain the cost of various sizes of pumps, motors, controls, and other mechanical accessories from manufacturers. The cost of pumpwell and discharge structures increases with the sizes of pumps. This is especially true with regard to pumpwell foundations that are usually the deepest part of the entire dry dock foundation and lead to special construction problems.

7-3.3 Power Considerations.

Dewatering pumps of all naval dry docks should be driven by electric motors. These main pumping units require a considerable amount of electrical energy for brief periods of time and at infrequent intervals. If electrical current is purchased for this purpose, it involves a large demand or service charge. If current is furnished by the station, this results in a relatively heavy station demand, necessitating installation of additional power capacity for generating equipment.

7-3.3.1 Power Demands.

Keep the maximum power requirements as low as practicable, consistent with the required capacity. Keep power demands as constant as possible through the whole pumping head range. Although the initial cost of high-speed standard motors is relatively low, their operating characteristics are not suitable for driving dewatering pump units. Therefore, the design of the motor driven, direct connected pumping unit for dry docks involves an adjustment and compromise of the conditions of: varying hydraulic head, minimum range of required power, lower unit speeds, and relatively good efficiency. These conditions often necessitate a sacrifice in efficiency. High efficiency, however, is not of prime importance in equipment that is operated so small a percentage of the time.

7-4 PUMPING SYSTEMS.

7-4.1 Components.

The main dewatering system of a dry dock usually includes:

- The suction inlet located within the dock chamber
- The suction passage and/or culvert
- Pump suction chamber
- Pump suction bells
- Pumps
- Discharge check and gate valves
- Discharge culvert including backwash trash rack
- Hinged stop gate, sliding stoplog, or discharge sluice gate.

Where pumping plants may be designed to remove water from more than one dock, additional suction sluice gates are required to permit independent pumping of the docks. The pumphouse only has the operations level and the wet sump below the floor elevation. The discharge from the pumphouse should be as close to or above the tide level to reduce flood risk through the dewatering system. See Figure 7-1 for elevation view of pumphouse operations level.

7-4.2 Elevation of Discharge.

The most desirable operational pumping arrangement is a system in which the discharge invert is directly overboard above the level of the caisson weather deck, and in which no discharge check and gate valves, trash racks, or stop gates are required. Operation is simplified as there is no large power driven valves with electrical controls to be operated and maintained.

7-4.2.1 Design.

The design outlined above allows elimination of a large portion of the pump room substructure, with an accompanying reduction in pumping plant initial cost. The additional elevation required in delivering water overboard above the level of the caisson weather deck increases the total static pumping head. This increase, however, may be more than offset by reduction in friction owing to elimination of the pump check and discharge valves. The designer should consider the installation of a loop in the discharge piping to carry the water above the level of the caisson weather deck and then back down to discharge below sea level. The loop should have a siphon breaker installed at the top of the loop. The looped system may prove to be more efficient than one discharging at a higher level.

7-4.3 Pumping Head.

The pumping head of the main dewatering pumps is the sum of the maximum hydrostatic head and hydraulic system losses. See Figure 7-2. Maximum hydraulic system losses exist when maximum flow occurs, which is the time of minimum static head.

7-4.4 Pump Suction.

With reference to design and satisfactory functioning, the most critical portion of a hydraulic system is the suction portion extending from dock chamber to dewatering pump suction bell. This portion consists of the suction inlet, suction pit below the inlet, and conduits leading from the pit to individual pumps or to a pump suction chamber common to all pumps, and the pump suction bells. If the conduits are separate for each pump suction, sluice gates may be installed in each conduit to permit working on a pump without impairing the use of other pumps.

7-4.4.1 Periphery of Pit Opening.

In dewatering a dry dock, one or more of the main pumps may be shut down as the water level approaches the dock floor, in order to prevent loss of pump suction. As the water level continues to recede it generally becomes necessary to throttle the discharge of the last operating pump. This condition occurs when the pump capacity exceeds the quantity of water flow reaching the pump suction from the dock chamber through the pump suction pit and conduits. The elevation of the pumps with reference to the dock floor does not contribute to this condition. To delay the time of shutdown and throttling, design the dock floor suction inlet to have as large a perimeter as practicable.

7-4.4.2 Area of Pit Opening.

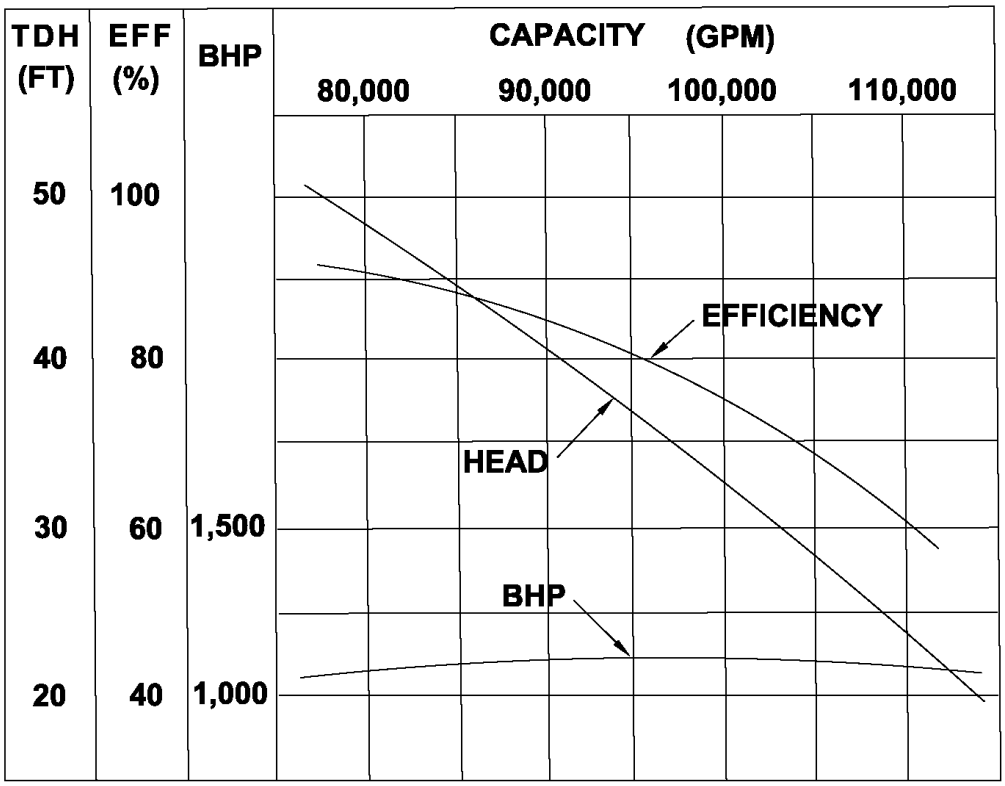
The suction pit opening (free area) should be of sufficient size to result in a flow velocity in the range of 3.5 to 4.5 ft/s (1.1 to 1.4 m/s). Base the flow on the pumping rate when the water level is 2 ft (0.6 m) above the dock floor and discharging against mean high tide. The suction condition may be greatly improved by providing openings on the opposite side of the dock chamber connected by conduits under the dock floor.

7-4.4.3 Use of Sidewall Culverts.

Where a sidewall culvert drainage system is used to facilitate removal of low-level water from the dock floor, it should drain to and terminate in the main dewatering pump suction chamber.

Figure 7-2 Characteristic Curves for 54 in. Mixed Flow Pump

TIME	TOTAL DYNAMIC HEAD (FEET)			CAPACITY (GALLONS)	NET STATIC HEAD (FEET)
	DISCH	SUCTION	NET		
12:10	116.5	92.5	24.0	109,000	0.8
12:33	113.8	87.5	26.0	105,000	5.5
1:06	109.6	76.8	32.8	100,000	13.1
1:37	106.8	72.0	34.5	95,000	20.3
2:08	104.6	64.3	40.3	90,000	26.7
2:40	102.7	58.0	44.7	85,000	33.3
3:06	101.4	53.0	48.4	80,000	38.3



7-4.4.4 Shape of Pump Suction Works.

Design the configuration of a pump suction pit and the conduit leading to the pump suction chamber, or suction bell, so that the flow will have a constant or uniformly accelerated velocity. The surface of the passages should be smooth and of such shape as not to produce eddies. There should be no sharp turns or abrupt changes in a conduit section. It may be necessary to install stream guide vanes in the suction chamber to effect good distribution and flow to the pump suction bells.

7-4.4.5 Arrangement of Suction Bells.

7-4.4.5.1 Design for Velocity.

Where several pump suction bells draw from a common chamber, the flow in the region of the bellmouth should be free from high velocities and changes in direction that tend to cause vortices.

In addition:

- The velocity of approach should be in the range of 2 to 3 ft/s (0.6 to 0.9 m/s).
- The designed bellmouth velocity should be in the range of 4 to 5 ft/s (1.2 to 1.5 m/s).
- The water depth below the bellmouth should be approximately one-half the bellmouth diameter.
- Laterally there should be no obstruction to flow within one diameter of the centerline of the bell.

7-4.4.5.2 Design for Vortex Action.

The system design should give such hydraulic characteristics as will preclude vortex action at the suction inlet and at the suction bell.

7-4.5 Pump Discharge.

The design of the pump discharge line is less critical than that of the suction line. The discharge conduit surfaces should be smooth, and sharp angles that tend to produce eddy currents must be avoided. The conduit should be such that the streams from individual pumps converge in as near a parallel direction as practicable. Changes in conduit sectional areas should be gradual and should not produce fluctuating velocities.

7-4.5.1 Allowable Velocities in Discharge Works.

At discharge of individual pumps, use 20 ft/s (6.1 m/s) maximum. In cross section of combining discharge culvert, use 14 ft/s (4.3 m/s) maximum.

7-4.5.2 Head Losses.

Head loss computations exclude losses through the pumping unit. These are included in the manufacturer rating. Total loss should not exceed 10 to 12 ft. (3.1 to 3.7 m). Suction loss should be not more than 2 to 3 percent of total loss.

7-4.5.3 Valves.

Where the discharge terminations are submerged, both gate and check valves are required. Where the discharge is above water, only a low resistance discharge flap valve is required. Gate valves should be the outside stem and yoke type suitable for throttling operation, and should be motor driven with push-button control. Check valves should be the low resistance, horizontal, nonslam, or dashpot control type. Check valves must be designed to shut automatically upon a power outage.

7-4.6 Pump Capacity.

Base the capacity of the main dewatering pumps on the desired dewatering time, volume to be removed, type of graving dock construction, and characteristics of the hydraulic system. As the water level in the dock recedes, the pump discharge volume falls off accordingly. The unit pump rating in gallons per minute should be taken as the average discharge volume. This average is based on the pump discharge when the hydrostatic suction head ranges from that of mean high water down to the head existing when the water level in the dock is 2 ft (0.6 m) above the dock floor.

7-4.7 Pump Efficiency.

Rate dewatering pumps in accordance with average overall efficiency instead of efficiency at a fixed capacity rating. Average overall efficiency is based on the range of head stated above, and is defined as the ratio of the total work done to the total power input to the motor. The total work is determined by multiplying the amount of water pumped in each interval between water level readings, by the average head in the same interval.

7-4.8 Pumps.

In the design and operation of pumping units, provision must be made for certain relationships between the suction lift and/or head, discharge head, capacity, and speed. This design factor is necessary to obtain rated capacity and efficiency, and to avoid outage and high maintenance from vibration and cavitation.

7-4.8.1 Main Dewatering Pumps.

At least two main dewatering pumps are required to meet the dewatering time requirement and to have redundancy. Limit the size to 54 in. (1.4 m).

7-4.8.1.1 Classes of Pumps.

The three general classes of pumps suitable for moving large volumes of water at relatively low heads are as follows:

- Axial flow. For static head pumping up to 25 ft (7.8 m), axial flow units (propeller) may be the most desirable.
- Mixed flow. Mixed flow units give good results on heads up to approximately 75 ft. (23.3 m).
- Centrifugal. Centrifugal pumps are more suitable for the higher heads.

7-4.8.1.2 Design Problems.

Dry dock dewatering presents unusual water pumping problems because of the extreme variations in both suction and discharge heads. See Figure 7-2 for typical operating characteristics of a 54 in. (1.4 m) mixed flow impeller pump operating under graving dock hydraulic conditions.

7-4.8.2 Drainage Pumps.

Provide drainage pumps to remove seepage, precipitation, caisson and valve leakage, and wash water, and to clear the dewatering pump suction chamber and drainage system. Because of sandblasting operations, the drainage pumps (and sump pumps discussed below) must be capable of handling a certain amount of sand and sandblasting products in suspension without excessive wear on casings of impellers. Also, ready access should be provided to pump suction chambers through manholes or other openings located so as to facilitate easy cleanout of these chambers.

7-4.8.2.1 Pump Capacity.

Estimate the total capacity required for relieved docks from an evaluation of the foundation permeability. For gravity docks, where only two units are required, the capacity of each unit should be:

- Submarine or destroyer docks: 2,500 gpm (568 m^3/h).
- Cruiser docks: 5,000 gpm (1,135 m^3/h).
- Carrier and Auxiliary docks: 7,500 gpm (1,703 m^3/h).

7-4.8.2.2 Types.

Drainage pumps should be vertical shaft, direct connected, motor driven; they may be of the wet or dry pit type:

- Wet pit pumps may be similar to main dewatering pumps of the axial discharge type.

- Dry pit pumps may be a mixed flow or centrifugal unit.
- Axial discharge pumps are the least expensive in that no suction piping and only a relatively small amount of discharge piping is required.

7-4.8.2.3 Head and Motor.

The required pumping head of drainage pumps is higher than that for the main dewatering pumps and is not so variable. Motors are generally located on the dewatering pump motor drive floor.

7-4.8.2.4 Environmental Requirements.

Local regulatory authorities may have specific requirements for drainage pumping discharges. Refer to local regulations.

7-4.8.3 Sump Pumps.

Sump pumps, vertical drive wet pit (submerged) centrifugal type, should have a capacity of 75 gpm (~280 l/min) each, and should be installed in duplicate.

7-4.9 Pump Drives.

Use vertical motors directly connected by line shafts to pump impellers. Main dewatering pumps generally are of the dry pit type. Install the motors and electrical switchgear on a floor only sufficiently below the top of the dock to allow for equipment and operating headroom. Place drainage pump motors and the drive mechanism for control of the main valves on the motor drive room floor. Drainage pump motors may be at a lower elevation to shorten the shafts, as long as they are above the possibility of being flooded due to a flooding pumpwell, or are submersible.

7-4.9.1 Speed.

Speeds of dewatering pump motors are dictated by the specific speed of the pump impellers; generally, low speed motors are required.

7-4.10 Driving Shaft.

The entire weight of revolving parts of the vertical pumping unit should be carried by a thrust bearing in the base of the motor at the top of the shaft. Specific requirements include the following:

7-4.10.1 Thrust Bearings.

Use self-aligning thrust bearings.

7-4.10.2 Guide Bearings.

Guide bearings must be of sufficient strength and adequate design to prevent vibration for lateral deflection of the vertical shaft. Use self-aligning and adjustable; the bearing surfaces may be of bronze or babbitt.

7-4.10.3 Lubrication.

Provide adequate lubrication. Generally, use water for this purpose where the bearings are submerged in the pump discharge stream. Provide clean, cold, fresh water of ample volume and pressure.

7-4.11 Elevation of Pumps.

Determine pump elevation by the vertical position of the dewatering pump impeller centerline. For vertical type centrifugal or mixed flow dewatering pumps, refer to the centerline of the pump discharge. For vertical mixed flow main pumps, the pump elevations must be about 3 ft (0.9 m) below the dry dock floor.

7-4.12 Priming.

All graving dock pumps not set at an elevation at which the impeller is submerged at all times must be equipped for priming. Priming consists of flooding the pump suction piping and the pump casing surrounding the impeller by removing air by means of a vacuum pump.

7-4.13 Heating and Ventilating.

Provide heating and ventilation in the pump room, as required to prevent damage by moisture condensation and freezing, and for the comfort of the operating personnel.

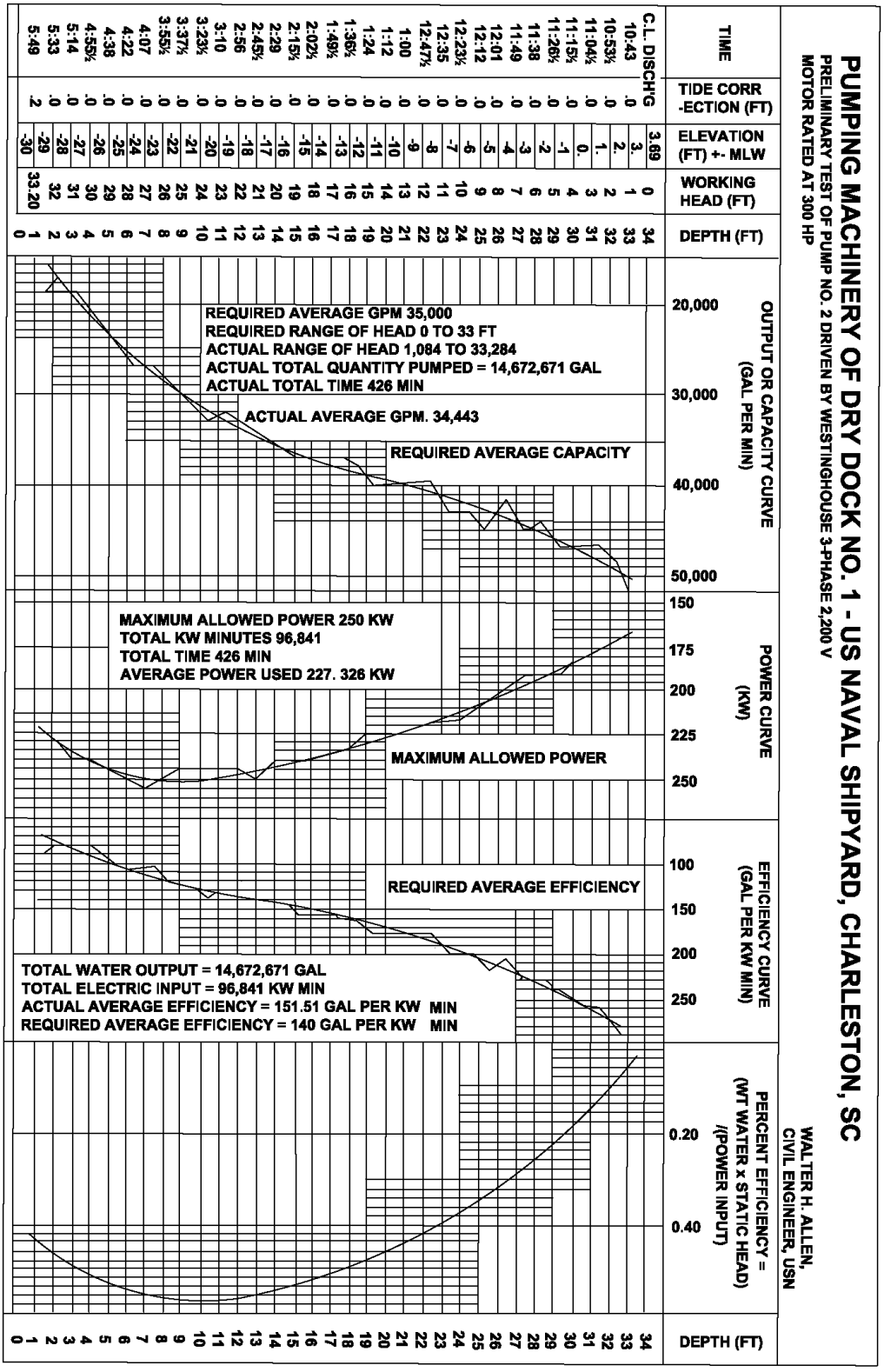
7-5 FIELD TESTING OF DEWATERING SYSTEM.

In order to check the operating characteristics with design requirements, it is necessary to field test the dewatering pumps, including the hydraulic system as installed. These tests cover pump capacity, power consumption, and evaluation of efficiency. For the results of an actual field test, see Figure 7-3.

7-5.1 Determination of Capacity.

Prepare a volumetric curve on which the volume of water in the graving dock, in cubic feet, is plotted against elevations referred to the datum plane, or to some other fixed elevation such as the graving dock floor or coping. When appreciable leakage occurs, a leakage curve is prepared by recording the rate at which water in the dock rises at various elevations.

Figure 7-3 Curves from Field Tests



7-5.1.1 Curve Construction.

During pumping tests, the water elevations in the dock are usually taken at intervals of 10 minutes. To the amounts of water pumped, as determined from these observations, add the appropriate amount of leakage taken from the leakage curves. The average capacity is the total amount of water pumped, divided by the pumping time. Take water level readings in the dock with great accuracy, preferably at two or more points simultaneously, and average. Use specially constructed gauges for obtaining accurate readings, unaffected by waves. To eliminate inaccuracies in observations, plot all readings to large scale, draw a smooth curve, and make any necessary corrections.

7-5.2 Power Input.

Take readings, simultaneously with those for capacity, of the power input to motors, as determined by calibrated wattmeters placed in the circuit as near as practicable to the main switchboard panels. In computing results, make corrections for ratio, scale, and phase-angle error. Determine frequency from speeds taken on a synchronous motor feeding from the same source of supply as the pump motors. Read pump speeds with a speed counter and stop watch directly from the motor shaft.

7-5.3 Determination of Head.

Efficiency requirements may be based on total dynamic head as determined by calibrated gauges in the suction and discharge of each pump, but variable results are obtained by this method. Tests based on static heads between the levels of the water in the dock and the sea are more reliable than gauge tests, and give a more practical indication of the performance of the plant as a whole. The objection to this method is that a pump manufacturer, in order to furnish guarantees of efficiency, must estimate all friction losses in the system.

7-5.4 Tide Effect.

Generally, tests to determine capacity and efficiency are so timed that the end of the test will occur when the elevation of the tide is at approximately mean high water or mean higher high water. Although it is necessary that the pumps be capable of dewatering docks at any tide stage, the average condition of the tide for graving dock pumping is probably nearer half tide than high water. At locations where tide range is considerable, it may be more reasonable to base capacity and efficiency requirements and tests on half tide conditions.

CHAPTER 8 FITTINGS, BLOCKING, SHIP SERVICES

8-1 FITTINGS.

Major fittings, and fittings peculiar to graving docks, are covered in this section; other fittings are merely mentioned. All fittings must be made of corrosion resistant materials and installed in a way that will minimize maintenance. Ferrous metal fittings must be zinc coated; small fittings may be cadmium plated.

8-1.1 Capstans.

Capstans are used at graving docks for pulling vessels into the dock chamber, and entrance caissons into seat or stowed position.

8-1.1.1 Location.

Locate one capstan on the centerline of the dock at the head end; one at each side of the caisson seats at the entrance end; and others on the sides of the graving dock, spaced not more than 300 ft (93 m) apart. Set capstans shoreward of the outermost crane rail of the track nearest to the centerline of the dock.

8-1.1.2 Requirements.

Typical capstan designs use the reversing gypsy-head type consisting of a barrel mounted on a vertical shaft and driven by an electric motor through reduction gearing. For electric control typically 460 volts nominal, three-phase 60 Hertz current, a magnetic reversing controller, including transformer and relay cabinet, push-button station having flexible cord, with a variable frequency drive (VFD) to provide infinite speed control with accurate current and thermal overload control. Arrange the completed equipment to operate with a minimum of noise and vibration.

Horizontal drum, winch type capstans are also acceptable. It is important to solicit and receive input from the shipyard rigging shop when deciding on capstan requirements.

Arrange all parts subject to wear so that they may be accessible for inspection, lubrication, and cleaning. Secure all fastenings that are likely to become loosened by vibration by locknuts or other suitable devices. Use material commonly used for the service required and marine environment. The entire capstan unit should be designed and furnished by the same fabricator. Templates should be furnished for setting anchor rods.

8-1.1.3 Capacity and Speed.

Capstans must be capable of pulling up to 30,000 lbs (13,500 kg) at a line speed of 30 fpm (0.15 m/s) and up to 15,000 lbs (6,750 kg) at 60 fpm (0.30 m/s) with slack speed of 90 fpm (0.46 m/s). Design capstans to also be used as bollards with a line pull of 100,000 lbs (45,000 kg) applied at the center of the barrel and directed upward at an

angle of 30 degrees with the horizontal. Any required variations in the above indicated line pulls and speeds will be specified in project requirements.

8-1.1.4 Capstan Pits.

Typically, capstan driving mechanisms and foundations are located below coping elevation in pits generally consisting of concrete chambers founded on heavily reinforced concrete slabs firmly anchored and supported by batter and vertical piles. To avoid interference with lines, expose only the capstan barrel and the watertight cover of the capstan pit. See Figure 8-1.

- Secure machinery with anchor bolts embedded in chamber foundations. Provide watertight manholes for limited ready access to machinery, and an overall pit cover made in sections to permit removal of machinery.
- Provide capstan pits with drainage systems large enough to drain off normal precipitation as well as possible heavy leakage.
- Capstan pits, subject to humidity that might interfere with electric motor operation, may require portable blowers to dry out the pit before operation. For drawing of capstan and pit for dry dock application, refer to American Civil Engineering Practice, Volume II.

When replacing or renovating capstans consider removable or portable capstan units. These units would consist of a palletized self-contained capstan or winch, motor, controller. The capstan unit would be brought in via crane lift or fork truck only for the evolution, then removed and stored off site during the ship availability. In this design the capstan unit would not have a pit but a pad at the coping elevation and secured to permanently installed anchors in the coping concrete similar in design to aircraft runup pads.

8-1.1.5 Controls.

Install electric power capstan controls in machinery pits. Provide topside controls and locate them so that they allow the operator an unobstructed view, clear of lines and working parties. Topside controls should be portable so they may be stowed when not in use. Install controls in watertight enclosures.

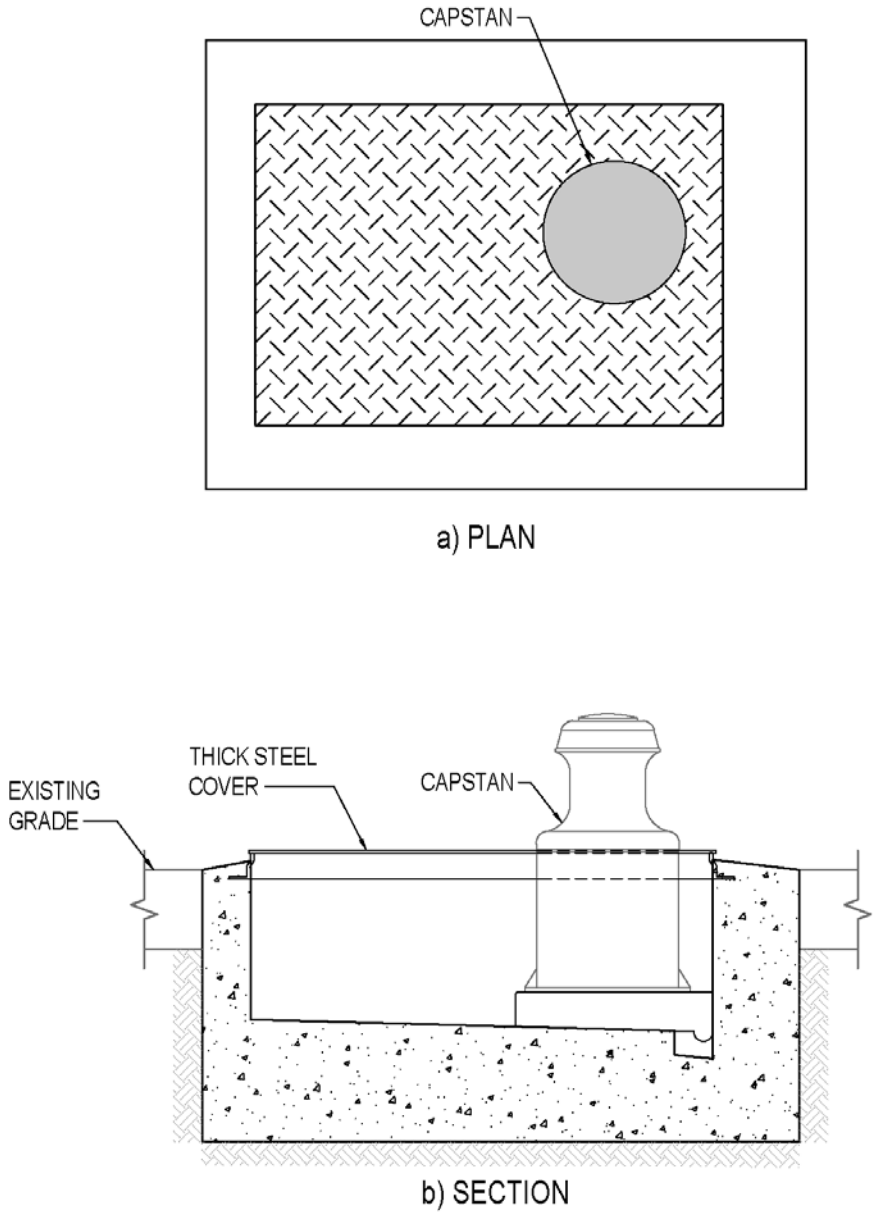
8-1.2 Bollards.

Bollards are iron or steel castings, upright (concrete filled) secured to foundations by steel bolts. Refer to UFC 4-152-01 and UFC 4-159-03 for description of bollards.

8-1.2.1 Location.

Set bollards in line with the capstans at approximately 50 ft (15.5 m) on centers between capstans.

Figure 8-1 Capstan Pits



8-1.2.2 Pull.

At a minimum, provide large bollard with horn per Table 6-11 of UFC 4-159-03 (nominal load 35 ST (31.8 t)).

8-1.2.3 Shape.

Bollards must include at least one horn and be shaped so that lines will not slip, jam, or ride off the top.

8-1.2.4 Foundations.

A bollard foundation may be a concrete substructure adequately supported by piles arranged to resist large overturning moments. Construction economy may be affected by tying bollard foundations to outer crane rail or dry dock foundations. Refer to UFC 4-159-03 for description of bollards.

8-1.3 Cleats.

Install 20 ST (18.1 t) cleats spaced at about 60 ft (18.6 m) centers on the coping for securing mooring lines. Refer to UFC 4-152-01 and UFC 4-159-03 for description of cleats. Consider aligning cleats on both sides of the dock at the coping level.

8-1.4 Stairways.

Stairways in the dry dock may be cast as part of the wall concrete or may be constructed of structural steel with open mesh treads bolted to the walls. Stairways can be damaged by falling objects, fouled lines, and swinging crane loads. Semi-permanent prefabricated stairways bolted to walls facilitate repair and allow for relocation. Stairs must comply with NFPA 101, dimensional criteria for new stairs.

The number and location of stairways must meet the following parameters:

- One stairway from coping to dry dock floor on each side of the dock at the head end.
- One stairway from coping to dry dock floor on each side of the dock at the caisson end.
- Spacing between stairways along each side of the dock must not exceed 300 ft (91 m).
- Pumpwells must have at least two stairway exits from pump room floor.

Alternatively, a life safety analysis or evacuation plan developed by a qualified fire protection engineer in consultation with the DFPE, both as defined in UFC 3-600-01, *Fire Protection Engineering for Facilities*, may be performed to optimize the number and location of pumpwell and dry dock floor stairways. The analysis must account for the actual work performed in pumpwell and on the dry dock floor with a ship in dock, and

the number of individuals accessing the dock during typical shifts. Obstructions such as docking blocks, fork trucks, scaffolding, CONEX boxes and other equipment will impact evacuation. The pumpwell analysis must account for the mechanical equipment in the pumpwell that would impede movement. The life safety analysis must include those impacts when evaluating evacuation routes. In all cases, at least two stairways from the coping to the dock floor must be provided, with one located at the caisson end and one at the head end.

8-1.5 Ladders.

Provide ladders only where the available space is insufficient for stairways, or where traffic is too light to warrant stairway construction. Place ladders in pumpwells as leads to access hatches and large manholes. Refer to 29 CFR 1910.23 for ladder requirements. Also consult local safety regulations as to the maximum allowed ladder length without fall protection.

8-1.5.1 Steel Shapes.

Fabricate ladders of steel shapes. Plug weld rungs into rails. Install ladders so that the distance from the center of the rungs to the finished wall surface will not be less than 7 in. (178 mm). Secure ladders to the adjacent construction with heavy clip angles, welded to the rails and secured to masonry, concrete, or stud framing with not less than two 3/4 in. (19 mm) diameter bolts. Intermediate clip angles must be provided not over 5 ft (1.6 m) on centers. Provide brackets as required for securing of ladders welded or bolted to structural steel and built into the masonry or concrete. In no case should ends of ladders rest upon finished roof or floor. Ladders and supports must be galvanized after fabrication unless a corrosion resistant material is used. Bar steel rungs are installed 12 in. (305 mm) apart, vertically below manholes, and at other locations where frequent access is not generally necessary.

8-1.5.2 Stainless Steel.

Low carbon stainless steel (UNS S31600/ S31603) rungs and ladders should be considered for alternating wet-dry, high corrosion areas.

8-1.6 Safety Railing.

Provide railing (guard rail system) around fixed installations (such as machinery), around open shafts, along dock walls at altars or setbacks, and along the top edge of retaining walls in accordance with 29 CFR 1910.29. Removable solid railing sections may be installed where access is required around permanent openings and installations. Incorporate fall protection requirements where removable railings are installed. Install fall protection tie off points in areas that require inspection when railings are removed (fall protection may not be required during docking/ undocking).

8-1.6.1 On Coping.

Provide a removable railing with toeboards unless the coping wall serves as a fall protection barrier. Chain railing was used in the past but maintaining adequate chain tension was a common problem. Solid metal pipe or fiberglass railing, provided in 8 to 12 ft (2.5 to 3.7 m) sections for ease of removal/reinstallation, is preferred. Solid railing sections should fit securely into sleeves fastened to the coping and are open on the bottom to prevent debris accumulation.

8-1.6.2 On Stairways.

Provide rigid pipe rails of two parallel pipes approximately 2 in. (51 mm) diameter and running between fixed pipe stanchions on all stairways. These may be a removable type, if necessary. The top rail is not less than 36 in. (914 mm) and not more than 38 in. (965 mm) as measured from the leading edge of the stair tread to the top surface of the rail, the midrail is midway between the leading edge of the stair tread, and the top rail.

8-1.7 Marking Plates.

Provide plates in dock structures marked with their exact stationing in the dock to facilitate setting of keel and side blocking.

8-1.7.1 Composition and Marking.

Marking plates should be bronze or stainless steel metal plates approximately 8 in. (203 mm) long by 4 in. (102 mm) wide set flush with end anchored into the embedding concrete. Each plate must be marked appropriately with centerlines, and with respective distances to the graving dock centerline and abutment. Figures should be 2 in. (51 mm) high and permanent.

8-1.7.2 Location.

Marking plates must be laid out accurately. Set marking plates at the following points:

- One on each coping at the dry dock entrance.
- In both copings at approximately 50 ft (15.5 m) intervals from the dry dock entrance toward head end.
- One near the coping edge on the graving dock centerline, at the head end.
- One several feet back from the coping edge on the dock centerline, at the head end.
- One in the dock floor, several feet to one side of the dock centerline, sufficient to clear keel blocks, and at approximately 50 ft (15.5 m) intervals from the dry dock entrance coordinated with b) above.

8-1.8 Fenders and Chafing Strips.

To protect masonry structures at a dock entrance, or a caisson berth, provide fenders and/or chafing strips as required. Use fenders as necessary to protect equipment (such as stairways, ladders, floodlights, and service outlets) from being fouled by a vessel entering or leaving a dock. Generally, treated timbers anchored by bolts are used as chafing strips, but suitable, rotatable, pneumatic and rubber fenders may also be used. Refer to UFC 4-152-01 for design of fenders, and UFGS 35 59 13.14 20 for polymeric piles.

8-2 SHIP BLOCKING.

Responsibilities for design and material specification of ship blocking rests with the Naval Sea Systems Command (NAVSEA). The information herein is basic guidance; Consult NAVSEA for criteria beyond the planning stage.

8-2.1 Ship Supports.

Provide means to keep a docked vessel far enough above the floor to permit work on its keel, giving allowance for removal or installation of sonar domes, rudders, propellers, and similar parts. Blocking arrangements are laid out in the dock in accordance with the docking plan for each individual vessel.

8-2.2 Dog and Side Shores.

Long overhangs of vessels are frequently supported by shores. Shores are wedged against the ship bottom and/or its sides, either against dock wall altars or against the dock floor.

8-2.3 Keel Blocks.

Keel blocks are placed under the longitudinal centerline keel of the vessel. The exact location of the blocks depends on a vessel's docking plan. All keel block are interchangeable; therefore, each is designed for the maximum ship load likely to be imposed upon it at any location. Compression is the primary stress, but provision must be made to resist uplift, overturning, and horizontal movements induced by eccentric loads, earthquakes, or accidental impacts. Reinforced concrete stresses are not critical in design; grade of concrete and amount of reinforcement steel are selected to resist rough handling and temperature variations. Standard composite keel blocks (see Figure 8-2) were historically rated at 25 LT/sf (274 t/m^2), based on an allowable stress for wet timber in compression perpendicular to the grain taken at 250 psi (1.7 MPa) for soft caps. This allowed a reasonable safety factor. For the standard 6 ft (1.9 m) center-to-center keel block spacing, that rating represented a 37.5 LT/ft (125 t/m) ship load. Now, the safe allowable timber compressive stress for distributed loading, taken as the fiber stress at the proportional limit of Douglas Fir, is 370 psi (2.6 MPa). This assumes a uniform pressure over the entire 42 by 48 in. (1,067 by 1,219 mm) top of a docking block, resulting in a total load of about 330 LT (335.2 t). Most ships have narrower skegs and the allowable block loading is decreased accordingly. For allowable block

loadings for this condition, refer to NSTM Chapter 997, Docking Instructions and Routine Work in dry dock.

8-2.4 Bilge or Side Blocks.

Bilge or side blocks are composite or timber, built up, shaped, and located according to dimensions indicated in the table of offsets of docking plan of the vessel. These are designed for 250 psi (1.72 MPa) load applied uniformly over the effective bearing area in contact with the hull of the ship. Batten each block adequately for stability, and the resultant load reaction should fall within the middle one-third of the base dimension of the block on the dock floor.

8-2.5 Type of Construction.

Build composite blocks with wood top and bottom layers, and concrete sandwiched in between. Use sufficient concrete to make the blocks non-buoyant. Secure the wood layers to the concrete with steel bolts embedded in the concrete. U-bolts embedded in the sides of the concrete may be provided for lifting, or pipe holes may be provided through the blocks to insert pipes for lifting by forklift or crane rigging. All hardware (except dogs) should be zinc coated or cadmium plated. For a typical block, see Figure 8-2. For heavy loads, these blocks may be used double as indicated in Figure 8-2.

8-3 SUPPORTING FACILITIES.

8-3.1 Industrial Shop Facilities.

Shipbuilding graving docks and graving docks used for extensive repair, alteration, and the rebuilding of vessels must be supported by industrial shop facilities capable of manufacturing or otherwise supplying, installing, and testing the large number of items required.

8-3.2 Transportation Facilities.

A graving dock must be serviced by the following transportation facilities.

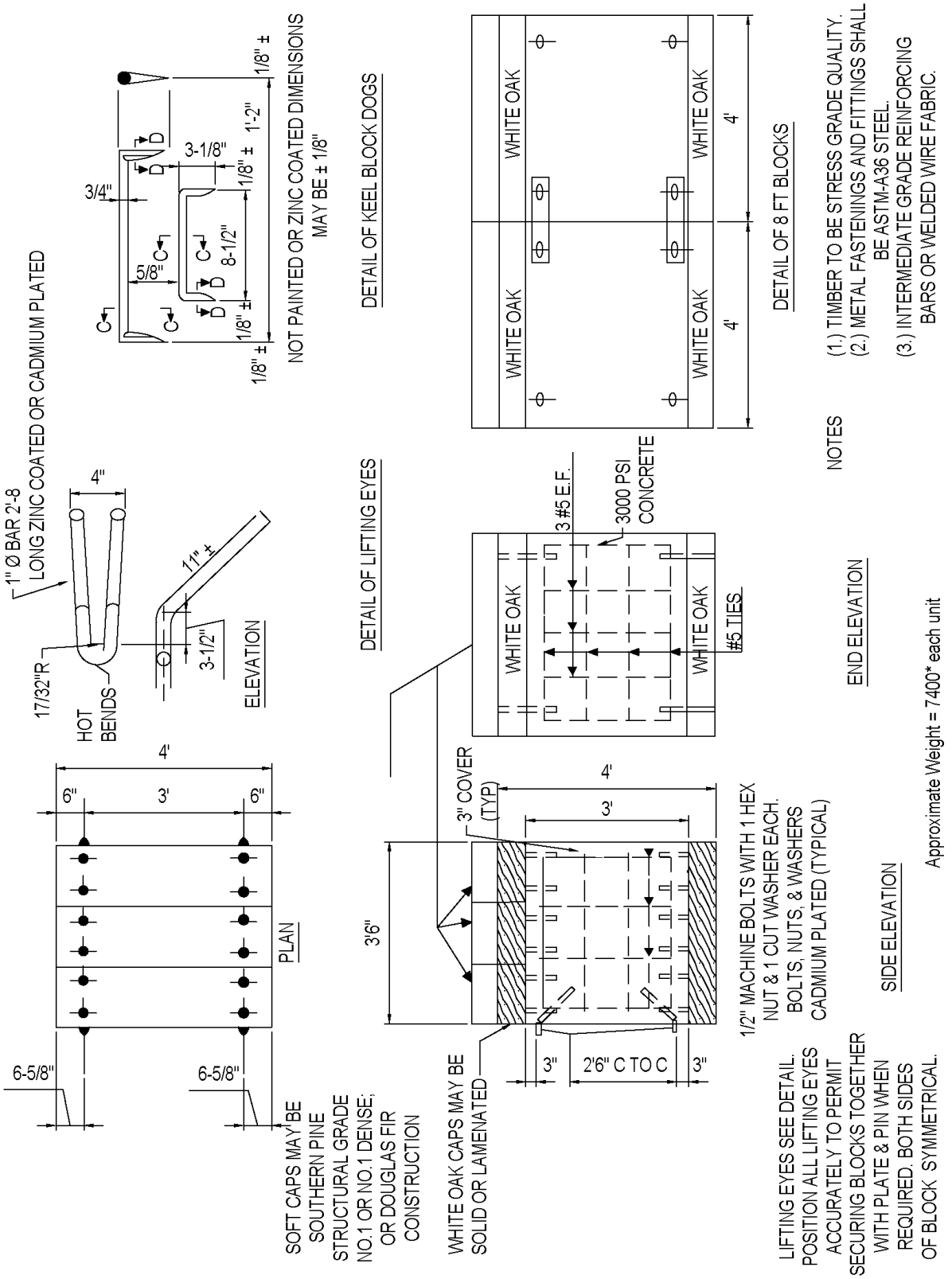
8-3.2.1 Paved Road Network.

This network provides access to the entire dock area and should be capable of carrying trailer trucks, flatbed trucks, mobile track cranes, truck cranes, and other heavy traffic.

8-3.2.2 Parking Facilities.

Provide parking as space permits clear of the graving dock operating areas.

Figure 8-2 Ship Blocks



8-3.2.3 Standard Gauge Railroad Track.

Where material for the graving dock operations are delivered to the yard by rail, a standard gauge track may be provided on either side of the dock. At the dock, locate this track between the portal crane rails nearest to the dock. This standard gauge track may also be used for the operation of locomotive cranes. At some yards, materials may be handled by heavy truck cranes instead of locomotive cranes, and railroad tracks may not be required. Use UFC 4-152-01 for track support design.

8-3.2.4 Portal Crane Track.

8-3.2.4.1 Location.

To minimize the required reach of dry dock cranes over a graving dock, locate crane rails as close to the edge of the coping as possible, but not nearer than about 5 ft (1.6 m). Because they must withstand high weight concentrations and shock loads, crane rails, unless supported directly on the dock walls, are usually supported by concrete beams on closely spaced piles, or by continuous spread footings generally tied in at intervals with the graving dock sidewalls. There are some locations where trackage may be supported by ties and ballast. Portal cranes may be designed to operate on either a two-rail track or a four-rail track. Space tracks far enough apart to allow passage of railroad and truck traffic between outer rails of pairs of rails.

8-3.2.4.2 Interchangeability.

To obtain maximum operational efficiency and economy, portal cranes should be interchangeable among the various yard facilities they might serve. As far as possible, incorporate the following features into a yard crane track layout:

- All portal crane tracks should have the same gauge as other yard crane tracks.
- When track consists of two pairs of rails, lay each pair at standard railroad gauge.
- Interconnect the various crane tracks.
- Provide spur track turnouts for repairing cranes.
- Provide a sufficient number of switches and passing tracks to permit individual cranes and other rolling stock to travel without interrupting the operation of other cranes.
- Refer to NAVFAC 11230.1 for track inspection, certification, and alignment procedure.

8-3.3 Weight and Materials Handling Equipment.

Small capacity locomotive or motor truck cranes are assigned to graving dock activities to supplement portal cranes. The locomotive cranes operate on the standard gauge railroad track.

8-3.3.1 Portal Cranes.

These cranes are constructed on portal frame bases that travel on wide gauge (20 to 30 ft (6.2 to 9.3 m)) tracks. Capacities and reach should be as specified for each individual project.

8-3.3.1.1 Clearances.

Clearances must be such as to permit complete rotation (360 degrees) without interference with the ship in dry dock, buildings, or other structures. Cranes and track layout must be carefully studied to ensure adequate clearances in the way of overhanging deck structures of aircraft carriers. For carrier docks, provide two sets of tracks on each side of the dock, one of conventional arrangement with rail near the edge of the coping, and one outboard at a distance sufficient for the crane to clear the flight deck of the carrier.

8-3.3.1.2 Power Drive.

Portal cranes may be powered by self-contained diesel electric drive or all electric.

8-3.4 Personnel Facilities.

Provide facilities such as lavatories, showers, and lunchrooms near the graving dock.

8-3.4.1 Lavatories.

Provide lavatories fairly close to the graving dock. They should contain toilets, urinals, washbowls, showers, first aid equipment, and perhaps equipment lockers. They should be large enough to accommodate the normal complement of the yard crew working in or around the graving dock, and the crew of any docked vessels. When the sanitary facilities of a docked vessel are being worked on, they are very often unavailable for use; therefore, separate dockside facilities are often reserved for use by the vessels officers and crewmembers on duty.

8-3.4.2 Lunchrooms.

Provide an appropriate type lunchroom near the graving dock.

8-3.4.3 Quarters for Ship’s Crew.

When extensive repairs or alterations are performed on a vessel in active service, work is often carried on around the clock. The accompanying noise and construction activities

may prohibit habitation on the vessel. Under these conditions, provide quarters ashore, or berthing barges for the use of the officers and crew of the ship.

8-3.5 Storage Facilities.

Provide storage space to house the infrequently used dock gear, such as hawsers, cables, rafts, floats, fenders, portable communication equipment, and portable floodlights.

8-4 MECHANICAL SERVICES.

Ships in graving docks are unable to fill their own requirements for mechanical services essential for work, habitation, comfort, and protection. These services, and those required for repairs and cleaning associated with the docking operations, must be supplied from dockside facilities. Such services include steam, compressed air, water, Wheeler system, oxygen, acetylene, and sewage disposal. Utility requirements for specific ship classes is provided in UFC 4-150-02.

8-4.1 Pipe Galleries and Tunnels.

Carry service pipes, in tunnels, utilidors, or in galleries at the top of the dock sides. The open type gallery is desirable and should be used unless prohibited by some compelling reason or when steel is attached to the wall.

8-4.1.1 Design.

Design the gallery to be approximately 7 ft (2.2 m) high, and recessed 4 ft (1.2 m) or more into the dock wall. Provide a wall on the dock side approximately (2-1/2 ft (0.8 m) high, topped by a low railing for safety of personnel in the gallery (3-1/2 ft (1.1m) fall protection barriers).

8-4.1.2 Service Line Location.

Mount service lines on the walls and ceiling of this galleries and pipe tunnels.

8-4.1.3 Advantages.

Open type galleries have the following desirable features:

- Safer to work in than on an altar
- Better lighting
- Ample working space
- Ample room for addition of services
- Accessibility to all outlets along the dock.

8-4.1.4 Outlets.

Locate service outlets in accordance with criteria in UFC 4-150-02.

8-4.1.5 Looped Pipelines.

Sectionalize and valve all liquid, steam, and gas lines to provide service with a minimum of interruption of work should a break occur along any line.

8-4.2 Fresh Water.

For industrial use, and with an abundant supply, it may be used to fill fire protection, flushing and cooling requirements. In cold climates, waterlines must be protected from freezing. Provide meters to record water consumption. All fresh water outlets must have a backflow preventive device, and be painted as specified in UFC 4-150-02, for services on piers.

8-4.2.1 Potable Water.

Provide one 2-1/2 in. (63.5 mm) valved outlet at each service gallery, and size the mains to adequately provide the required quantity of distilled or potable water at a residual pressure of 40 to 80 psi (276 to 551 kPa) at any outlet. The quantity of water required by dry docks is contained in UFC 4-150-02.

8-4.2.2 Flushing and Cooling.

Flushing/cooling systems are to be part of the fire protection systems where high pressure fire protection systems are provided, including the following:

- If a graving dock is provided with fire hydrants only outside the dock, as fire protection, install the flushing/cooling systems separately.
- Provide one 2-1/2 in. (63.5 mm) valved outlet in each service gallery.
- Supply the quantity of water required for flushing and cooling to the most remote flushing/cooling outlets at not less than 40 psi (276 kPa) residual pressure. Connect systems either to station pumps or to separate graving dock pumps having a minimum discharge pressure of 150 psi (1034 kPa). The required quantities for combined flushing, cooling and fire protection are contained in contained in UFC 4-150-02.

8-4.3 Salt or Non-potable Water Supply.

When fresh water is not abundant, use salt or non-potable water system for flushing, cooling and fire protection.

Provide salt or non-potable water service to the dry dock to meet cooling, flushing, auxiliary seawater and fire protection requirements. Flow rates and pressures are

governed by other documents. Refer to UFC 4-150-02, MIL-STD-1625 and NAVSEA 8010.

8-4.3.1 Station System Connection.

Where a graving dock fire protection system is connected to station fire protection and flushing/cooling systems, make connection through a valved check valve and a valved pressure reducing valve in a bypass permitting the station system to supply flushing/cooling water to the dock system. This arrangement also permits the graving dock fire protection pumps to augment the station system in emergencies.

8-4.3.1.1 Alternative Arrangement.

If this arrangement is not possible, install flushing/cooling pumps with minimum discharge pressures of 150 psi (1034 kPa) at most remote outlet. Arrange graving dock fire pumps in parallel operation for flushing and cooling, and arrange series operation for standby fire protection.

8-4.3.1.2 Fire Pumps.

Redundancy must be provided such that the required flow rate and pressure can still be provided after the loss of any single fire pump and/or the loss of the normal system power supply. Standby diesel fire pumps are normally provided to meet this requirement. Fire pump installations must conform to the provisions of NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*.

8-4.3.2 Type of Piping.

All piping for graving dock fire protection systems must be cement lined AWWA ductile iron pipe, class to suit required fire pressures, with lugged and rodded joints and fittings (except the pipes in pumpwells and service galleries should be flanged). Any joint of equal strength may be used, subject to the approval of the cognizant Service.

8-4.3.3 Pipe Sizes.

Where station systems are connected to dry dock systems, pipe sizes from station pumphouse to docks should be generous enough to provide pressures for dry dock flushing and cooling requirements.

8-4.4 Wastewater Collection.

Segregation of sanitary sewage, industrial wastewater and hydrostatic leakage water is required. Dry dock and ship sewage will be collected and discharged into the station sewerage system. Hydrostatic leakage not mixed with industrial waste is not polluted, therefore can be pumped into receiving waters, except at locations where local environmental regulations forbid it. Refer to local regulations.

8-4.4.1 Sanitary Sewer System.

All sewage and hotel wastes from ships in dry dock must be collected and transported to a treatment plant. Preferably, locate a sewer main on each side of the dock. Discharge of all sewage to a main on only one side of the graving dock should be considered if local circumstances dictate. Provide receiving manifolds located along the coping of the graving dock and connect to the main sewer through laterals. Transport sewage from the ship to the manifold receiving connection by way of a hose. Design the sewer system to meet peak flow rates from the largest ship class for which the dry dock is designed. These are contained in UFC 4-150-02. For additional design criteria refer to UFC 3-240-01, *Wastewater Collection and Treatment*.

8-4.4.1.1 Receiving Hose Connections.

Space the receiving hose connections approximately 300 ft (93 m) centers. The spacing may be varied to suit docking conditions in a specific dry dock. Locate the hose connections between the edge (coping) of the graving dock and the crane track to eliminate any interference with the operation of the cranes. Make each connection 4 in. (102 mm) diameter and install an in-line check valve to prevent backflow.

8-4.4.1.2 Laterals.

Laterals between the receiving hose connections and the main sewer must have a diameter of 4 in. (102 mm). Where possible, the laterals should be located in the dry dock service and pipe galleries to minimize installation costs and to facilitate maintenance. Pitch laterals to drain to the main sewer. Consider local conditions for the optimum location of the laterals.

8-4.4.1.3 Main Sewers.

Size main sewers to receive ship discharges plus any other flow entering into the collection system. Main sewers should be located in the pipe galleries or beyond the structural concrete of the graving dock. Consider local conditions for the optimum location of the main sewers. Main sewers should be gravity sewers and slope toward the inboard end of the dock and connect to the station sewer system or to a pump lift station. Use a force main where it is impracticable to install a gravity sewer. Locate sewer cleanouts in the main sewers at a maximum spacing of 300 ft (93 m).

8-4.4.1.4 Ship-to-Dock Transfer System.

Ships outfitted with CHT systems discharge sewage under pressure on the lowest weather deck. Ships not outfitted with CHT systems will discharge through existing outlets in the hull. For ships not outfitted with CHT systems, a temporary system for collecting sewage from multiple outlets must be installed.

- Auxiliary Pumping: Gravity dry dock sewer systems may require auxiliary pumping when the ship’s discharge point is below the level of the top of dry dock wall. The facilities required for auxiliary pumping include hose,

portable wet well, and pump. Use a 4 in. (102 mm) sewage hose to transfer sewage from the ship or portable pumping unit to the dry dock sewer system. Refer to Figure 8-3.

- Collection System and Components: The temporary collection system for ships not outfitted with CHT system, and the auxiliary pumping system components, are collateral equipment to be furnished by the shipyard.

8-4.4.2 Industrial Wastewater Collection.

Collect and treat industrial wastewater, including runoff and hydrostatic leakage that come in contact with industrial waste, such as sand blasting grit and organotin paint chips, as necessary, prior to discharge. Refer to UFC 3-240-01.

8-4.5 Steam.

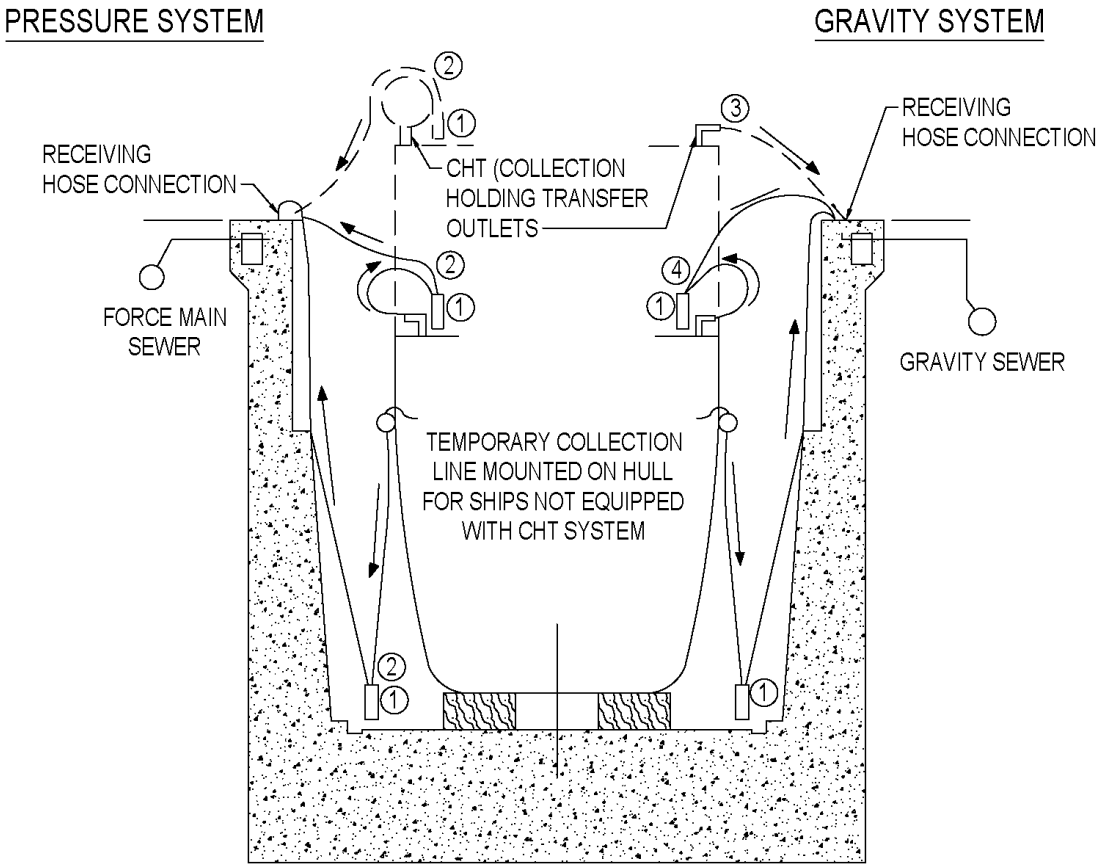
Steam may be required in a graving dock for heating, cleaning equipment and tanks, and ship use. In northern latitudes, provision must be made for heating those areas in which personnel must remain for lengthy periods, such as pump rooms, motor rooms, caissons, toilets, and shower rooms. Use steam for deicing and for keeping necessarily exposed fresh waterlines from freezing. Freezing may sometimes be prevented by running a parallel steam line.

8-4.5.1 Quantity.

Exact quantities of steam to be furnished to the ship are difficult to determine. Changes in ship designs, variations in ships of the same class, and differences in repair operations make close estimation of steam demand loads purely academic. On the other hand, providing sufficient steam to take care of the total maximum demand load that could occur under the worst conditions would result in a grossly over-designed and expensive system. UFC 4-150-02 gives the design steam demand for various ships.

Use engineering judgment to determine actual working values depending on the concurrency or nonconcurrency of other steam loads for the dry dock complex, frequency of docking of maximum ship, and effect of multiple docking. High-pressure steam for test operations is usually provided from portable generators. Consider planning for temporary portable steam generators that would utilize shipyard local power and potable water as supply.

Figure 8-3 Schematic of Conditions for Portable Sewage Pumping Systems in Graving Docks



① INDICATES PORTABLE WET WITH SUBMERSIBLE PUMP

② PUMPING MAY BE REQUIRED FOR ENTRY INTO PRESSURIZED SYSTEM

③ NO PUMPING REQUIRED WHEN CHT DISCHARGE IS ABOVE RECEIVING CONNECTION

④ PUMPING MAY BE REQUIRED WHEN CHT DISCHARGE IS BELOW CONNECTION

NOTE: THE TEMPORARY COLLECTION SYSTEM, HOSE, PUMP AND WET WELL ARE COLLATERAL EQUIPMENT TO BE FURNISHED BY THE SHIPYARD

8-4.5.2 Steam Mains.

If steam service is required, provide graving docks with steam mains on at least one side of the dock. Size the pipe supplying the mains to provide a carrying capacity equivalent to that of the two dock mains. For example, a 6 in. (152.4 mm) mains. Base the determination of equal carrying capacities on a table of equalization of pipes. Refer to UFC 3-430-09. The number and location of steam branch outlets vary from three to six per side, depending on the size of dry dock. Provide a suitable flanged valve provided with a blind flange for each branch outlet. Size mains and branch outlets for steam service, unless specifically directed otherwise, in accordance with the following:

8-4.5.2.1 Submarine and Destroyer Docks.

For both single and double width docks, use 4 in. (102 mm) main and 2-1/2 in. (63.5 mm) outlets.

8-4.5.2.2 Cruiser, Auxiliary, and Carrier Docks.

Size mains according to quantity of steam carried and the permissible pressure drop. Outlets should be 2-1/2 in. (63.5 mm). Provide carrier docks with an additional 4 in. (102 mm) outlet, located at the center group of service outlets on each side of the dock, for feeding ships with 4 in. (102 mm) steam shore connections.

8-4.5.2.3 Piping.

Steam piping must be in accordance with the provisions of UFC 3-430-09 concerning steam distribution systems. Condensate return piping usually is not required, but should be provided when recovery of the condensate is economically desirable or when dictated by special project requirements.

8-4.5.3 Insulation.

Steam lines must be thoroughly insulated from source to outlets.

8-4.6 Compressed Air.

Compressed air is required in a graving dock for tools and sandblasting.

8-4.6.1 Quantity.

Determination of required quantities is dependent on the operations to be performed and ranges from 3,500 to 8,000 ft^3/min (1.7 to 3.8 m^3/s) for small and large docks, respectively.

8-4.6.2 Mains.

All classes of graving docks should have mains on both sides of dock.

8-4.6.3 Outlets.

Base number and location of outlets on service air requirements for hull maintenance. Provide a suitable flanged valve provided with a blind flange for each branch outlet. Do not use plug valves

8-4.6.4 Size of Main and Outlets.

Size of mains and outlets as shown in Table 8-1 must be as follows:

Table 8-1 Size of Main and Outlet

Dock	Main inch (mm)	Outlet inch (mm)
Submarine and Destroyer	4 (102)	2.5 (63.5)
Cruiser	6 (152)	2.5 (63.5)
Auxiliary	6 (152)	2.5 (63.5)
Carrier	6 (152)	3 (76.2)

8-4.6.5 Piping and Fittings.

Piping and fittings must conform to the requirements of UFC 3-430-09.

8-4.6.6 Air Pressure.

Air pressure at branch outlets should be 100 psi (689 kPa) unless otherwise specified in project criteria. High-pressure air for testing 3,000 to 4,500 psi (2067 to 3101 kPa) should be described in project requirements and may be portable equipment.

8-4.7 Oxygen and Acetylene.

Oxygen and acetylene are required for cutting metals, brazing, heating, and welding operations. Graving docks are, for the most part, not equipped with a central oxygen and acetylene distribution system, and consequently are supplied from individual portable tanks (bottles or cylinders). The provision of a central distribution system should be considered in a new dock construction and in existing docks where large quantities of these gases are required. If distribution systems are planned, use the criteria below.

8-4.7.1 Location of Piping.

Never run mains for these gases in a pipe tunnel or an enclosed or partly enclosed service gallery, because of the extreme hazard involved. Locate both mains and outlets above extreme high water to prevent contact with oil floating on the water surface during flooding of the dock. Mains are best located in a special open slot formed as an integral

part of the coping curb, or placed on the wall of the dock below the coping elevation, and protected from damage by a heavy fender member.

Place service outlets under open protective hoods above the coping level or on the inner faces of the coping line. Temporary connections to the dock floor may be made after each dewatering if distribution to the floor level is required.

8-4.7.2 Oxygen.

For oxygen piping, use standard weight, black steel, seamless tubing with beveled ends for welding. Pipe should be factory washed.

8-4.7.2.1 Sizes.

Provide these ranges of sizes, unless required otherwise:

- main from supply to side of dock, 2 to 3 in. (50.8 to 76.2 mm)
- distribution piping around the dock, 1-3/4 to 2-1/2 in. (44.5 to 63.5 mm)
- extensions to outlets 3/4 to 1 in. (19.1 to 25.4 mm).

It is standard practice to reduce the pipe size serving the more remote outlets in accordance with the reduction in volume of gas to be delivered.

8-4.7.2.2 Valves.

Use globe type shutoff valves, 400 psi (2,756 kPa), cold, non-shock gas working pressure. Prefabricate valve assemblies in the shop to minimize the possibility of leakage after fabrication.

8-4.7.2.3 Joints.

Use tinned threaded joints, made up with litharge and glycerin.

8-4.7.2.4 Testing.

Before outlets are attached, subject each section of line to a pressure air test at least 1.5 times the working pressure.

8-4.7.2.5 Identification.

Paint oxygen piping green and mark outlet valves “FOR OXYGEN.”

8-4.7.3 Acetylene.

For acetylene piping, use standard weight, black steel with beveled ends for welding.

8-4.7.3.1 Sizes.

Generally, provide these ranges of sizes:

- main from supply to side of deck, 1-1/2 to 2-1/2 in. (38 to 63.5 mm)
- distribution piping around the dock, 1 to 2 in. (25.4 to 51 mm)
- extensions to outlets, 3/4 to 1 in. (19 to 25.4 mm).

8-4.7.3.2 Valves.

Use forged or cast steel of the lubricated plug type cutoff valves.

8-4.7.3.3 Testing.

After fabrication, but before attaching outlet equipment, pressure test each section of line to at least 1.5 times the working pressure.

8-4.7.3.4 Identification.

Paint acetylene piping yellow and mark the outlet valves “FOR ACETYLENE.”

8-4.7.4 Supply.

If not supplied in portable tanks, the required supply of oxygen and acetylene may come from an existing yard system or be produced by stationary generators.

8-4.7.4.1 Alternate System.

If an existing system is not available, the choice between installation of stationary generators or banks of tanks will depend on the volume of gases required, estimated on both daily and weekly consumption rate. Where an appreciable volume of gas is required per week, it may be produced by stationary generators more economically than if supplied by tanks.

8-4.7.4.2 Building Design.

Buildings housing either tanks or generators should be of light steel construction and located at least 50 ft (15.5 m) from any adjacent structure or operation.

8-5 ELECTRICAL SERVICES.

8-5.1 Electrical Conduits.

Keep electrical circuits separate from service piping. They may be placed in concrete encased ducts behind the dock wall or, for large dry docks, in a separate tunnel shoreward from the pipe tunnel or gallery. Secondary electric power distribution lines are sometimes placed in supplementary utility tunnels, separate from immediate dry dock outlet system.

8-5.1.1 Support.

Wherever electric cables in underground installations are mounted on wall racks, support the cables away from the wall to allow leakage water to pass by.

8-5.2 Substations.

One or more electrical substations are required per UFC 4-150-02 to provide for conversion and distribution of electricity at the required voltages and capacities for ship services, and for operation of dock supporting facilities. Use mobile or portable transformer units to supply occasional high demand loads, and for testing nuclear vessels. Provide suitable protected primary feeder terminations at appropriate locations for portable design guidance.

Two feeders should be run to the pumphouse, in the event that the main feeder goes down. They should be fed from two separate power sources.

Install a back-up stand-by diesel power generator near each pumphouse to run at least the drainage pumps and alarms in the event all electrical power is lost. Consider sea level change and EHW for elevation of substations and generators.

8-5.2.1 Design.

A single substation may be incorporated into the pumpwell machinery room or, for a large dry dock, one may be required on each side of the dry dock, and not necessarily in the pumpwell machinery room.

8-5.2.2 Power Service Outlets.

Power must be conducted from the substation to dockside capstans, lights, and other necessary outlets, through cables in ducts run from manhole to manhole. The outlets should be weathertight and above mean high water. Make provisions for draining this secondary underground electric distribution system. Refer to UFC 4-150-02 criteria for outlets for ship services and portable equipment, and recommended design of electrical distribution systems.

8-5.3 Power Uses.

Electric power is required for the following:

- Pumps (see paragraphs 8-5.7.1, and 8-5.7.2)
- Sluice gates and valves (see paragraph 8-5.7.3)
- Capstans and winches (see paragraph 8-1.1.2)
- Lighting (dry dock, laydown area and pumphouse) (see paragraphs 8-5.7.8, 8-5.8.2.1, and 8-5.8.4)
- Ship services (see paragraph 8-5.8.1)

- Permanent Loads and Industrial Power (see paragraph 8-5.8.2)
- Telephones (see paragraph 8-5.7.9)
- Alarm systems (see paragraphs 7-2.8, 8-5.2, 8-5.8.3, 9-3.5.3, and 9-3.5.4)
- Control systems (see paragraphs 8-5.7.6, 8-5.7.7, 9-3.5.1, and 9-3.5.2)
- Welding machines (see paragraph 8-5.8.2.2)
- Battery charging (for some submarine requirements, see UFC 4-150-02.
- Heating, ventilating fans and air conditioning (see paragraph 7-4.13)
- Caisson (see paragraph 9-3.5.2)
- Elevators (as required by operations).

8-5.4 Methods of Installation.

Install outlets for servicing the vessels in the galleries on the sides of the dock, with other services. Carefully place outlets to facilitate connecting ships to the shore cables. All outlets, if subject to flooding, must be the watertight receptacle type. Provide a grounding system with connections in each service gallery.

8-5.5 Power Requirements.

Estimation of total power requirement calls for a careful analysis of the occurrence of simultaneous power uses listed in Section 8-5.3 entitled “Power Uses”.

8-5.5.1 Individual Requirements.

Correlate individual requirements by preparing a schedule of probability of usage. For assistance in formulating a schedule, refer to UFC 4-150-02 that shows ship service power and welding requirements for the various classes of vessels. These values are only indicative of range, and may be influenced by special requirements peculiar to any given installation. Meet the direct current welding requirement with portable converters rather than a fixed direct current bus system.

8-5.5.2 Special Requirements.

The project scope will specify any special power requirements. The total requirements for the electrically supplied supporting facilities must be estimated from the final design capacity of various installations.

8-5.6 Pumping Plant.

All electrical equipment in pumping plants must be a type suitable for installation in damp, humid atmospheres. Provide electrical heaters in large motors and switchgear to minimize condensation. The power distribution equipment should be a coordinated assembly of switchgear. Assemble the controls for all pumps, gates and valves, and the valve position indicators in a suitable panel or benchboard unit.

8-5.7 Power Demand Range.

The following tabulation presents probable range of electrical power demand for pumping the several classes of graving docks and is shown in Table 8-2. These figures may be used for preliminary purposes of study and/or design but are only indicative of the ranges to be expected.

Table 8-2 Range of Power Demand for Graving Docks

Class of Dock	Range of Power demand hp (kW)
Submarine	1,005 to 1,675 (750 to 1,250)
Destroyer or Frigate	1,273 to 1,742 (950 to 1,300)
Cruiser	1,742 to 4,020 (1,300 to 3,000)
Carrier & Auxiliary	4,690 to 6,700 (3,500 to 5,000)

8-5.7.1 Main Pump Motors.

Main pump motors should generally be of the wound rotor induction type, with starting resistance steps provided in the secondary windings, except where variable pitch impeller type pumps are used. In this latter case, use synchronous motors with reduced voltage starting where required. In general, operate these motors on a minimum of 2,400 volts, and at greater voltage where economically sound. Use drip-proof construction, and provide space heaters to heat the windings to approximately 5 °F (3 °C) above the ambient room temperature whenever the motor is disconnected from its voltage supply.

8-5.7.2 Drainage Pump Motors.

Drainage pump motors should be of the squirrel cage induction type, operated at 480 volts and at higher voltage where economically sound. Provide reduced voltage starting when required by design conditions. Provide drip proof construction and space heaters for the windings of the pump motors.

8-5.7.3 Other Motors.

Provide sump pumps, sluice gates, gate valves, sewage pumps, and ventilation fans operating at 460 volts. Motors should be drip proof or totally enclosed.

8-5.7.4 Switchgear.

Install high voltage protection and distribution equipment in a steel-enclosed, dead front assembly of switchgear. Carefully coordinate interrupting ratings of the gear with the systems to which connection is to be made. Construction should be drip proof, and space heaters should be provided to maintain the compartments of the switchgear approximately 5 °F (3 °C) above the ambient room temperature when the pumping plant is not in use.

8-5.7.5 Grounding.

Provide grounding systems for all electrical equipment frames, enclosures, and conduit systems.

8-5.7.6 Control Voltage.

Control voltage for all electrical equipment should be either 115 or 230 volts.

8-5.7.7 Control Panel.

Assemble pushbuttons and indicating lights for all pumps, gates, and valves (in addition to the synchronous position indicator for each valve and the dry dock water level indicator) on a steel control panel or benchboard type structure. Provide motor control on or adjacent to the starting equipment for each motor.

8-5.7.8 Lighting.

Provide vaporproof LED fixtures. Provide receptacle outlets at strategic locations for use during repair and inspection.

8-5.7.9 Telephone.

Provide telephone outlets at or near the control panels. Consider systems to support data, cybersecurity, and cell phone signal in pumpwell.

8-5.7.10 Installation.

All electrical installation should be in accordance with the requirements of NFPA 70, National Electrical Code. Use rigid steel type conduit. Plastic coated rigid steel conduit should be used where the conduit is exposed and subjected to flooding. Galvanized, rigid steel conduit should be used where the conduit is exposed but not subjected to flooding. Concrete encased conduit should be Schedule 40 PVC. Use cables in accordance with the latest revisions of the Uniform Facilities Guide Specifications (UFGS) Division 26, *Electrical*.

8-5.8 Dock Services.

Services are required as described in the sections below, as specified.

8-5.8.1 Ship Services (Hotel).

Power for ship services is supplied to provide the living requirements of the ship's crew, and includes loads such as lighting, cooking, pumps, fans, and other equipment. Current characteristics of the system must be the same as that of the ship supplied. Power is taken to the ship with portable cables, and connected to its electrical system through a connection box at one or more ship service outlets, which are located as indicated for each ship class in UFC 4-150-02.

8-5.8.2 Permanent Loads and Industrial Power.

Other electrical equipment such as dock lighting, receptacles, weight handling equipment ,and industrial power should be supplied from dedicated 480Y/277 Volt transformers.

8-5.8.2.1 Temporary Lighting and Power.

Design temporary lighting and power systems to supply 120-volt, 1-phase power for portable tools, lights, blowers, and other equipment used aboard the ship for repair.

8-5.8.2.2 Welding.

Provide welding service by both single- and multi-operator welding sets. The multi-operator sets are generally placed on shore, and single operator sets are placed on board ship or, if space permits, on shore. Large size welding sets are motor driven. The small sizes are either motor generator or static types. All types should be 480-volt operated. The base welding power should provide 75 percent of the total demand, and the single operator placed either aboard ship or on shore should supply 25 percent of the total demand.

8-5.8.2.3 Welding Power.

Provide power for welding equipment should from the Industrial power Cam-lok receptacles.

8-5.8.2.4 Electric Lines.

On small docks, electric lines are placed in ducts encased in concrete on the land side of the walls. For large docks, where the electrical requirements are great, place lines in a separate concrete electrical tunnel on the land side.

8-5.8.3 Fire Alarm Service.

For fire alarm system design and installation, refer to UFC 3-600-01.

8-5.8.4 Lighting.

All lights in the dry dock should be centrally controlled and the lighting intensity on the work surface should be not less than 10 foot-candles (107.6 lux).

8-5.8.4.1 Temporary Lighting.

Consider the minimum lighting requirements in 29 CFR 1915.82(a)(2) and supplementation lighting requirements in 29 CFR 1915.82(a)(4) for minimum foot candle lighting levels.

8-5.8.4.2 Night Lighting.

Provide adequate lighting on the walls of the dry dock for night work and, for daylight work, in high sidewall dry docks where daylight lighting is often impaired.

8-5.8.4.3 Types.

These lights may be of the submersible or non-submersible type. If the latter, they must be kept above the dock flooding level. If of the former type, they may be placed at a lower level, and sometimes at two levels for deeper docks.

8-5.8.4.4 Location.

Place lights on mounts to permit training and elevating, and locate at suitable intervals horizontally. They must be placed in niches or protected by cages.

8-5.8.4.5 Floodlighting.

Fabrication and material storage areas around the dock generally are lighted by banks of floodlights mounted on portable or fixed towers, or on sides of buildings. The lighting intensity for these areas should be about 10 foot-candles (107.6 lux). Portable towers should be connected to Industrial power receptacles.

8-5.8.4.6 Emergency Lighting.

Provide emergency lighting in accordance with in 29 CFR 1915.82(c)(1) and 1915.82(c)(2).

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CHAPTER 9 ENTRANCE CLOSURES

9-1 SELECTION.

This chapter contains basic data for criteria to design and construct entrance closures, including various types of gates and caissons. Advantages and disadvantages of each type are discussed.

9-1.1 Requirements.

Basic requirements in the choice of entrance closure are reasonable initial costs, ease and rapidity of control, low maintenance, and feasibility of traffic movements across the top.

9-1.2 Types.

A review of available types reveals why floating caissons have been adopted as standard for Navy dry docks. Other types may be suitable for smaller, temporary, nonmilitary dry docks.

9-1.2.1 Miter Gates.

Miter gates were probably the first satisfactory mechanical gates. Each closure consists of a pair of gate leaves, hinged at the dock walls, swinging horizontally so when closed the free ends meet in fitted contact. Gates are moved by means of a hawser to a nearby power capstan. The sides and bottoms bear against seats in the dry dock walls and floor. This type of gate is suitable for timber construction and steel; however, they are now no longer commonly used.

9-1.2.2 Hinged Gates.

A flap gate is a rigid, one-piece gate hinged at its bottom, and swinging downward and outward. It is a compartmented structure with means for varying its buoyancy for raising and lowering. Although this type of gate does not impose such severe loads on the hinges as the miter gates, it has similar disadvantages except those of recesses. Means must be provided to support a gate when down in open position.

9-1.2.2.1 Foster Hinged Gate.

This type of gate was a commercial device developed by C. J. Foster, Inc. It was a structure that could be folded, and that did not require transverse girders between the sidewalls of the dock. It was designed for unlimited widths and depths to suit dock conditions. Reaction due to water pressure on the gate was distributed to the floor slab of the dock. Massive abutments were not required to support the ends of the gate.

9-1.2.3 Set-in-Place Gates.

Set-in-place gates are in various forms and may be built in one piece or multiple sections. They are of beam and plate construction, with reactions carried to the walls by girders and to the floor by beams. Since their placement and removal must be done by weight handling equipment, the sizes of cranes required for naval dry dock closures makes this type of closure unpractical.

9-1.2.4 Sliding and Rolling Caissons.

These types are built-in box shapes, mounted on hardwood sliding surfaces or metal rollers that move them into or out of place. They may be equipped with air chambers for buoyancy which reduce the work of moving. They have some advantages of a floating caisson but require expensive recesses in dock walls for stowage. Cleaning and maintenance of the roller or slide paths are difficult.

9-1.2.5 Floating Caissons.

Floating caissons are watertight structures with flooding and dewatering systems for operation. For design of hull, floating stability, and all operational purposes, they are symmetrical both transversely and longitudinally. See Figure 9-1 and Figure 9-2 for typical design and hull elements of a floating caisson with flood through capability.

9-1.2.5.1 Advantages.

- The cost is reasonable, since practically all of the hull elements function structurally.
- A caisson may be handled easily and is seaworthy for towing to other sites (to another dry dock for repair) or from its construction site to point of use.
- It may be used at more than one seat in the same dry dock or other dry docks.
- Its symmetrical form allows reversibility with either side toward the dock chamber, permitting maintenance and repair on exposed side.

9-1.2.5.2 Disadvantages.

- The time for closing and opening the dock entrance is slower than for other types of closures.
- Because of shore service connections (electric and sometimes air), it is not operative too far from the caisson seat.

Figure 9-1 3D Perspective View of Caisson

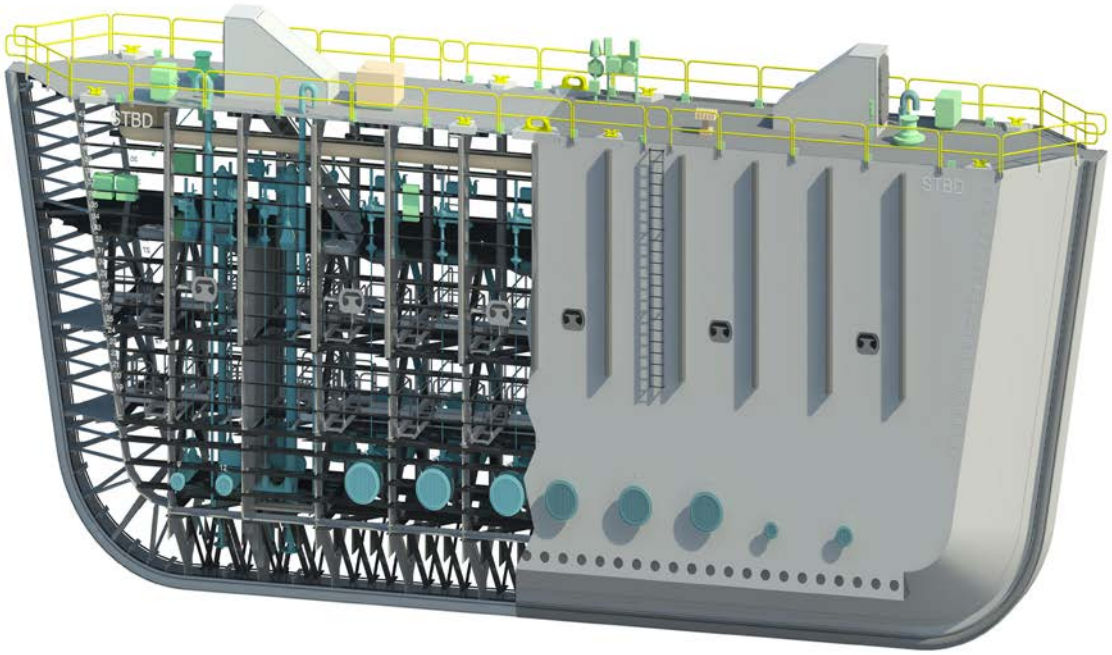
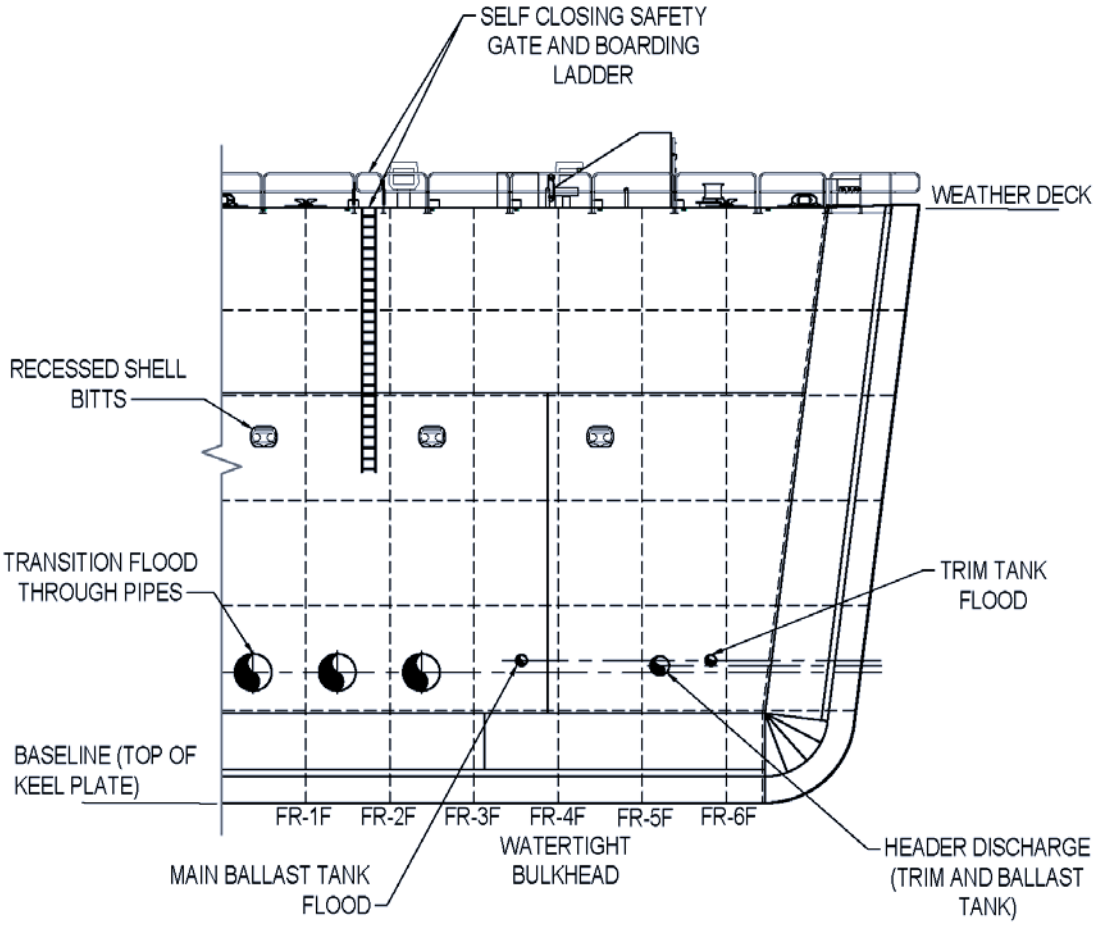


Figure 9-2 Hull Elements



9-2 DESIGN OF FLOATING CAISSONS.

9-2.1 Application.

The following paragraphs describe types of floating caissons, their operation, and materials of construction.

9-2.2 Requirements.

Caissons must allow reasonably rapid opening and closing of the dock entrance at any tide stage, be stable transversely and longitudinally at any draft, have strength and other characteristics to resist water pressure, and provide watertight seal when seated.

9-2.3 Types.

Floating caissons are usually one of the four types described below.

9-2.3.1 Ship Type Caisson.

This type has a faired shape similar to the lines of a ship. The required curvatures for frames and plates make the construction uneconomical, and it is now outmoded.

9-2.3.2 Hydrometer Type.

This type has a narrow width over as much of the height as possible between its waterline at extreme light draft when afloat and its waterline at mean high water when seated. This reduces the amount of adjusted water ballast during lowering and raising for seating and unseating operations.

9-2.3.3 Box Type.

This type is constructed in the shape of a box, with vertical or sloped ends to suit the seat shape. The girder ends project from the box to bear against the seats built in the dock side walls.

9-2.3.4 Rectangular Type.

This type is similar to the box type. It has simplified internal and external welded construction. All body girders and breasthooks are completely enclosed by the plating. All modern designs have been of this type.

9-2.4 Ballast Control.

The draft of caissons is adjusted for seating, unseating, and towing by flooding or pumping out water ballast. (Refer to Section 9-2.7 entitled “Machinery” for ballast control).

9-2.5 Operation.

Operation is functional as applied to the design objectives. Detailed operational instructions must be supplied for each installation but are, in general, as described in the two sections below: “Opening the Entrance” and “Closing the Entrance”.

9-2.5.1 Opening the Entrance.

To open the entrance, the procedure is as follows:

- In preparation for lifting the caisson from its seat, the water level inside the graving dock must be raised to the water level outboard the caisson, by flooding the dock basin.
- Caisson dewatering pumps are started; then with the discharge valves open and sufficient water ballast removed, the caisson floats off the seat. Pumping is continued until desired draft is obtained. The caisson in operation is very rarely pumped up to light draft.
- After the discharge valves are closed and secured, and the machinery is shut down, the caisson is warped out of the graving dock entrance channel limits by capstans and/or tugs. The caisson weather deck is fitted with chocks, bitts, and cleats for line attachment.

9-2.5.2 Closing the Entrance.

To close the entrance, the opening operation is reversed, except that ballast tanks are filled by opening flooding valves to let in water. During submergence, the caisson must be positioned correctly with respect to seats, and must have negligible list or trim.

9-2.6 Materials of Construction.

Modern caissons are built of welded steel.

9-2.7 Machinery.

The main machinery of a floating caisson consists of dewatering pumps and flooding, dewatering, and equalizing valves to control the water ballast. Design the ballast control system so that complete control of trim may be maintained during submerging and raising operations. The pumps are driven by electric motors powered through cables attached to shore connections located near the caisson seat at coping. Compressed air, when used, is also obtained from shore connections, through air hose.

9-2.7.1 Auxiliary Machinery.

Auxiliary machinery may include electric fans, motorized dry dock flooding valves, and an air compressor. When a dry dock is flooded through the caisson, two valves in each flooding tube are required for double valve protection.

9-3 DESIGN OF RECTANGULAR TYPE FLOATING CAISSONS.

9-3.1 Shape.

Since construction of caissons is not sufficiently repetitive, definitive drawings have not been prepared.

9-3.1.1 Elevation.

In elevation, the shape of a caisson must conform to the shape of the seats in the dry dock walls, which have been dimensioned to provide the required ship clearances.

9-3.1.2 Height.

The elevation of the caisson weather deck is normally the same as the dry dock coping. However, the elevation of the weather deck need not be any higher than required to prevent overtopping at the maximum possible outside water level (storm surge or extreme high water (EHW) level with consideration for sea level change). If there is a significant difference between the level of the dry dock coping and the maximum possible outside water level, then consider a lower weather deck elevation.

9-3.1.3 Cross Section.

For a typical caisson cross section, see Figure 9-3. Determine beam by strength and stability requirements. Slope the bottom and sides from the stems and keel at an angle of approximately 45 degrees, to meet the beam width. Slope the sides slightly inward at the top but maintain requirements for roadway and deck layout.

9-3.1.4 Plan.

Make the structure symmetrical about both axes. See Figure 9-4.

9-3.1.5 Stability Afloat.

Caisson stability afloat must meet the requirements of the current edition of The ABS Rules for Building and Classing Steel Vessels Under 90 Meters. The stability analysis will consider all ballasting conditions (tanks empty, partially full, full), towing loads, windage loads, mooring loads, live loads on weather deck and machinery deck (safety deck), and free surface effects.

9-3.2 Tanks.

Ballast is used to control the caisson draft and stability.

Figure 9-3 Cross Section and Typical Framing Arrangement of Welded Caisson

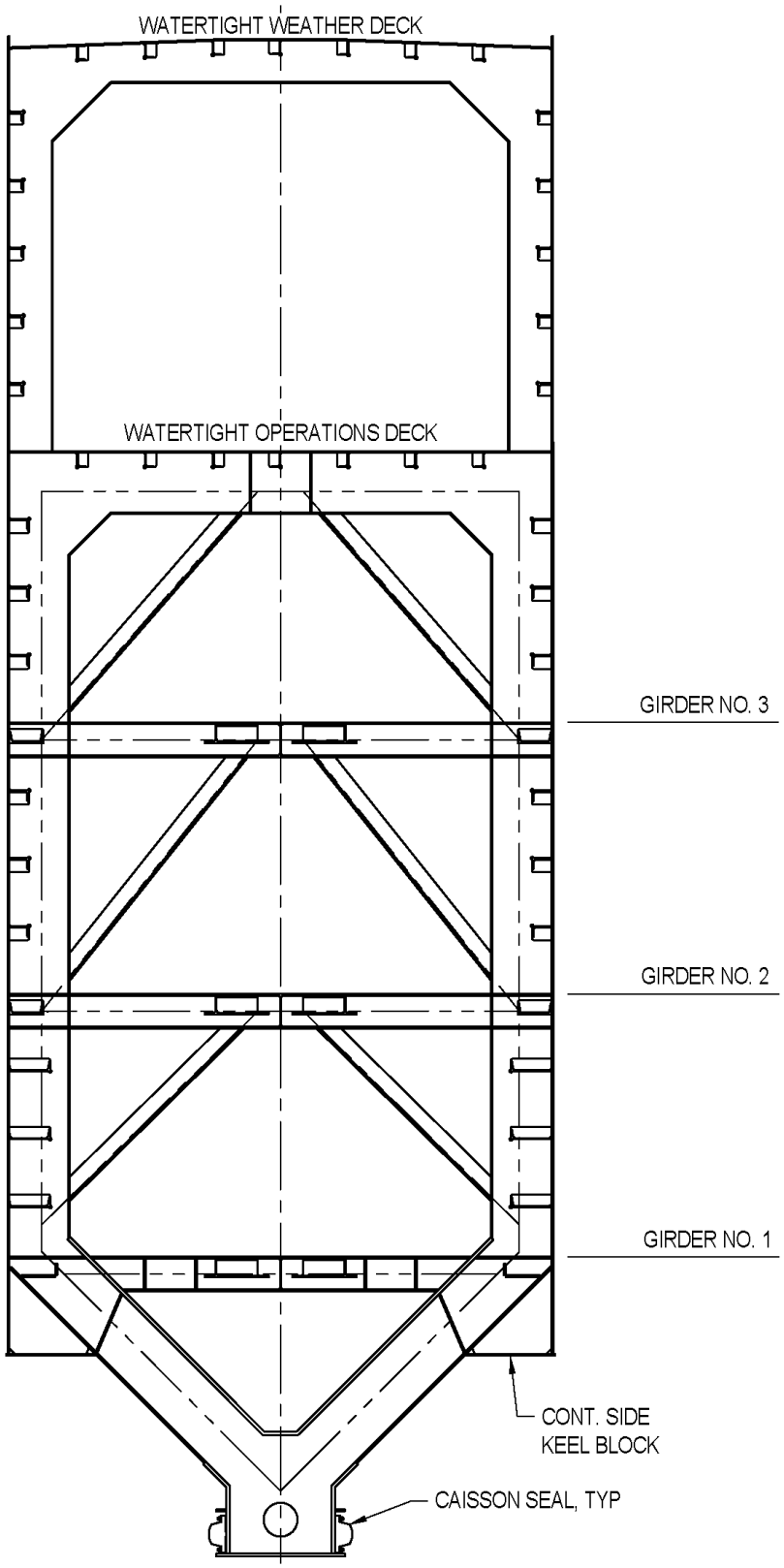
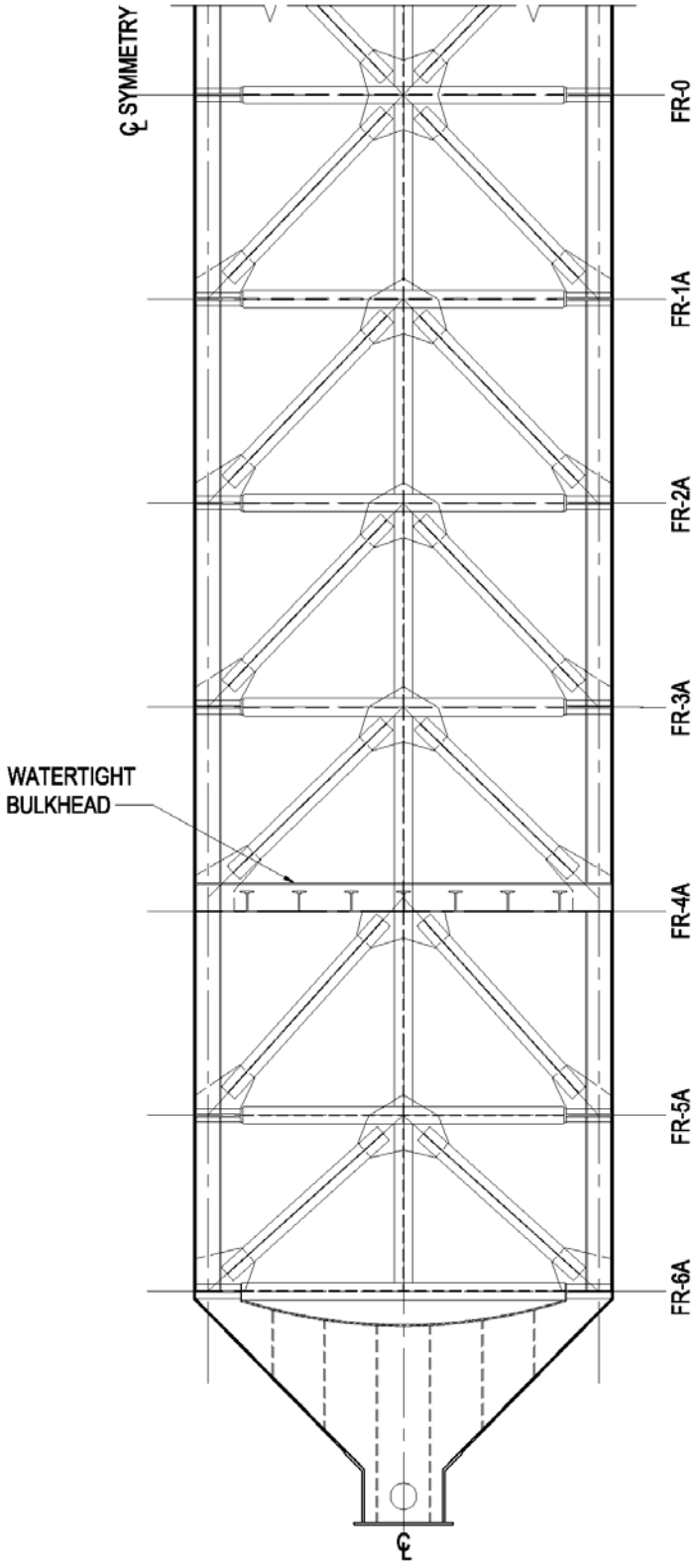


Figure 9-4 Typical Horizontal Girder for Welded Caisson



9-3.2.1 Fixed Ballast.

Fixed ballast is required to insure stability under all operating conditions. Fixed ballast at the bottom of a caisson is concrete. Quantity of fixed ballast is determined by the minimum draft and stability requirements. The minimum draft of a floating caisson must be such that it can be raised from the sill or seated at mean lower low water.

9-3.2.2 Water Ballast.

The maximum draft of a caisson normally occurs while the caisson is being seated at extreme high water. As a general rule, caissons are designed to allow for seating at mean high water, and the machinery deck (safety deck) is located, and dip pipes proportioned, to suit this condition.

If the dock can be superflooded, adequate water ballast must be provided so the total weight of the caisson (light weight plus water ballast) exceeds the amount of water displaced with the water level outside the dock at mean high water and the water level inside the dock at the maximum superflood level.

If the dry dock is located in an area where there is a significant possibility that the water level will rise above the overtopping level (coping or floodwall level) and flood the dock during destructive weather, then the caisson should be designed such that when floating and fully ballasted it has a freeboard of between 1 ft (0.31 m) and 2 ft (0.62 m) below the weather deck level. This will allow the caisson to be safely removed from its seat when the water level approaches the top of the caisson.

9-3.2.3 Ballast Tank Design.

9-3.2.3.1 Tank Layout.

Ballast tanks should be configured so the caisson can be trimmed, if necessary, by adjusting water ballast. This is normally accomplished by either using a single main ballast tank with trim tanks on either end of the caisson, or by using two ballast tanks with a watertight bulkhead on the caisson’s centerline.

9-3.2.3.2 Tank Sizing.

It is desirable to be able to dewater ballast and trim tanks one at a time with the caisson in its seat and the dock dry to facilitate inspections and maintenance. If tanks are to be dewatered individually for inspections and maintenance, then they must be sized such that the caisson’s weight (light weight plus water ballast) always exceeds the caisson’s buoyant force, and there must never be an unseating moment on one end of the caisson. This calculation is done with the outside water level at MHW to allow tank inspection and maintenance under all normal operating conditions.

9-3.2.3.3 Machinery Deck (Safety Deck) Location.

The locations of machinery decks (safety decks) depend on necessary water ballast, adaptability to framing arrangements, and required headroom for machinery. There are advantages to raising the machinery deck (safety deck) higher over the end trim tanks than over the center tanks of the caisson because it allows use of shorter pump shafts and valve stems. Locate machinery decks (safety decks) at elevations higher than those indicated by computations.

9-3.2.3.4 Dip Pipes.

Provide dip pipes in each water ballast compartment to limit ballast water to design level and to keep water from wetting the underside of the machinery deck (safety deck). Dip pipes serve as vents until ballast water reaches the pipe ends. Once the dip pipes are immersed, the air remaining in the ballast tank is compressed until it limits the water level in the tank to the maximum design level. This provides a safety feature if there is a failure in the ballast tank's flooding or dewatering systems. These pipes are installed extra long, and cut off to the elevation determined by submergence tests. Steel dip pipes corrode quickly since their interiors are inaccessible and protective coatings can't be maintained. For this reason, dip pipes should be constructed from type 316L stainless steel.

9-3.3 Watertight Integrity.

The caisson hull structure must be watertight below the weather deck level. Main ballast and trim tank vent/dip pipes, caisson power supply, etc. must penetrate the weather deck and not the side shell plating. Windows and/or portlights must not be installed in the side shell plating.

Provisions to ensure the watertight integrity of the weather deck must be provided including watertight hatches for personnel access to the machinery deck (safety deck) level and trim tanks (if applicable). Weather deck penetrations for utilities, tank vents, machinery level ventilation, etc. must be watertight to at least 6" above the level of the weather deck.

Provisions to ensure the watertight integrity of machinery spaces must be provided. Watertight hatches must be provided in the machinery deck (safety deck) and bulkheads (if applicable) for access to the main ballast tank and trim tanks. All machinery deck (safety deck) penetrations including pump and valve shafts, lubrication lines, electrical wiring, etc. must be watertight.

The caisson must be designed to ensure that it will remain afloat in a satisfactory condition of equilibrium with the uncontrolled flooding of any one compartment (main ballast or trim tank) except the machinery space.

9-3.4 Analysis and Design.

Analyze and design caissons for all applicable loading conditions such as dead and live loads, hydrostatic pressure, and seismic. Refer to Figure 9-5 and Figure 9-6 for some example loading scenarios. Structural steel design may be in accordance with either AISC Steel Construction Manual or ABS Rules for Building and Classing Steel Vessels Under 90 Meters.

9-3.4.1 Approximate Analysis.

To resist external water pressure when a caisson is seated and the dock is empty, consider the caisson closure as a rectangular slab supported at side and bottom edges with free top edge. For approximate determinations of principal moments, shears, and reactions, assume the design length as a mean of the top and keel lengths and apply elastic theory for a rectangular plate supported on three sides. Determine also the distribution of shears and moments in individual frames and girders, stiffeners, and plating.

9-3.4.2 Framing.

Main framing should consist of a series of vertical trusses or frames attached to horizontal girders or frames at panel points. Make a bulkhead frame near each end watertight for trim tanks. Only the machinery/safety and weather deck horizontal girders are made watertight. Space vertical frames about 8 ft (2.5 m) on centers, with spacing of horizontal girders preferably not exceeding 10 ft (3.1 m). Place short intermediate horizontal girders, usually called breasthooks, in the upper half near the caisson ends, for better distribution of shears and end reactions.

9-3.4.2.1 Vertical Frames.

For construction details, see Figure 9-3.

Design as follows:

- Design vertical frames to resist caisson shears and bending moments in vertical directions and local bending between girders. The part of the total vertical caisson bending moment applicable to a frame is determined from the approximate analysis (refer to Section 9-3.4 above entitled “Design Analysis”). Chord stresses are determined by beam analysis.
- Local bending moments between girders on the outboard side result from water pressure loads brought to the vertical frames by hull plating and stringers.
- Web member stresses are found by assuming the distributed vertical pressure loadings to be concentrated at panel points and computing the consequent shears.

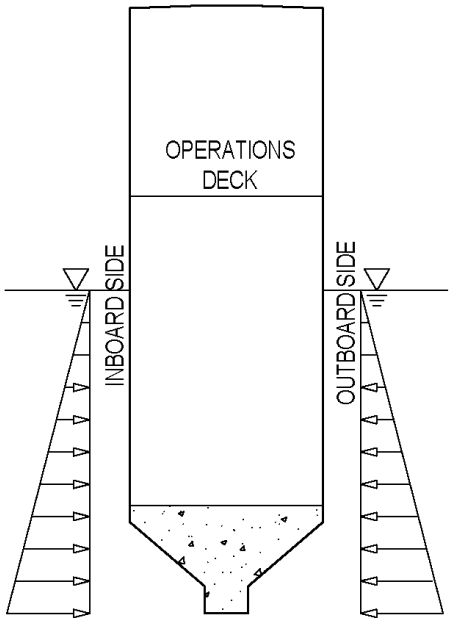
- Diagonal web members should preferably be tee sections; horizontal strut members angle sections; and chord members wide angle sections formed by bent plates or a web plate with a welded flange.
- Web member connections should be fillet welded.

9-3.4.2.2 Horizontal Girders.

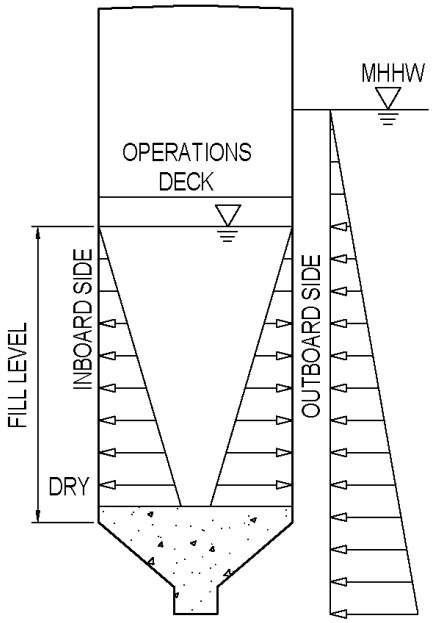
See Figure 9-4 for details of a typical girder. Design as follows:

- Design horizontal girders similarly to vertical frames. In general, they are the same type of construction.
- Girder flanges should be combination tee and wide-angle sections and, for computing stresses from girder action, include all adjacent hull plating.
- Members of safety and top decks must resist local loads introduced by secondary framing and deck plating at those locations.
- Webs at the girder ends are longitudinally stiffened plating for required shear resistance.
- Weather decks should be cambered to provide drainage and designed for specified uniform live loadings and concentrated vehicular loads normal to the girder plane.
- Design machinery decks (safety decks) for water pressures and machinery loads.
- Horizontal members in ballast and trim tanks should be designed such that air will not be trapped beneath the members as the tanks are flooded, and water will not be trapped above the members as the tanks are dewatered. Steel in air pockets will not be protected by the cathodic protection system when the tanks are flooded. Pooled water will hinder inspection and maintenance when the tanks are dewatered. Install vent/drain holes in unstressed areas of horizontal members, as required, to prevent these problems.

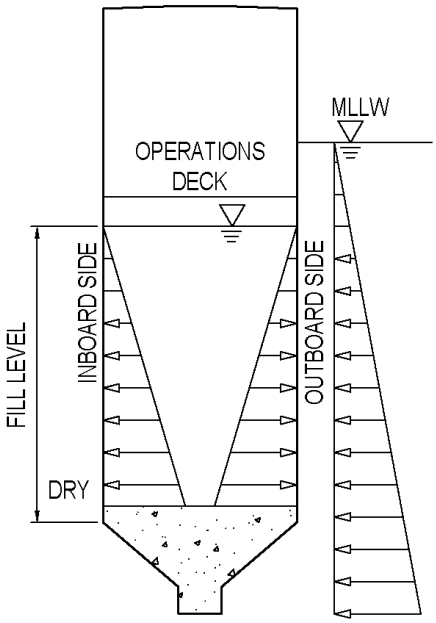
Figure 9-5 Example Load Cases for Caisson – 1 of 2



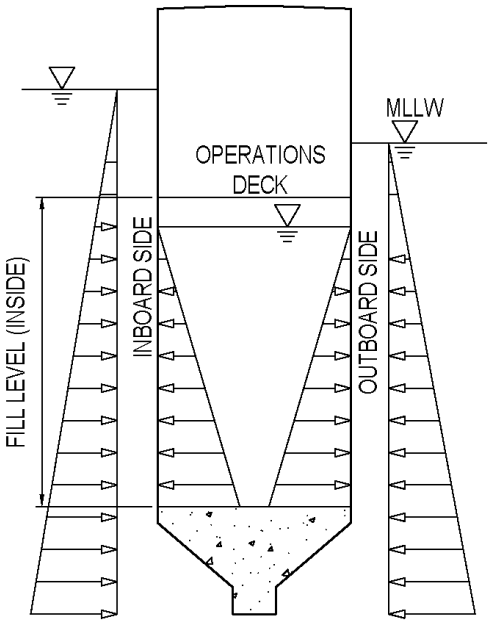
OPERATING LOAD CASE A
ALL TANKS DRY, FREE FLOATING



OPERATING LOAD CASE B1
MEAN HIGHER HIGH WATER LEVEL OUTSIDE, DOCK DRY,
A. END TANKS FULL & CENTER TANK FULL
B. END TANKS FULL & CENTER TANK DRY
C. END TANKS DRY & CENTER TANK FULL

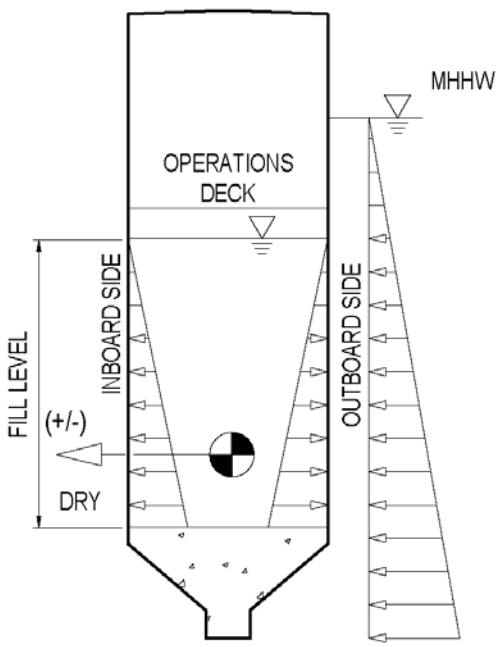


OPERATING LOAD CASE B2
MEAN LOWER LOW WATER LEVEL, DOCK DRY,
A. END TANKS FULL & CENTER TANK FULL
B. END TANKS FULL & CENTER TANK DRY
C. END TANKS DRY & CENTER TANK FULL

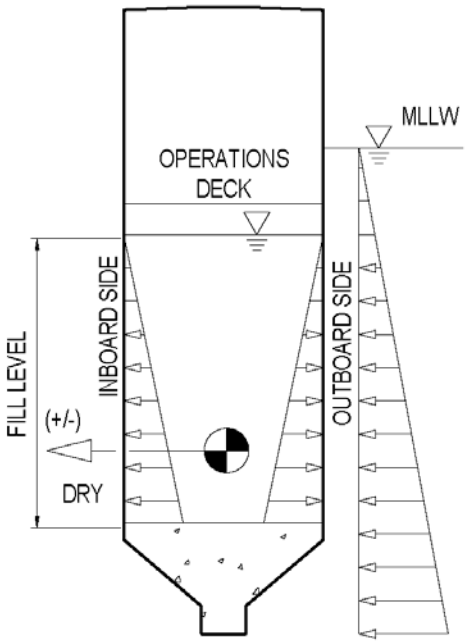


OPERATING LOAD CASE C
MEAN LOWER LOW WATER LEVEL OUTSIDE, DOCK SUPER FLOODED, END TANKS FULL & CENTER TANK FULL

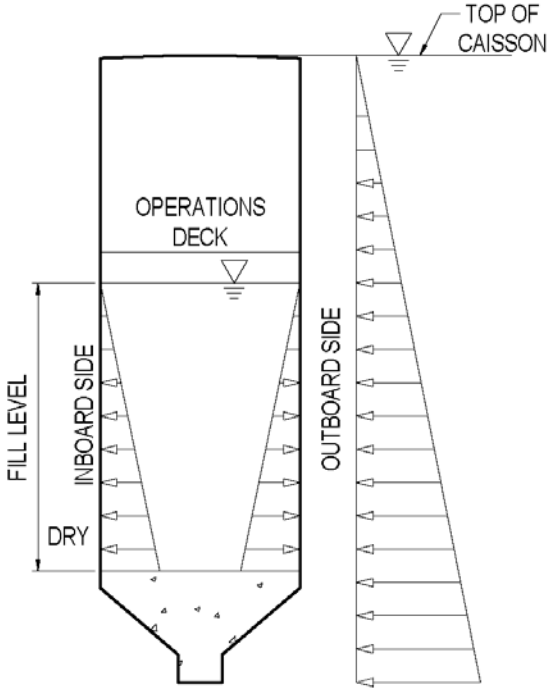
Figure 9-6 Example Load Cases for Caisson – 2 of 2



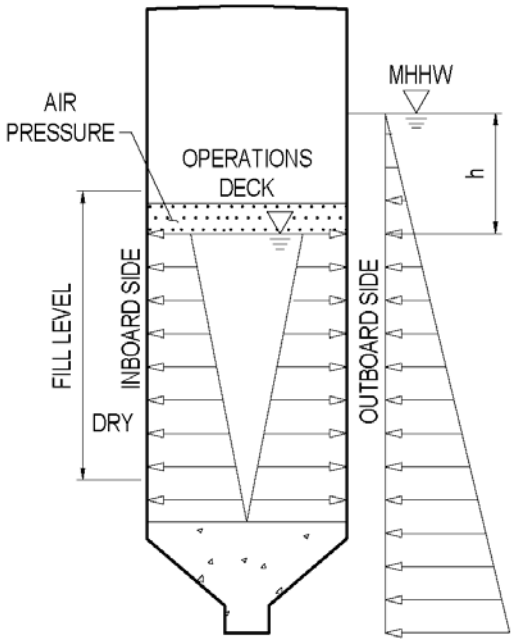
EXTREME LOAD CASE D1
MEAN HIGHER HIGH WATER,
DOCK DRY, EARTHQUAKE, ALL TANKS FULL



EXTREME LOAD CASE D2
MEAN LOWER LOW WATER,
DOCK DRY, EARTHQUAKE, ALL TANKS FULL



EXTREME LOAD CASE E
FLOOD STAGE OUTSIDE,
DOCK DRY, ALL TANKS FULL



EXTREME LOAD CASE F
MEAN HIGHER HIGH WATER,
DOCK DRY, ALL TANKS FULL TO TOP OF VENT OPEN

9-3.4.2.1 Secondary Framing.

Make shell plate stringers of flat bars, structural tees (ST or MT), bulb flats or angles running horizontally. At keel, provide web plate stiffeners in a vertical direction, spaced about 2 ft (0.6 m) on centers, between vertical frames. Design stringers as continuous beams to resist local water pressure transmitted by plating. Stringers for both weather and machinery decks (safety decks) should run in the long direction of the caisson. Design them as continuous beams.

9-3.4.2.2 Plating.

Stresses in shell plating are biaxial, due to bending in two directions. Determine maximum stresses in plating by combining stresses from overall bending and twisting of the caisson and bending stresses from local water pressure loading. Assume twisting moments resisted only by shearing stresses in the plating. Determine principal stresses by combining shear resulting from twisting, stresses produced by bending in both vertical and horizontal directions, and stresses due to local bending.

9-3.4.2.3 Stems and Keels.

Stems and keels distribute hydrostatic pressures on caissons to the masonry of dry dock seats. Keels are to be filled solid with concrete ballast, and stiffened with diaphragm plates.

9-3.4.2.4 Allowance for Corrosion of Steel Structure.

Steel caisson structure must be designed with a corrosion allowance such that allowable stresses will not be exceeded when corrosion has reduced structural component cross sectional areas by the amount of the corrosion allowance. Steel caisson structures will corrode during use regardless of coating systems and cathodic protection systems used. The use of a corrosion allowance (addition) during design should allow many years of use before costly structural repairs are required. The minimum corrosion allowance is listed in ABS Rules for Building and Classing Steel Vessels Under 90 meters 3-2-6/1.6.4(b).

9-3.4.2.5 Welding.

All caisson welded connections must be continuous to develop maximum strength and to facilitate cleaning and coating for corrosion protection. Skip welding must not be used in ballast and trim tanks or on the caisson exterior.

9-3.4.2.6 Maintainability.

The caisson must be designed and constructed such that all structural steel surfaces are readily accessible for maintenance and repair of protective coatings.

9-3.4.3 Gaskets and Seats.

The bearing of caisson ends and keel is taken through special molded, steel reinforced, rubber seals set on both faces of caisson keel and stem. Contact NAVFAC EXWC for details. See Figure 9-7.

9-3.4.3.1 Graving Dry Dock Seats.

For cruiser, auxiliary, and carrier docks, build recesses into the dry dock entrance floor 2 ft (0.6 m) and into the dry dock entrance side walls 2-1/2 ft (0.8 m), to form docking seats. For destroyer and submarine docks, these depths may be decreased respectively 6 in. (152 mm). Protect the bearing surface with either type 316 or monel armor plating.

9-3.4.3.2 Super-flooding Feature.

For dry dock designs including the super-flooding feature, face the dry dock seat recesses inboard and outboard to provide bearing reaction from either direction (refer to CHAPTER 6).

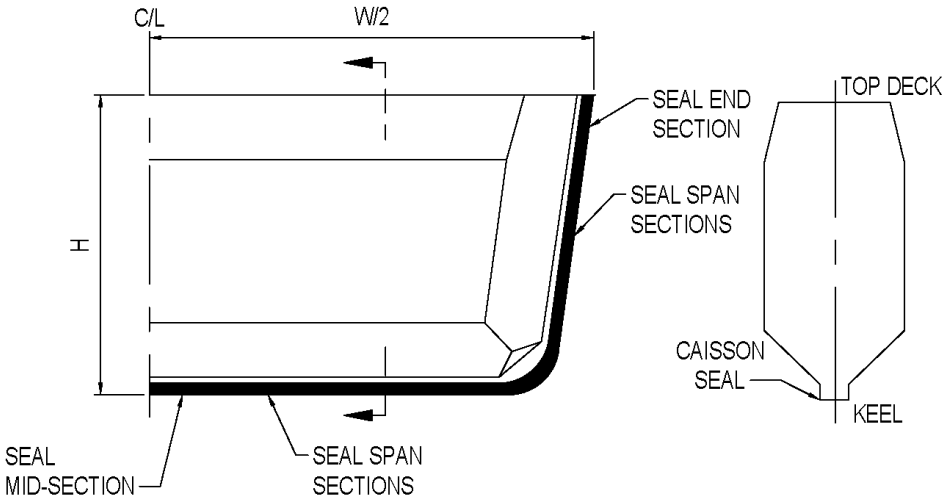
9-3.4.4 Side Docking Keels.

The caisson design must include side docking keels located approximately at the turn of the bilge on both sides of the caisson. The side docking keels provide a horizontal bearing surface for bilge blocks when the caisson is drydocked for maintenance or repair. See Figure 9-8. Side docking keels must be designed to accommodate two blocking plans such that the portion of the caisson that bears on the bilge blocks in the first docking plan is fully exposed to facilitate maintenance when the caisson is docked in the second docking plan. Design analysis must ensure adequate caisson stability while drydocked per NSTM Chapter 997, Docking Instructions and Routine Work in Dock.

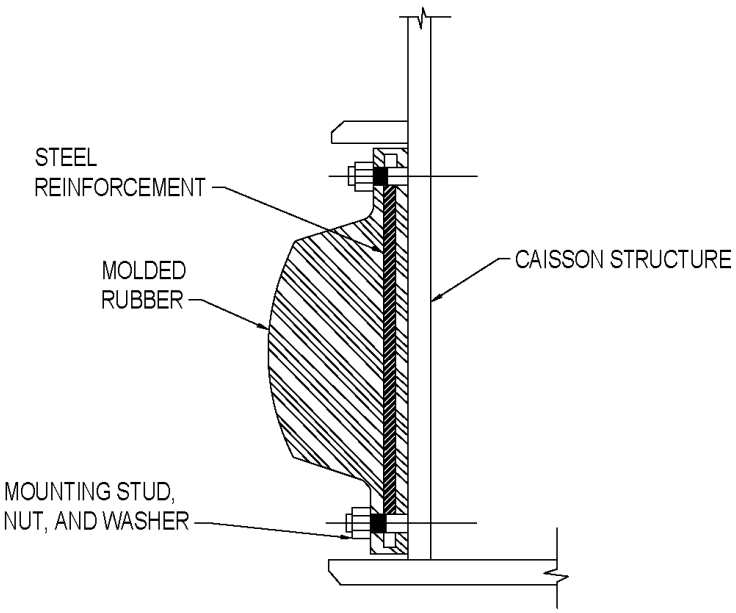
9-3.5 Equipment.

Mechanical and electrical equipment must conform to the same specifications as the corresponding equipment in the dry dock pumpwell.

Figure 9-7 Detail of Gasket for Caisson

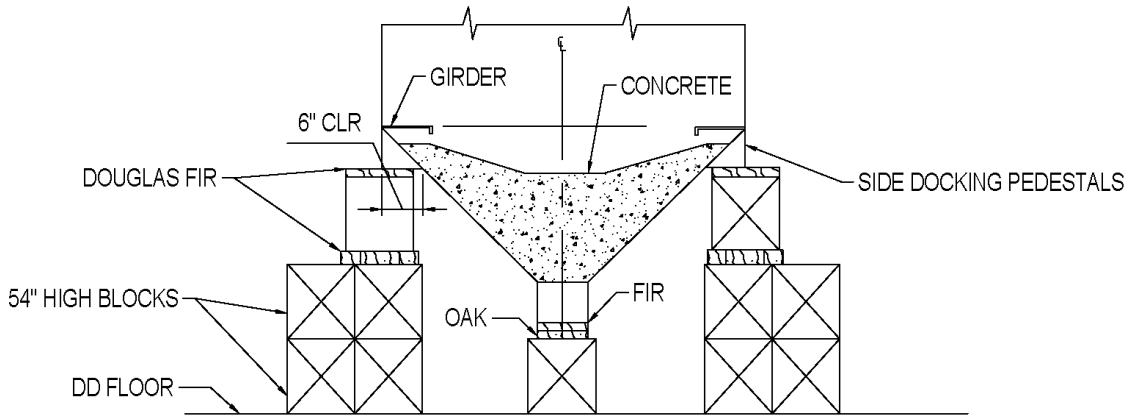


a) CAISSON SEAL LOCATIONS



b) SEAL ASSEMBLY

Figure 9-8 Caisson Side Docking Keels



9-3.5.1 Major Equipment.

Provide the following major items of equipment. Each system (caisson tank flooding, caisson tank dewatering, dry dock flooding, etc.) must consist of at least two parallel and independent systems for redundancy:

- Vertical shaft pumping units as required. Control by start-stop pushbutton mounted on or near the floor stand and/or at the control console.
- Gate valves or butterfly valves as required for water control. Use motor operated, except for small valves which may be hand operated. Provide sea connection with screens and gratings.
- Check valves in discharge pipes of main pump units.
- Inclinometers of suitable type to show both list and trim.
- Gauges for indicating the water level in each ballast compartment and draft.
- Heating and ventilating systems to suit climatic conditions.
- Dock flooding via piping through the caisson and 36 in. (76.2 mm) valves with controls. Two valves are required in each pipe. Use valves suitable for pressure from both sides to accommodate rotation of the caisson. Locate pipes high enough to avoid sucking mud and debris on the harbor bottom into the pipes. Consideration should be given to angling the ends of pipes down to prevent the movement of ship blocking. Install flanges on

the caisson shell on both sides of the caisson to facilitate the installation of blanks over the pipes. Refer to CHAPTER 6.

- Pumps and piping systems must be designed such that individual system components can be removed for repair and replaced without cutting and welding.

9-3.5.2 Electrical Equipment.

Supply 480 volts nominal, 3-phase, 60 Hertz per second electric current from the dry dock system to shore connection receptacles on the caisson. Operate main motors at 460 volts. Operate heater and fan motors on 120 volts, obtained from a transformer provided in each starter. Operate lights and convenience receptacles on 120 volts, obtained from 460/120-volt transformers. Provide controls, circuit breakers, and similar items, as necessary.

9-3.5.3 Ballast Tank Alarms.

Provide high and low water alarms for the main ballast tanks. Both alarms must annunciate locally and at the shipyard operations center.

9-3.5.4 Miscellaneous Fittings.

The following miscellaneous fittings are required:

- Companionway ladder or ladders with railings
- Vertical fenders to ballast compartments
- Timber composite or rubber fenders both sides of hull.
- Cast steel chocks and cleats on the weather deck. If the elevation of the weather deck is significantly higher than the pier elevation when the caisson ballast tanks are empty, consider also installing mooring fittings in the caisson shell at the appropriate elevation. The use of these fittings when mooring the caisson pier side for extended periods will eliminate problems with extreme vertical angles on mooring lines
- Non-skid surfacing on weather deck. Do not use a bituminous surface.
- Hinged or portable ramps (where required) for providing pedestrian access or vehicular access to roadway on caisson.
- Curb lights
- Hand railing (galvanized or other corrosion resistance)
- Access manholes and machinery hatches. Machinery hatches in the weather deck and machinery deck (safety deck) must be sized and located to facilitate the removal and reinstallation of all pumps and valves

- Capstan installations for line handling and warping out of and into dry dock seat or to mooring location, if necessary
- Visible and audible water alarm on weather deck.

9-3.5.5 Cathodic Protection.

All metal surfaces of the caisson that are normally immersed in sea water including the exterior shell plating, main ballast tank(s), and trim tanks should be protected from corrosion by a sacrificial anode type cathodic protection system. UFC 3-570-01, Cathodic Protection, provides guidance on system design. Consider using aluminum anodes for caisson cathodic protection rather than the commonly used zinc anodes. Aluminum anodes are both more efficient (three times as many amps-hours per pound consumed) and provide more protection (better protective potential for longer time) than conventional zinc anodes. Zinc is an environmental contaminant of concern in seawater, and the use of zinc anodes may cause problems with environmental regulators. Aluminum is not a contaminant of concern in seawater, so utilizing aluminum anodes instead of zinc anodes should eliminate this issue. However, some aluminum anodes contain mercury,so be sure to specify aluminum anodes that contain no mercury.

9-3.5.6 Protective Coatings.

Epoxy protective coatings meeting either MIL-DTL-24441D or MIL-PRF-23236D must be used to protect all caisson steel.

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CHAPTER 10 CONSTRUCTION

10-1 CRITERIA.

This chapter presents data and information as criteria for the construction of a dry dock body, the entrance closure, supporting facilities and accessories, and mechanical and electrical equipment.

10-1.1 Approach.

Criteria for the dry dock body are intended to guide the designer by indicating basic construction problems encountered, depending on the type of dry dock chosen. They are also intended to assist in the preparation of construction specifications as well as design drawings. References to construction of the dry dock body are based on the use of concrete. Phases of construction are presented in chronological order of the work.

10-2 DRY DOCK BODY.

10-2.1 Clearing and Demolition.

A site must be cleared of all interfering structures above and below water. Dispose of removed material according to contract requirements. Remove all objects that will interfere with excavation.

10-2.2 Rerouting Utility Lines.

Essential mechanical and electrical services that will be interrupted by construction work must be rerouted before demolition. Possible extensions of the services to the new dry dock, when completed, must be considered in rerouting.

10-2.3 Excavation.

Excavation is the first major step in the construction of a dry dock. It is necessary to make room for construction of the dry dock body, and often the removal of unsuitable foundation materials is required. Excavation may be done by dredging or in the dry, depending on the type of material, method of dewatering, or intention to construct the dry dock by underwater methods. Dredging is generally the most economical method.

10-2.3.1 Dredging.

A Department of the Army, Corps of Engineers permit must be obtained for dredging work in navigable waters and material disposal. Dredging may be done by hydraulic methods, or mechanical methods such as clamshell bucket or dragline. If soil is removed by hydraulic dredging, it may be piped to approved disposal areas, to yard locations for fill, or to stockpiles for future use. If dredging is done by clamshell or dragline, the removed soil must be barged to a disposal point.

Hydraulic dredging is not feasible for certain soils such as stiff clays or those containing boulders or rock. Blasting may be necessary for very hard materials, after which a clamshell or dragline is used for its removal. For additional information on dredging operations, refer to UFC 4-150-06, *Military Harbors and Coastal Facilities*.

10-2.3.2 Water Removal.

If water can be removed and kept excluded from a site with reasonable effort, construct dry docks in the dry. This method affords the greatest economies in material and the best quality of completed construction. The method of handling water percolation depends on the type of enclosure and on the nature of surrounding and underlying soils. For dry docks constructed in the dry, continued exclusion of water is most important. (Refer to the Section 10-2.4 entitled “Cofferdams”.)

10-2.3.3 Dry Excavation.

For hard materials, dry excavation is preferred. Where dewatering a site must be done by tiers of well points, excavation in the dry is initiated after the water table in the bank has been lowered. Excavation in the dry may be done by power shovels, draglines, clamshells, bulldozers, tractor drawn pans, or combinations of these methods.

10-2.3.4 Fine Grading.

Fine grading is done by hand tools, bulldozers, and scrapers. Replace over-excavation by well-consolidated material or lean concrete.

10-2.4 Cofferdams.

Cofferdams usually consist of sheet pile or earth structures, or both combined. The function of a cofferdam is to surround a site and to cut off, or minimize, water inflow. Portions of a cofferdam may become permanent parts of the finished dry dock. At the dry dock entrance end, a cofferdam must be removable to allow access for vessels when the dry dock is in operation. There are several types of cofferdams, four of which are described in the sections below.

10-2.4.1 Excavated Pit Cofferdam.

Where most of a dry dock is on land, and the soil in the area is sufficiently impervious and mostly of granular character, a hole may be dug and dewatered by means of well points or deep wells, or a combination of both.

10-2.4.1.1 Entrance Closure.

The entrance closure may be an earth-dike, with or without a line of sheet pile cutoff, or it may consist of a line of earth filled sheet pile cells.

10-2.4.1.2 Clay and Rock Foundations.

The open pit method is generally not suitable for clays. Dry docks built in rock fall into this category, except that water influx is usually small and can be collected in sumps to be pumped out by conventional pumps, see (d.) of Figure 4-1.

10-2.4.2 Earth Dike Cofferdam.

If suitable foundation and borrow material is available, a simple earth dike may suffice to exclude water from a site, even where dry docks will be located well out in the water. Usually, however, a sheet pile cutoff is provided as a dike core. Where sheet pile cutoffs can penetrate to impervious material, earth dikes are ideal. Where earth dikes are used, also provide for lowering the water table by well points and/or deep wells. For an example of a dry dock constructed with this type of cofferdam, see (e.) of Figure 4-1.

10-2.4.3 Cellular Sheet Pile Cofferdam.

For particularly unfavorable soil conditions (for example, where embankment material in place, or available, is very pervious or otherwise unsuitable), a continuous wall of cellular sheet piles may be used to enclose an entire dry dock site. Normally, do not choose this type of construction because the cost is relatively high. This method may prove feasible for shipbuilding docks of semi-permanent character where sheet pile cells become incorporated into the dock structure. See (a.) of Figure 4-2.

10-2.4.4 Internally Braced Sheet Pile Cofferdam.

The use of this type depends on special foundation conditions. The bottom must be relatively impervious and must have the strength to resist a blow. One example of this type of bottom is firm clay into which sheet piles can be driven to a substantial depth for cutoff. The clay must be firm enough so that the depth of material surrounded by the sheet piles has sufficient strength to resist uplift. Design as follows:

- Sheet piles of the Z-type are usually used because of the high ratio of rigidity to weight.
- Internal bracing must be placed in two directions and in vertical tiers spaced to accommodate the strength of sheet piles. Wales and struts may be of wood or steel or a combination of both. Steel is usually required below the top tier.

10-2.5 Foundation Piles.

Piles may be required to help support dry dock structures constructed on weak soil types. They may also be used to help hold down a dry dock floor slab against uplift pressures. Piles may be needed for track and capstan supports.

10-2.5.1 Types.

Piles may be of wood, steel, or concrete. Wood piles that are not completely covered must be treated.

10-2.5.2 Driving.

Piles may be driven either in the dry or underwater. Steel piles placed underwater are usually driven to a predetermined top elevation. Timber piles driven underwater may be cut to a predetermined top elevation by an underwater saw operated by a barge mounted motor and guide frame.

10-2.5.3 Length.

Because piles will vary in length at any given location, the lengths ordered must be sufficient to allow for possible variations. Piles may or may not penetrate into a structural foundation slab, depending on design anchorage requirements.

10-2.5.4 Locations.

The accurate positioning of each pile is important to maintain the validity of design assumptions and make possible the installation of prefabricated items.

10-2.5.5 Precautions in Driving and Handling.

Be sure that piles are undamaged by handling prior to driving, and substitute sound piles for those damaged in driving. Creosoted timber piles and precast concrete piles are particularly susceptible to handling and driving damage.

10-2.6 Foundation Course.

To stabilize soft bottom material, place a foundation course consisting of a layer of gravel or crushed rock several feet thick. For dry docks with relieved floors, grade the foundation course material to function as a filter. Where drainage pipes are used in conjunction with the filter course, the material around the pipes must be carefully placed and carefully compacted, to preclude damage to the pipes.

10-2.7 Foundation Slabs.

Foundation slabs may be poured either by the tremie method or in the dry.

10-2.7.1 Tremie Method.

For the tremie method, divide the floor slab into reasonable size placements by forms placed underwater. Place as follows:

- Each placement must be placed through multiple pipes to minimize the distance of concrete flow after emerging from the tremie pipe end. Pipes should be no more than 12 ft (3.7 m) apart.
- Water must be excluded from tremie pipes before they are filled with concrete. Water may be kept out by special foot valves or expelled by various go-devil devices that separate water from the concrete columns in the pipes as the columns build up with introduced concrete.
- Tremie concrete must be brought to within 1.5 to 2 ft (0.46 to 0.61 m) (nominally) of the top of the finished slab. Pour the remainder of the finished slab in the dry. This procedure allows cleaning the top of the tremie concrete after dewatering, embedment of various floor fixtures, and a final accurate floor finish and elevation.

10-2.7.2 In the Dry Method.

When docks are constructed in the dry, the floor is placed to full thickness in one operation, and contains the embedded items.

10-2.7.3 Field Verification of Weight.

For full hydrostatic docks, verify the actual weight of concrete and reinforcing steel being placed during construction, in order to ascertain the possible necessity for additional weight for conformity with design computations.

10-2.8 Sidewalls and Abutments.

Construct all abutments and sidewalls in the dry. For walls constructed on tremie placed slabs, the walls must be built within dewatered cofferdams placed on top of the tremie slabs. See Figure 5-1 for examples of cofferdams on tremie slabs.

10-2.9 Miscellaneous Items.

Other structures built in connection with a graving dock (such as capstan, bollard, and crane rail foundations) present no unusual problems and may be constructed in accordance with accepted practice. Care must be taken to ensure accurate positioning of items to be embedded in concrete, and watertightness of such structures as capstan pits, pumpwells, and service galleries. All holes left by removal of items (such as from ties) should be patched, because such unevenness in concrete surfaces accelerates deterioration and may cause leakage.

10-2.10 Backfill.

Backfill may be placed in the water or in the dry next to sidewalls and abutments. For tremie docks, it may be expeditious to place backfill in the wet. In the dry, backfill should be placed in shallow layers and each layer thoroughly compacted. Backfills comprise foundations for roadways, laydown area, and other structures built directly on them, and must have sufficient strength to support such loads.

10-3 ENTRANCE CLOSURES.

10-3.1 Construction and Use.

Entrance closures (caissons) are usually built of welded steel construction, but may also be built of reinforced concrete. Construction may be by a naval shipyard, but is usually done by a private contractor. Being adaptable for towing, a caisson may be built some distance away, in a yard particularly suited to economical prefabrication, and subsequently towed to the graving dock site.

10-3.2 Dimensions.

It is important to accurately check dry dock seat dimensions against those of the proposed closure, particularly for clearances. This is essential in the case of new caissons for existing docks. Contract documents for caisson construction should require that as-built caisson dimensions be within 1/4 in. (6.3 mm) of molded dimensions. Seal bearing surfaces should be within 1/8 in. (3.2 mm) of a vertical plane (or the designed shape if the seat is not planar). Measurements should be made during construction to verify that the as-built dimensions are within tolerance.

10-3.3 Ballast.

Permanent ballast necessary for proper operation and stability of a caisson is usually provided prior to an inclining test, and additional ballast, if necessary, is added at testing time.

10-3.4 Launching.

Caissons may be constructed in a graving or floating dry dock or on shipbuilding ways. Some small caissons can be built on piers and placed, by crane, in the water.

10-3.5 Steel Caissons.

Methods and operations used in prefabrication, assembly, and launching of steel caissons are very similar to those of other welded steel floating vessels.

10-3.6 Concrete Caissons.

Several prototype concrete caissons were built using practices developed for construction of concrete vessels and ships. These practices differ from standard concrete construction methods in the unusual care needed to achieve a watertight, durable, and structurally sound caisson. The service record of concrete caissons should be evaluated prior to proceeding with new designs. The concrete caisson may be placed in the outer seat while the steel caisson is being overhauled.

10-3.7 Closure Tests.

Five types of tests are required as described in the sections below.

10-3.7.1 Watertightness Test.

Watertightness must be made prior to launching, either by filling a caisson with water or by use of low pressure air.

10-3.7.2 Seating Test.

After launching, caissons must be seated and then raised several times with both faces toward the dock, to validate caisson operational performance. Tests should include the operation of all equipment (pumps, valves, capstans, etc.) and the dock should be pumped dry to validate performance of the rubber seals. If the dock is equipped for superflooding, it should be superflooded to the maximum design level with both caisson faces toward the dock.

10-3.7.3 Deflection Test.

Deflections at various points of a caisson under full load (high tide with a graving dock empty) must be determined in comparison with no-load positions, and then checked against original design data. For a convenient reference line, use a wire stretched along the caisson centerline and fastened at the caisson ends.

10-3.7.4 Inclination Test.

Inclination tests are used to determine the stability of a caisson under light conditions. The tests are on a caisson equipped and ready for operation, by moving known weights off center and recording the resulting caisson inclination angles. Angles are indicated by plumb bob pendulums, and obtained at light drafts only. Occasionally, a change in the amount of permanent ballast may be necessary because of such tests.

10-3.7.5 Submergence Test.

In a submergence test the caisson ballast and trim tanks are fully flooded. This test validates the airtight and watertight integrity of the machinery deck (safety deck) and ensures that the ballast tank dip pipes are cut to the proper length. This test also ensures that the caisson can sink deep enough to be seated at mean high water, and that the caisson weather deck will be above sea level when the tanks are fully flooded.

10-4 SUPPORTING FACILITIES AND ACCESSORIES.

10-4.1 Crane Rails.

Provide complete crane foundations, anchor bolts, and rails for portal cranes. Rails must be factory bent to required curvatures. Thermite weld or weld rail joints in accordance with alternate methods subject to NAVFAC approval. Refer to typical installation details in UFC 4-152-01.

10-4.2 Cranes.

Dry dock cranes are usually obtained by separate contracts with firms specializing in this type of equipment. Because of size, cranes are assembled at sites by manufacturers, from prefabricated sections. Performance tests are required after assembly.

10-4.3 Railroad Tracks.

Installation of ballasted dockside railroad tracks should follow standard railroad construction practice. Other railroad tracks are supported by a dock wall or special foundations, such as piles.

10-4.4 Bollards and Bitts.

An important construction problem in the installation of accessory anchorages is that of correct positioning of anchor bolts during concrete placements. Since changing positions of embedded bolts after the concrete has set causes difficulties and expense, and is undesirable structurally, every possible precaution should be taken against disturbing such bolts during placement.

Accessories subject to corrosion must have basic corrosion resistant shop coats of paint after manufacture, with finish coats on installation prior to acceptance.

10-4.4.1 Bollards and Cleats.

Space bollards and cleats to suit classes of vessels using the docks. Bollard foundations consist of large blocks of solid concrete, which generally rest on piles or are anchored directly to dock structures or crane track foundations. Embed anchor bolts in the concrete. Set bollard castings by crane on layers of mortar placed on the concrete foundations.

10-4.5 Ladders.

Use replaceable corrosion resistant ladders, and anchor ladders with 0.75 in. (19 mm) diameter Type 316 anchors to walls. Refer to 29 CFR 1910.23 for ladder requirements.

10-4.6 Manhole Steps.

Manhole steps may be built into either concrete or brick masonry. If the spacing and stagger pattern of steps is constant, it is usually economical to fabricate special stepholding forms as reusable standard wall panels.

10-4.7 Draft Boards.

Do not install ceramic tile draft boards at the same time a concrete wall is placed, but form the concrete to allow for subsequent tile installation. Set individual tiles flush with

the wall in a bed of mortar. The gauge zero usually coincides with the elevation of the blocking 4 to 6 ft (1.2 to 1.9 m) above floor level.

10-4.8 Marking Plates.

Where marking plates already have centerlines, it is practically impossible to set them accurately at the time concrete is placed. Therefore, either form the concrete for subsequent plate installation or set plates in the placement and stamp on the centerlines afterwards.

10-4.9 Fenders and Chafing Strips.

Fenders, chafing strips, and other fittings used for protective purposes (such as timber or metal guards around stairways, floodlights, and similar items) are customarily furnished and installed by contractors. Individual guard units should be preassembled, as completely as possible, and then fastened by anchor bolts embedded in concrete. Because of exposed positions and repeated submergence, treat all timber and coat all metal with corrosion resistant material.

10-5 MECHANICAL AND ELECTRICAL EQUIPMENT.

10-5.1 Installation.

Mechanical and electrical equipment for graving docks is manufactured, and to a large extent assembled, at manufacturers' plants. Installation of such equipment may be done under the direction of manufacturer superintendents, general contractor, subcontractor, or yard forces. Installation of mechanical and electrical equipment is generally in accordance with standard building practices. Only those installation features peculiar to graving docks are considered below.

10-5.2 Capstans.

Placement of heavy capstan machinery usually should be done with truck or locomotive cranes. To maintain an even bearing, place a layer of grout between machinery foundations and concrete bases containing the anchor bolts.

10-5.3 Pumping Machinery.

Pumping machinery is usually installed by the manufacturer. Because of the complexity of running performance tests on main pumps, detailed tests are made at the factory. Usually, only one main pump is tested in sufficient detail to obtain all necessary data for plotting suitable performance curves.

10-5.3.1 Shaft Alignment.

It is extremely important to install pumps, pump motors, connecting shafts, and shaft support bearings so the shafts are correctly aligned with no unbalanced stresses imposed on the bearings.

10-5.3.2 Running Test.

After installation, perform a thorough running test on the entire pumping plant. Fire pumps should be tested in accordance with NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection.

10-5.4 Piping and Flow Control Equipment.

Piping and flow control equipment should be purchased, installed, and tested by a separate contractor under the general contractor. Valves larger than 6” should be motor operated. All motor operated valves and sluice gates should have a handwheel that allows manual operation in the event of a power failure. All valve and sluice gate manual handwheels should operate such that turning the handwheel in the clockwise direction when viewed from in front or above closes the valve or sluice gate.

10-5.4.1 Installation Practice.

Large diameter piping is supported above the floor by small concrete piers. Small diameter piping is generally hung from ceilings or walls by a variety of suitable pipe hangers or brackets. An alternate method of installing small diameter piping is to run the pipes along racks that are attached to masonry walls by expansion bolts or structural steel. In areas subject to earthquakes, the brackets and connections must be capable of resisting seismic forces.

10-5.4.2 Installation Timing.

Because of the character of mechanical or piping installation, and general lack of sufficient working space to improve efficiency, the mechanical work should be done after the structural work has been nearly completed. This phase is particularly applicable when separate contracts are let for structural and mechanical work.

APPENDIX A BEST PRACTICES

Consult NAVFAC EXWC SME for best practices.

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APPENDIX B GLOSSARY

B-1 ACRONYMS.

AASHTO	American Association of State Highway and Transportation Officials
ABS	American Bureau of Shipping
ACI	American Concrete Institute
AOA	Analysis of Alternatives
ASCE	American Society of Civil Engineers
ASD	Allowable Stress Design
ASTM	American Society of Testing and Materials
AT/FP	Anti-terrorism/Force Protection
AWWA	American Water Works Association
BFE	Base Flood Elevation (1.0% annual chance of exceedance)
CHT	Collection-Holding-Transfer
DFE	Design Flood Elevation
DFPE	Designated Fire Protection Engineer
EFE	Extreme Flood Elevation
EHW	Extreme High Water (Highest water level expected on station)
ELW	Extreme Low Water (Lowest water level expected on station)
ESLE	Extreme Sea Level Elevation
EXWC	Engineering and Expeditionary Warfare Center
FDC	Fire Department Connection
FEA	Finite Element Analysis
FEMA 0.2%	0.2% annual chance of exceedance flood
FS	Factor of Safety
LED	Light Emitting Diode

MHW	Mean High Water
MHHW	Mean Higher High Water
MIL-STD	Military Standard
MLW	Mean Low Water
MLLW	Mean Lower Low Water
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
NFPA	National Fire Protection Association
NOAA	National Oceanic and Atmospheric Administration
NSTM	Naval Ship's Technical Manual
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
PVC	Polyvinyl Chloride
PWD	Public Works Department
SHT	Special Hull Treatment
SLC	Sea Level Change
SME	Subject Matter Expert
SSBN	Ballistic Missile Submarine (nuclear-powered)
SSGN	Guided Missile Submarine (nuclear-powered)
SSN	Attack Submarine (nuclear-powered)
SSI	Soil Structure Interaction
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specifications
UNS	Unified Numbering System (alloy designation system)
USACE	U.S. Army Corps of Engineers

VFD	Variable Frequency Drive
2D	Two-dimensional
3D	Three-dimensional

B-2 ABBREVIATIONS AND SYMBOLS.

ea	each
ft	foot
ft^2	square foot
fpm	feet per minute
ft/s	feet per second
ft^3/min	cubic foot per min
g	gravity
gpm	gallons per minute
hp	horsepower
in.	inch
k	kip, kips (1,000 lbs)
kg	kilogram (force)
km/h	kilometer per hour
kN	kilonewton
kN/m	kilonewton per meter
kN/m^2	kilonewton per square meter
kN/m^3	kilonewton per cubic meter
kPa	kilopascal
ksf	kips per square foot
lb	pound
lb/ft	pound per foot
lb/ft^2	pound per square foot
lb/ft^3	pound per cubic foot
lb/in^2	pound per square inch

LT	Long Ton (2,240 lbs)
m	meter
m^2	square meter
m/s	meter per second
m^3/s	cubic meter per second
m^3/h	cubic meter per hour
mil	0.001 in.
mm	millimeter
mm^2	square millimeter
MPa	megapascal
MPa/m	megapascal per meter
mph	miles per hour
P	Port (left side of vessel when facing forward)
pci	pound per cubic inch
pcf	pound per cubic foot
plf	pound per linear foot
psf	pound per square foot
psi	pound per square inch
S	Starboard
sec	second
ST	Short Ton (2,000 lbs)
t	tonne = metric ton = 1000 kg
V	Velocity

B-3 DEFINITION OF TERMS.

Bilge: The curve of a ship's hull joining the side and the bottom.

Bitts: A pair of vertical wooden/iron posts mounted either aboard a ship or on a wharf, pier or quay.

Bollard: A short vertical post used on a ship or a quay for mooring.

Bulkhead: A dividing wall or barrier between compartments in a ship.

Capstan: A revolving cylinder with a vertical axis powered by a motor used to supply force to ropes and cables.

Captive Crane: A traveling crane limited to use at one facility because of the absence of track connections to other facilities.

Cavitation: The formation of cavities in a fluid flow due to low pressures attending high velocities in the fluid.

Chafing Strip: Strips of wood or other material placed on sides of waterfront structures, fittings, or vessels to protect against chafing from contact with other structures, ropes, or chains.

Cleat: A T-shaped piece of metal or wood on a pier or vessel to which ropes are attached.

Cribbing: A framework, usually of timber, designed to distribute concentrated ship loads and to provide longitudinal stability to the keel blocks.

Elastic Mat: Structural slab on ground (usually of concrete) supporting separated vertical loads. The elastic deflections of the mat are correlated with resulting nonuniform soil reaction in computing stresses in the mat and the earth pressures.

Fairlead: A fitting through which a line may be led so as to preserve or change its direction without inducing excessive friction.

Go-Devil: A tight plug in a pipe, utilized to clear a pipe of liquid or debris.

Gypsy Head: A small auxiliary drum at the side or top of a winch.

Keel: The principal bottom structural element of a ship extending along the centerline for the full length of the ship.

Mortar Intrusion Concrete: Concrete made by injecting cement or sand-cement mortar into the interstices of previously placed aggregate (it can be placed in the dry or underwater).

Skeg: Vertical projection extending below the hull of a vessel to reduce yawing.

Sonar Dome: A bulge or appendage on the keel of a ship, usually forward, for housing sonar equipment.

Stoplog: A dam consisting of a piece or pieces in slots in the sides of a waterway to shut off flow.

Trash Rack: A grille, usually of vertical metal bars, used to screen out debris from the entrance to a waterway.

Tremie Concrete: Concrete placed underwater in such a manner that there is no free drop of the concrete through the water. This can be accomplished by pouring through a pipe or placing with special bottom-dump bucket. See Tremie Pipe.

Tremie Pipe: A vertical pipe through which concrete is placed underwater. In operation, water must be expelled from the pipe (so as not to mix with the concrete) by a go-devil (see above) placed ahead of the concrete, or the pipe must be freed of water before placing concrete and kept dry by means of a special flap valve at the bottom. During concrete placing, the bottom end of the pipe is kept buried in the concrete mass being placed to prevent backflow of water into the pipe.

Weep Hole: Opening provided in a wall or bulkhead to facilitate drainage of water. It usually serves to reduce hydrostatic pressure behind the structure.

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APPENDIX C REFERENCES

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MILITARY SPECIFICATIONS, STANDARDS, AND PUBLICATIONS (ASSIST)

https://assist.dla.mil/online/start/

MIL-DTL-24441D(SH), *Paint, Epoxy-Polyamide, General Specification for*

MIL-PRF-23236D, *Coating Systems for Ship Structures*

MIL-STD-1625D(SH), *Safety Certification Program for Drydocking Facilities and Shipbuilding Ways for U. S. Navy Ships*

NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

https://www.navfac.navy.mil/

NAVFAC Instruction (NAVFACINST) 11230.1, *Inspection, Certification, and Audit of Crane and Railroad Trackage*

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

https://www.navsea.navy.mil/

S9086-7G-STM-010/CH-997R3, *NSTM Chapter 997, Docking Instructions and Routine Work in Dry Dock*

S0570-AC-CCM-010/8010, *Industrial Ship Safety Manual for Fire Prevention and Response*

S9086-CL-STM-010, *NSTM Chapter 077, Personnel Protection Equipment*

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

https://www.osha.gov

29 CFR 1910.23, Ladders

29 CFR 1910.29, Fall Protection Systems and Falling Object Protection- Criteria and Practices

29 CFR 1915, Occupational Safety and Health Standards for Shipyard Employment

29 CFR 1915.82, Lighting

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UFC 1-200-01, *DoD Building Code*

UFC 3-190-06, *Protective Coatings and Paints*

UFC 3-220-01, *Geotechnical Engineering*

UFC 3-230-01, *Water Storage and Distribution*

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UFGS 35 59 13.14 20, *Polymeric Piles*

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https://www.usace.army.mil/

EM 1110-2-6053, *Earthquake Design and Evaluation of Concrete Hydraulic Structures*

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https://ww2.eagle.org/en.html

ABS Rules for Building and Classing Steel Vessels under 90 meters (295 ft) in Length

AMERICAN CONCRETE INSTITUTE (ACI)

https://www.concrete.org

ACI 207.1R, *Guide to Mass Concrete*

ACI 207.2R, *Report on Thermal and Volume Change Effects on Cracking of Mass Concrete*

ACI 207.4R, *Cooling and Insulating Systems for Mass Concrete*

ACI 318, *Building Code Requirements For Structural Concrete And Commentary*

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UFC 4-214-03
17 March 2018

UNIFIED FACILITIES CRITERIA (UFC)

CENTRAL VEHICLE WASH FACILITIES

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U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes UFC 4-214-03, dated JAN 2004 and TM 5-814-9, dated FEB 1992.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

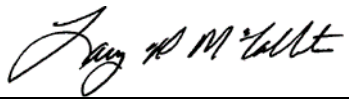
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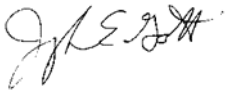
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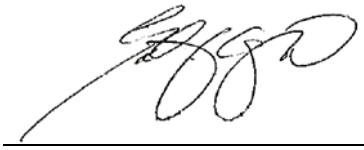
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UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Document: UFC 4-214-03, *Central Vehicle Wash Facility*

Superseding: TM 5-814-9

Description: This criteria is a comprehensive reference for scoping, design, and construction of vehicle wash facilities and their appurtenant structures.

Reasons for Document:

- Criteria formatting was updated to conform to UFC 1-300-01.
- Criteria was updated to include sustainable design features, namely Net-Zero water usage considerations for scoping, design, and construction.
- Criteria was updated to reflect current codes and methodology.

Impact:

- The update to this criteria will provide a path to more sustainable designs by means of water use reduction.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This manual provides a comprehensive reference source for planning, and designing a central vehicle wash facility (CVWF) and decentralized, net zero wash facilities. The CVWF provides a rapid, economical method for washing tracked and wheeled tactical vehicles. The design elements provide for water pollution control, solid waste disposal, and conservation of manpower and water. This manual is limited to wash facilities and wastewater treatment for cleaning vehicle exteriors only; this design information does not pertain to facilities for treating wastewater from maintenance cleaning activities.

The Original Technical Manual (TM) 5-814-9 was adopted in 1992 to provide for large operational and rapid washing of tracked and wheeled tactical vehicles. The Technical Manual was converted to the current UFC 4-214-03 in 2004 utilizing the same concepts for washing tactical vehicles. The detailed requirements for washing these type vehicles are based on large lay-down areas and large quantities of water with introduction of new water as necessary. This update incorporates Chapter 8 which introduces new Net Zero design capabilities for Installations to meet the current needs for saving water and utilizing smaller lay-down areas for washing tactical vehicles. Installations are encouraged to review this alternative method of washing tactical vehicles in combination with the modernization of the type of wheeled vehicles necessary for rapid deployments. The Net Zero Concept is especially pertinent for changing climate and for smaller installations with large Reserve Components.

1-2 APPLICABILITY.

Information in this manual applies central vehicle wash facilities and decentralized, net zero wash facilities on all installations that maintain a fleet of tactical vehicles for which there is a consistent washing requirement demanding cost-effective, on- post facilities.

1-3 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, General Building Requirements. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein. All applicable codes and criteria should be followed, including, but not limited to the International Building Code (IBC) and UFC 3-600-01 Fire Protection.

1-4 BACKGROUND.

The Department of Defense has unique vehicle cleaning requirements in terms of numbers, types of vehicles, washing time, and degree to which washing is critical. Civilian technologies for cleaning off-road tactical vehicles and treating the wastewater created by this washing are not recommended. However, civilian technology may apply to facilities for washing vehicles in a transportation motor pool (TMP), most of which are the wheeled, on-road type such as sedans and buses. Figure 1-1 shows the

recommended washing sequence for tactical vehicles. For installations where specific conditions require that a prewash be constructed, the washing procedure is shown in Figure 1-2. The central vehicle wash facility is designed to provide expedient, cost-effective vehicle cleaning for tactical vehicles. The concept incorporates water conservation including recycle techniques and pollution control.

Figure 1-1 Standard Sequence for Tactical Vehicles

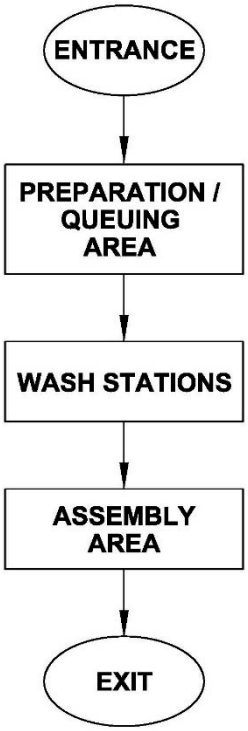
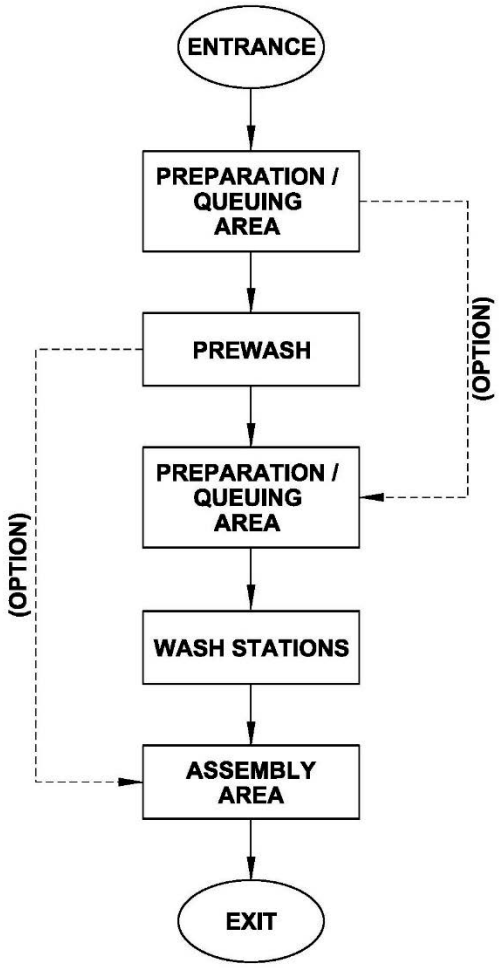


Figure 1-2 Washing Procedure with Optional Prewash



1-5 REFERENCES.

Appendix A contains a list of references used in this document. The publication date of the code or standard is not included in this document. In general, the latest available issuance of the reference is used.

1-6 GLOSSARY.

Appendix C contains acronyms, abbreviations, and terms.

CHAPTER 2 CVWF DESIGN CONCEPT

2-1 OVERVIEW.

The standard CVWF consists of a vehicle preparation area, wash stations, and vehicle assembly area Figure 2-1 Standard Central Vehicle Wash Facility Plan. However, the layout of a facility will be site-specific, based on the installation's mission and needs. Information on siting and master planning is found in Chapter 3. A design example is provided in Appendix B.

2-2 PREWASH (OPTIONAL).

At installations with heavy soiling conditions, high demands for washing, and/or limited washing times, a prewash system is recommended. There are several options for prewash systems which have been constructed for use in tactical vehicle washing: bath, air spray, water spray stand, and automatic washer. The vehicle bath is the most effective prewash system for tactical vehicles. Figure 2-2 shows a typical CVWF plan with the CONUS approved bath prewash system for tactical vehicles. Commercial type, such as those in a TMP, would utilize commercial automatic washers and not facilities described for the CVWF.

2-3 WASTEWATER TREATMENT.

A system for conveying and treating wastewater is included in the CVWF design, since water used to wash the vehicles will become contaminated with dirt, debris, and products related to vehicle operation such as oil, fuels, hydraulic fluid, and grease. All wastewater must receive primary treatment to remove settleable and floating materials. Following primary treatment, the wastewater is either released to a collection system or further treated onsite and stored for reuse during future washing operations. The water used to wash vehicles should be recycled whenever possible and feasible. However, even in a total recycle system, some of the wastewater may need to be released to a discharge system before or after receiving secondary treatment. This discharge is done to ensure that water quality and water balance are maintained. Measured makeup water is added to the recycle system to compensate for the volume of water carried off on the wet vehicles, released, and loss due to evaporation.

2-3.1 Primary Treatment.

All wastewater must receive primary treatment. A sediment basin that provides primary treatment is required to allow most of the suspended solids to settle and to allow the free grease, oils, and other pollutants to separate from the wastewater.

2-3.2 Secondary Treatment.

For the purposes of this manual, secondary treatment refers to intermittent sand filters, lagoons, or discharges to sanitary sewage systems. Two systems of onsite secondary treatment are used following primary treatment if the water is to be recycled. These methods include intermittent sand filters and lagoons. Lagoons are not the standard system but are included because they have been used as a wastewater treatment

method for CVWFs. Lagoons are not allowed in certain states for secondary treatment. Consult with state regulations. The third system of handling wastewater, discharge to sanitary sewer, may be available at an installation, but this method is not used in conjunction with a recycle system.

For Air Force projects, before discharging to an existing sanitary or stormwater system approval by the base or regional environmental section must be granted prior to discharge

2-3.2.1 Intermittent Sand Filter.

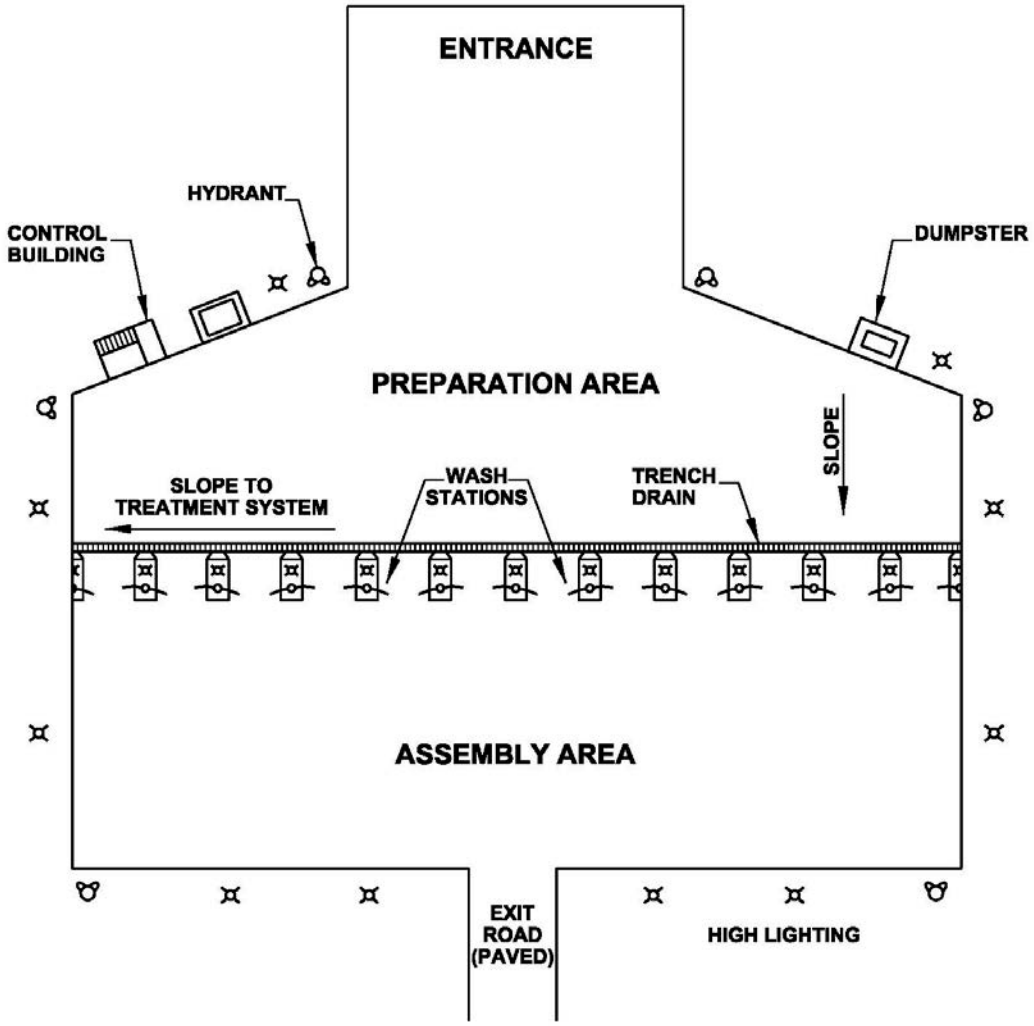
This secondary treatment system is comprised of an equalization basin and an intermittent sand filter. The equalization basin holds the wastewater after primary treatment and before it is applied to the filters to equalize flow rates by dampening the high and low- flow variations.

- A dosing tank may be provided after the flow equalization basin to provide a water volume of one charge or dose to a portion of the sand filter. The dosing tank is a designer's option which allows for flexibility in sizing the pumping facilities. The sand filter shall not be dosed more than 2 hours in any 8 hour period.
- Water quality testing and metering capabilities are recommended to be provided at a point following the intermittent sand filters to measure the quality and amount of the treated wastewater to be recycled. At this point, facilities should be provided which allow recirculating all or a portion of the filtered water back though filters via the equalization basin. The remaining filtered water flows into the water supply basin and is stored for reuse.
- Water overflow facilities to provide hydraulic protection for the secondary treatment process should be located at the water supply basin for emergency storm release. This overflow system should also be able to make controlled partial wastewater releases to further assist in maintaining the quality and quantity of the recycled water. Hydraulic protection should also be provided at the equalization basin as a backup. Chapter 6 presents details of the sand filter treatment system.

2-3.2.2 Lagoon System.

This secondary treatment system consists of a basin or a series of basins where the wastewater is held for an extended period of time to achieve the desired water quality. The treated water is allowed to flow to the water supply basin for reuse. Water quality testing and metering capabilities are recommended to be provided, as well as overflow protection. Chapter 6 explains the lagoon treatment system in greater detail.

Figure 2-1 Standard Central Vehicle Wash Facility Plan

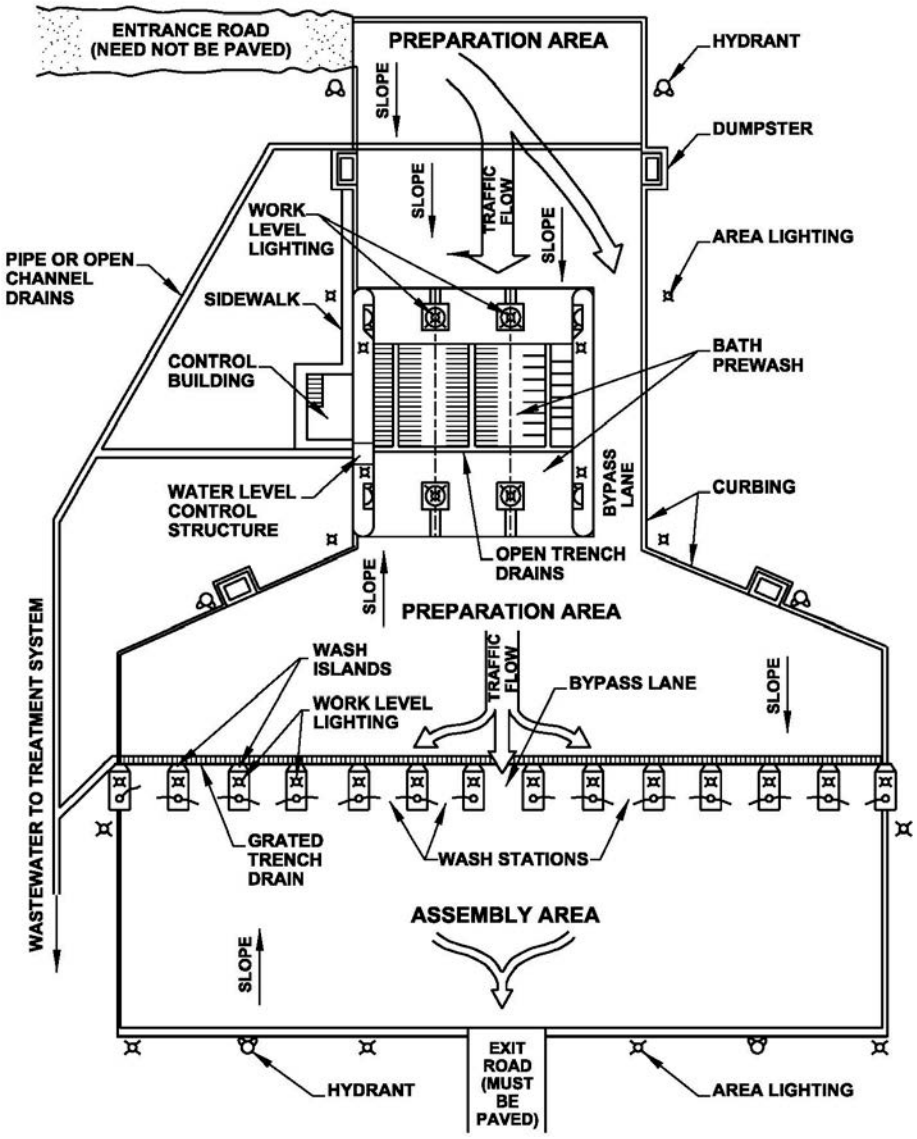


2-3.2.3 Discharge System.

If a recycle treatment system is not economically or technically feasible and/or operationally practical, and if was water supply is available, wastewater from the CVWF may be discharged to a sanitary sewer system or some other conveyance for further treatment elsewhere. Primary treatment is the minimum level of treatment required to ensure that the wastewater discharged into a system is of a quality acceptable to the receiving authority. Quality, however, may not be the only criterion. The rate of discharge may also be a limiting factor, thus requiring an equalization basin prior to the point of release to the discharge system. The discharge type treatment system is discussed in detail in Chapter 6.

For Air Force projects, before discharging into an existing sanitary or stormwater system approval by the base or regional environmental section must be granted prior to discharge.

Figure 2-2 Central Vehicle Wash Facility Plan with Bath Prewash



2-3.3 Water Supply Basin.

After secondary treatment in a recycle system, the water is discharged to a water supply basin for reuse in the CVWF. In a system without recycling, the water supply basin is optional. If a reliable, consistent source of water is not available, a water supply basin may have to be constructed in a size large enough to hold the wash water volume required. This basin can be filled from the water source at a slower rate during nonpeak hours for the high demand required during the washing operations. The design must protect the water source through the use of air breaks or equipment to prevent backflow and back siphonage. In addition, makeup water that enters the water supply should be metered.

CHAPTER 3 MASTER PLANNING

3-1 SIZING.

3-1.1 User Input.

The wash facility must be designed to meet the user's needs. The design will determine the type, size, and configuration of the wash facility and treatment system based on information supplied by the installation. Proper initial planning will result in the best final design. The planner will have to assemble data from many sources and use judgment in applying this data to the guidelines provided for sizing the facility components. Where data is not available, estimates must be made.

3-1.1.1 Military Missions Data.

The wash facility must support the particular needs of the installation. Troop types, their vehicle types, and their training program, both current and future, must be considered. This includes resident troops as well as transient troops. The combination of numbers of vehicles, types of vehicles, and frequency of washing will determine the type and size wash facility required. A complete list of each military unit which will use the facility is required, along with its vehicular complement and the expected frequency each vehicle would be washed.

3-1.1.2 Wash Frequency Data.

Certain components of the wash facility will be sized based on long term or average numbers of vehicles washed. Other components are sized on short term or peak use numbers. In both cases, the mix of vehicle types is an important consideration.

- The average use of the facility should be provided by the user broken down as weekly or biweekly, monthly, and annually. Seasonal variations must also be a consideration. Where training programs are impacted by seasonal weather or where large numbers of transient units in a particular part of the year impact expected use, the average weekly or monthly numbers would not be a fixed ratio of the average annual numbers. Monthly average should be the average of the six highest use months; weekly should be the average of the ten highest use weeks.
- The peak use of the facility should be provided by the user as the largest number of vehicles to be washed in a continuous short term period. If night washing is to be designed for, the peak use may, for example, be a continuous three day (72 hour) period. The peak use will represent full utilization of the wash facility components for the chosen time period. The planner must consider the length of time it will take for all the vehicles scheduled to wash in this peak exercise to return to the cantonment area after training. The rate of movement of these vehicles will help determine the time period to allow for in the peak use operation. Ideally the CVWF would accommodate all units as they arrived, without excessive backup, and at a continuous full

utilization of the washing components. It is important that the planner consider the frequency of the defined peak use; in some cases, a large-scale facility may not be justified based on the low frequency of this peak activity. The peak use should be a condition expected to occur at least three times per year.

3-1.1.3 Vehicle Soiling Data.

The types of soil found in the training ranges along with weather conditions are predictors for the amount of dirt which will have be able to washed off of the vehicles. This will affect the type of washing components, the time required for washing, the amount of water used and the waste- water treatment components.

- A characterization of the soils is needed. A study of the installation maps showing soil types throughout the total training areas should be made to determine if sands, clays, or combinations of soils occur. Samples of Soils should be taken from the range areas, as well as samples taken directly from dirty vehicles returning to the cantonment area after a heavy rain. Separate samples should be collected for each identifiable soil type (3 to 5 gallons each) and analyzed in a soils laboratory. The laboratory should prepare a standard gradation curve of grain size distribution showing gravel, sand, silt, and clay utilizing both a mechanical analysis and a hydrometer analysis down to 0.001 mm diameter. Both a dispersed and a non- dispersed hydrometer analysis need to be performed. The dispersed, which breaks the particles into individual grains, is used for standard classification. This will be used to categorize the soiling expected on the vehicles. The dispersed, which assesses the agglomerated particles, is used in the treatment analysis (chap 6), since the washing operation does not totally disperse the soil. Figure 3-1 shows an example of a cohesive (silty clay) soil gradation curve both dispersed and dispersed. Figure 3-2 shows an example of a noncohesive (sandy) soil.

Figure 3-1 Cohesive Soil Gradation Curve

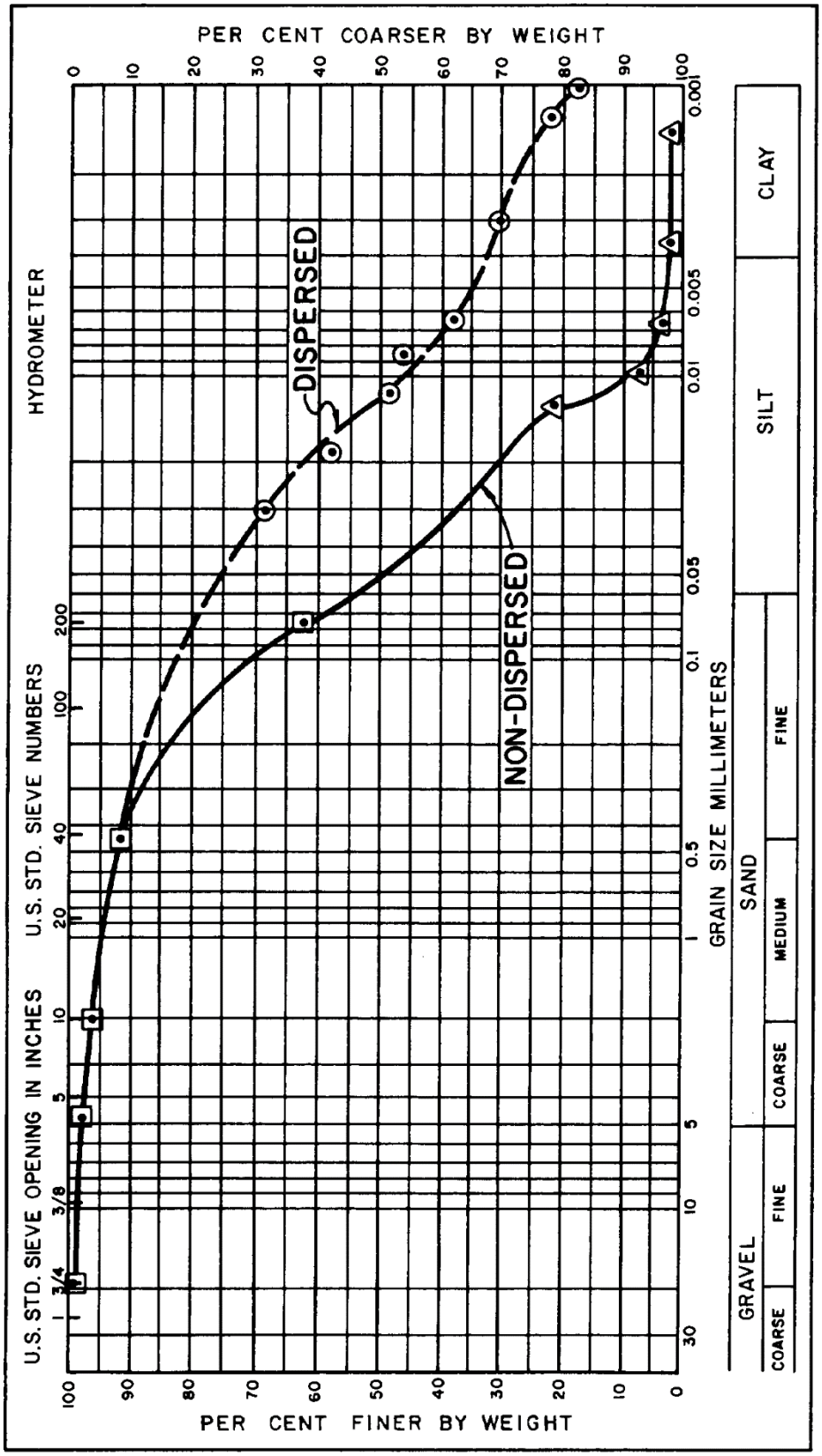
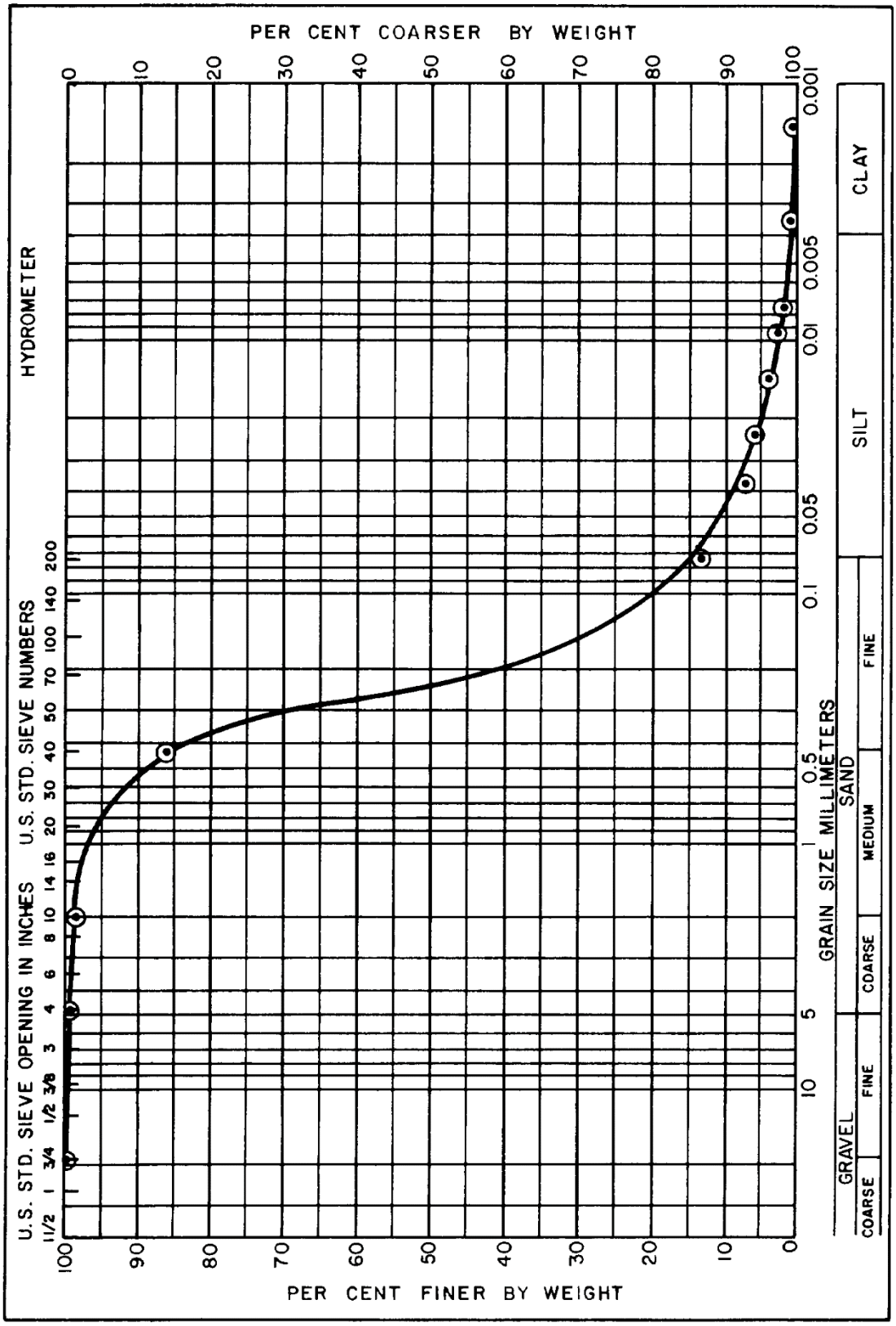
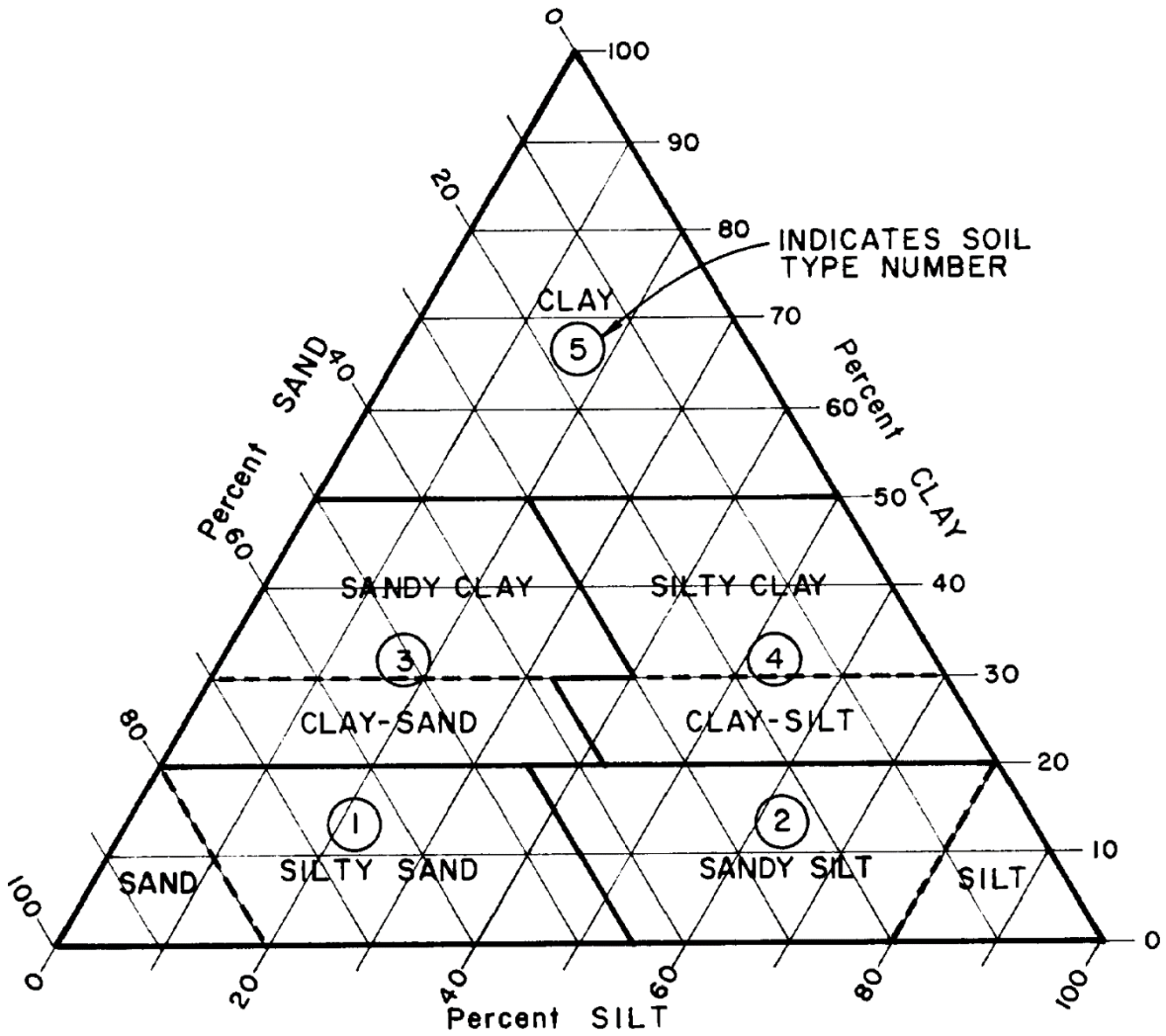


Figure 3-2 Noncohesive Soil Gradation Curve



- A classification of the soils expected to be on the vehicles is needed. By taking the particle size curve previously discussed and plotting the percentage of sand, silt, and clay (dispersed) on a triangular classification chart shown on Figure 3-3, a combined classification can be made. As a indicator of soiling potential expected on the vehicles, the chart is divided into 5 categories or soil type numbers (S_t). The sands and silty sands are given a type number of 1, being the likely to soil a vehicle and being the easiest to clean. The clays are given a type number of 5, being the most likely to soil a vehicle and being the hardest to clean. There a particular analysis may plot on the chart close to the line between two types, interpolation should be applied (i.e. a soil could be given a type number of 2.5). Where different soils occur in the training ranges, an average of those found may be used. The designer should use judgment when making this determination and give due consideration to the extreme adverse effects caused by high clay content soils.

Figure 3-3 Soil Classification and Soil Type Number Diagram



- Actual soiling of vehicles is a function of both soil type and the amount of rain or wet conditions expecting in the training areas. Therefore, climatic data must be provided in order to fully assess the potential for vehicle soiling. Arid regions would have minimum soiling potential where rainy regions would have maximum soiling potential. By assigning a climatic factor (Fc) to the area, ranging from 1 being arid to 2 being very rainy or wet, and multiplying this by the soil type number, a soiling index can be obtained for the installation. This is given by Equation 3.1.

$$\mathrm{Si} = \mathrm{St} * \mathrm{Fc} \qquad \text{(eq. 3-1)}$$

  The soiling index will be used to predict times and determine the need for prewash.

3-1.1.4 Climatic Data.

As previously stated, climatic data at the installation is necessary. In addition to amount of rain, seasonal variations in moisture and temperature are needed. Areas with long periods of freezing weather will require special design considerations to protect wash components, pumps, and piping. Most of the wash components, particularly the prewash, may not be feasible to operate near freezing conditions because of the safety hazard caused by overspray freezing on the pavement. Enclosed facilities may be warranted, however, they are very expensive from both a capital and operations standpoint. Another climatic consideration in the design is the evaporation rate in the region. In an area with high evaporative losses and low rainfall, certain features of the CVWF may not be practical. For example, a spray stand creates large water losses due to overspray. Use of any prewash system increases the volume required in the treatment system, with the higher water volume, the surface area of the basins must be increased (particularly a lagoon treatment), which promotes evaporative losses even more. The designer must evaluate the potential evaporative loss as it affects the need for make-up water and weigh this against the benefits of either a recycle system or a discharge system.

3-1.2 Prewash.

A prewash is used to reduce the time needed to wash vehicles, since it removes the bulk of the dirt in a timely, efficient way. Its function is to reduce the amount of time each vehicle must spend at the wash stations.

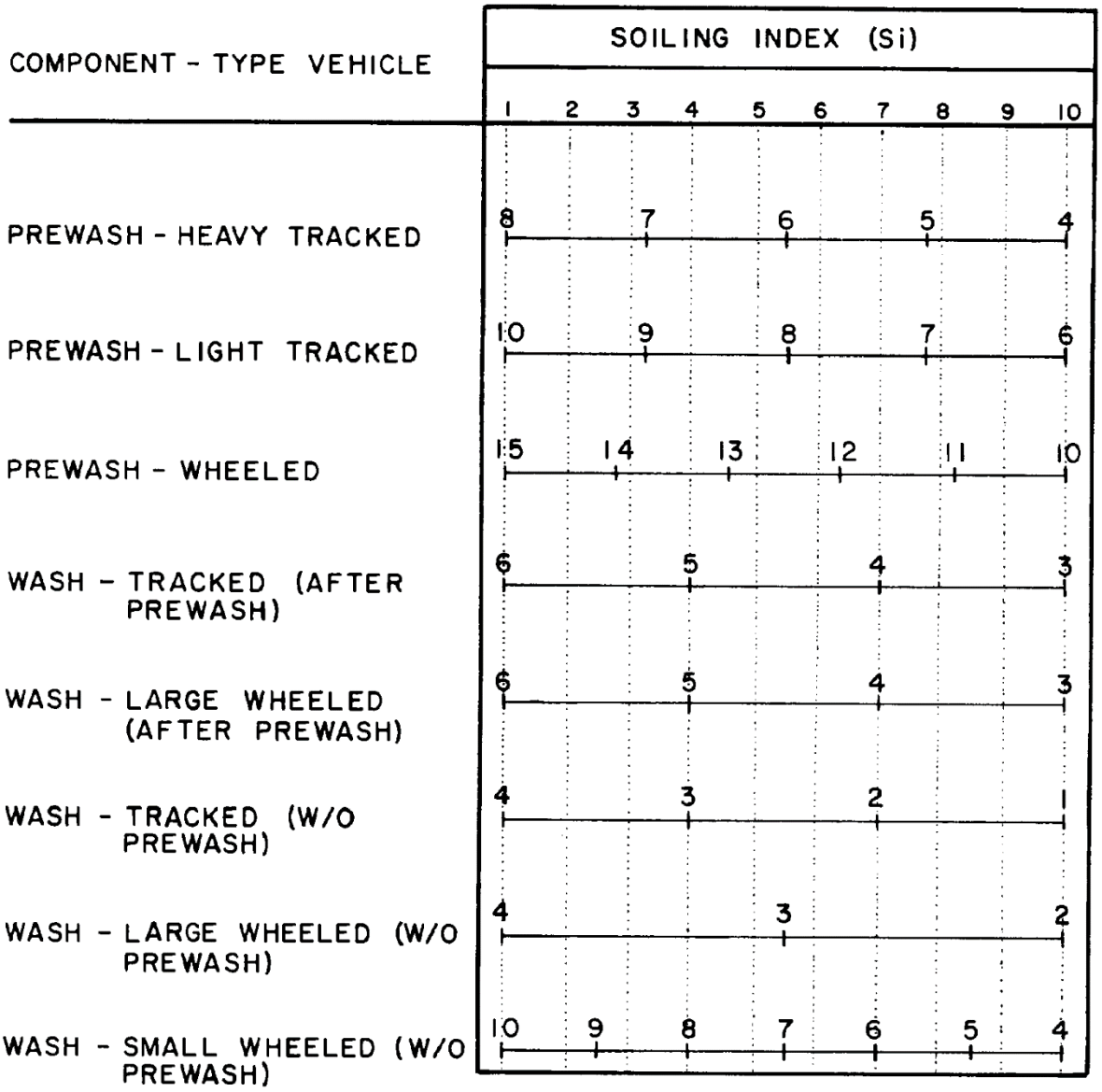
3-1.2.1 Bath Prewash.

A bath prewash is currently the most efficient and effective method to remove dirt from the exteriors of tactical vehicles. A large volume of water is required to fill the bath, but because of the reduced wash time required, the overall water volume required for cleaning a large number of vehicles may be reduced. Lanes specifically designed for washing tracked vehicles can be provided; lanes which can accommodate both tracked and wheeled vehicles (referred to as dual purpose lanes) can also be provided. These are described further in Chapter 5. Wheeled vehicles under 2.5 tons would not normally use the prewash bath.

3-1.2.1.1 Process Rate.

In a tracked bath lane, six to ten tracked vehicles per hour can be washed. In a dual-purpose lane, ten to fifteen wheeled vehicles per hour can be washed. The amount of soiling will determine the actual number of vehicles that can be processed through the facility; the heavier the soiling, the slower the vehicles can be processed. By using the Soiling Index (Si) in conjunction with the processing rate chart shown on Figure 3-4, the throughput rate can be determined for a particular design.

Figure 3-4 Vehicle Processing Rates (Vehicles per Hour)



- The number of lanes for the prewash will depend on two factors: The maximum number of vehicles that must be washed at the facility in a time specified by the installation (peak wash period) and the expected process rate through the facility. Equations 3-2 and 3-3 will help the designer determine the number of each type of lane needed for the prewash

system. The installation's requirements will dictate how the result should be treated. If the maximum washing time is critical, the number should be rounded up, otherwise, the number of lanes should be rounded to the nearest whole number.

$$\text{No. of tracked Lanes} = \frac{\text{Max.No.Tracked Vehicles to be Washed}}{\text{Process Rate} * \text{Peak Washing Period}} \quad \text{(eq. 3-2)}$$

- In equation 3-3, only the tracked and wheeled vehicles expected to use the dual-purpose lane should be considered in the equation. The number of tracked vehicles using the lane should not be included, since they will not be washed twice in the prewash.

$$\text{No. Dual Purpose Lanes} = \frac{1}{\text{Peak Wash Period}} * \frac{\text{No.Tracked}}{\text{Process Rate}} * \frac{\text{No.Wheeled}}{\text{Process Rate}} \quad \text{(eq. 3-3)}$$

3-1.2.1.2 Equation Example.

An example will better explain how to use the equations. Consider an installation that needs to wash 42 heavy tracked vehicles, 88 light tracked vehicles, and 125 wheeled vehicles in the prewash during peak use. The installation requires that all of the vehicles be washed in 9 hours. Soils at the installation are extremely cohesive clays, so the process rates through the prewash are expected to be slow. The designer had determined that the soiling index (Si) is 8 and from the chart (Figure 3-4 estimates that five heavy tracked vehicles per hour can be washed in each lane; seven light tracked vehicles per hour per lane can be washed; and eleven wheeled vehicles per hour per lane can be washed in a dual-purpose lane. For initial calculations the following will be used.

$$\frac{42 \text{ heavy tracked}}{5\frac{\text{veh}}{\text{hour}}{\text{lane}} * 9 \text{ hr}} + \frac{88 \text{ light tracked}}{7\frac{\text{veh}}{\text{hr}}{\text{lane}} * 9 \text{ hr}} = 0.93 + 1.40 = 2.33 \text{ tracked lanes}$$

$$\frac{125 \text{ wheeled vehicles}}{11\frac{\text{veh}}{\text{hr}}{\text{lane}} * 9 \text{ hr}} = 1.26 \text{ dual pupose lanes}$$

- The designer realizes that, with three tracked vehicle lanes one dual-purpose lane, the tracked vehicles will be washed in less than 9 hours, but the wheeled vehicles will require more than 9 hours. To achieve a more even distribution of vehicle washing, the designer recalculates the number of lanes needed by assuming that some of the light tracked vehicles will use the dual-purpose lanes. The designer adjusts the process rate for the light tracked vehicles in a dual-purpose lane. It will take longer to process a tracked vehicle in dual-purpose lane than in a tracked lane, since the flexors in a dual-purpose lane are not as effective as those in a tracked lane at removing the embedded soil from the tracks.

$$\frac{42 \text{ heavy tracked}}{5\frac{\text{veh}}{\frac{\text{hour}}{\text{lane}}} * 9 \text{ hr}} + \frac{65 \text{ light tracked}}{7\frac{\text{veh}}{\frac{\text{hr}}{\text{lane}}} * 9 \text{ hr}} = 0.93 + 1.03 = 1.96 \text{ tracked lanes}$$

$$\frac{125 \text{ heavy tracked}}{11\frac{\text{veh}}{\frac{\text{hour}}{\text{lane}}} * 9 \text{ hr}} + \frac{23 \text{ light tracked}}{5\frac{\text{veh}}{\frac{\text{hr}}{\text{lane}}} * 9 \text{ hr}} = 1.26 + 0.5 = 1.76 \text{ dual purpose lanes}$$

- Two tracked vehicle lanes and two dual-purpose lanes would offer a more efficient use of the bath than would the results given by the first calculations.

3-1.2.2 Automatic Washers.

The types and number of vehicles in the motor pool must be considered in sizing the automatic wash area. Administrative-type vehicles in a TMP usually return one at a time and are washed as they return. Thus, large numbers of units will not be waiting to be washed in a limited amount of time as is the case with tactical vehicles at CVWFs. Civilians usually are employed to do the washing at TMP wash facilities; therefore, all of the daily washing normally will occur during an 8-hour period during daylight. A one-or-two position automatic prewash unit may be all that is required. Again, the number of vehicles per cycle and average time of washing are used to determine the size of the prewash unit.

3-1.3 Wash Stations.

Before sizing the facility, with or without a prewash, the designer must have a clear understanding of the installation's washing requirements. The number of stations needed at the wash facility will depend on whether a prewash system is provided. A prewash will lessen the time that these vehicles must spend at the wash stations, thus reducing the number of stations needed

3-1.3.1 Sizing with a Prewash.

Sizing with a prewash. When a bath prewash is provided, the number of wash stations should be between two and five per tracked vehicle bath lane. A process rate of 3 to 6 vehicles per hour at each wash station can be expected after the vehicles have been washed in the bath. Since all vehicles will not go through the prewash bath, calculations of lanes must account for longer wash times for these vehicles. A process rate of 2 to 4 vehicles per hour for large, odd shaped, or tandem units can be expected. A process rate of 4 to 10 vehicles per hour for small wheeled vehicles such as jeeps or ½ tons can be expected. Installations with a limited washing time or a large percentage of wheeled vehicles to wash will require more wash stations. In any case, the number of stations can be calculated using the processing rates for each type of vehicle and its type of wash, as shown on Figure 3-4, and following the same logical steps used to size the prewash.

3-1.3.2 Sizing without a Prewash.

If no prewash is provided, the planner predicts the number of wash stations needed based on soiling conditions and process rates.

- The process rate for vehicles at the wash stations will depend on several factors, but usually will be between 1 and 10 vehicles per hour. This range is given to allow an adjustment for the vehicle types and soiling index at the site. Installations that have vehicles soiled with large amounts of cohesive soils (clays) will have slower processing rates than those with only noncohesive soils (sand) or dust on the vehicles. By using the Soiling Index (Si) in conjunction with the processing rate chart shown on Figure 3-4, the throughput can be determined for each vehicle type. The mission of the installation also will affect the rate. At some installations, vehicles may return to the motor pool immediately for inspection. In this case, the processing rate will be slower than if the vehicle were not being inspected, since the troops will most likely perform a detailed washing. Less time will be taken to clean the vehicles if they will be returned directly to the field for further training.
- The number of tracked and wheeled vehicles to be washed is used in equation 3-4 to estimate the number of wash stations needed at the facility:

$$\text{No. Stations} = \frac{1}{\text{Max. Wash Period}} * \frac{\text{No. tracked}}{\text{Tracked Process Rate}}$$

$$+ \frac{\text{No. Wheeled (Lg.)}}{\text{Lg. Wheeled Process Rate}} + \frac{\text{No. Wheeled (Sm.)}}{\text{Sm. Wheeled Process Rate}}$$

(eq. 3-4)

The user's requirements will determine how this number should be rounded. If the maximum washing time is critical, the number should be rounded up; otherwise, it should be rounded to the nearest whole number.

3-2 SITING.

3-2.1 Geography.

All future development and land uses at the installation must be considered when siting a CVWF. These future plans must not adversely affect the vehicle and equipment movement inside and outside the facility. At the same time, the facility must not interfere with activities in the cantonment and training areas and vice-versa; the land uses should be compatible. Vehicle noise and movement must not interfere with family housing, hospitals, and other installation activities. If night washing is planned, it must not disrupt local activities; for example, the lighting at the facility must not disturb the surrounding area.

3-2.1.1 Space Requirements.

Planners and designers must consider overall space requirements for the facility. Large, open areas will be needed if a total recycle treatment system is to be installed. Lagoon treatment systems require even larger areas than intermittent sand filter systems. Smaller areas will suffice for partial or total discharge systems. A CVWF with eight wash stations, no prewash, and no recycle system can require 2 to 4 acres; one with 20 wash stations, 4 lane prewash, and a complete recycle treatment system can require as much as 50 acres.

3-2.1.2 Cantonment Boundary.

The wash facility should be located near the permanent cantonment boundary and between the training areas and maintenance shops/motor pools. The vehicles must be cleaned before they enter the cantonment area; otherwise, the dirt will fall onto the roads and trails within this area. Future changes in the cantonment boundary must also be considered when siting the CVWF.

3-2.1.3 Training Area.

The facility should be located as close as possible to the main tank trails, access roads from the training areas, or similar sites. The vehicles are washed as they return from the training field areas prior to entry onto cantonment roads. Future locations for training areas also must be considered with respect to the CVWF site.

3-2.1.4 Transportation Arteries.

Several routes usually enter the cantonment area from many different training areas. A CVWF usually cannot be constructed at each entry point, so new roads or tank trails may have to be built to link the primary routes from the training areas with the wash facility. To prevent the vehicles from becoming soiled immediately after washing, they must return from the wash facility to the maintenance shops/motor pools on paved roads or tank trails. If the exit from the facility is placed close to existing roads or tank trails that are paved, new construction will be kept to a minimum. The facility must also be located to minimize the distance that dirty vehicles must travel on major transportation arteries. Otherwise, the dirty vehicles will drop soil on roads over which other vehicles travel. The number of tank-trail crossings over major roads, both to and from the wash facility, must also be minimized. The entrance and exit of the wash facility should be sited to avoid adverse effects on traffic both there and in the cantonment area. The facility should not be located in congested areas such as near the main gates, major intersections, hospitals, administration offices, and other high traffic areas.

3-2.1.5 Maintenance Shops/Motor Pools.

Present and future locations for tactical maintenance shops and motor pools must be considered in siting the CVWF. The facility should be located between the training areas and the maintenance shops/motor pools. The vehicles should return from the training areas and, after washing, return to the maintenance shops/ motor pools with minimal travel on cantonment roads.

3-2.2 Weather.

The wash facility must be designed with due consideration to all local and regional weather conditions.

3-2.2.1 Temperature.

If the installation is in a region with long periods of freezing temperatures, some standard CVWF components, such as the prewash bath may not be useable since the CVWF is not intended to be operated continuously at temperatures below 40 F. In areas with seasonal or occasional freezing temperatures, special piping and plumbing fixtures must be installed at the outdoor facilities to drain the exposed pipes and keep them from freezing. South-facing slopes should be considered for construction sites to take the greatest advantage of the sun for heating during the winter months. The washing structures and treatment system still must be protected from freezing temperatures to prevent pipes and other vulnerable components from freezing and rupturing.

3-2.2.2 Winds.

The designer should consider locating the wash facility and treatment system to minimize adverse effects from wind. Wind blowing over basins increases the rate of evaporation. In addition, winds that blow over the long axis of an elongated basin can create waves that will erode the banks. Wind can be used to move surface oil toward the oil skimmer in sediment basins provided the oil skimmer is located properly. Strategically placed vegetation, structures, and fences can reduce the adverse effects of wind. However, vegetation must not interfere with pipes, trenches, pavement, liners, or other functional parts of the facility.

3-2.2.3 Precipitation.

Gently sloping ground which is elevated slightly with respect to the surrounding grounds should be chosen to ensure that stormwater can be controlled. Stormwater collected on the pavement during washing operations should be directed toward the treatment system since this water may require treatment; in addition, it can be used as makeup water for a recycle system. Curbing should be installed where the soil and pavement interface, and where it is needed to control the drainage flow and to prevent erosion. Rainwater falling on the surrounding area should be directed away from the facility unless it is to be used as a source of makeup water.

3-2.2.4 Vegetation.

The site layout should make effective use of existing vegetation to protect the buildings, personnel, and basins against wind and sunlight. Trees, shrubs, and grass should not be removed except as necessary for construction or operation. The roots hold soil in place, thus preventing sheet wash and soil deposition onto the paved surfaces and into the stormwater collection system. Moisture in the treatment basins will promote growth of vegetation such as trees and shrubs on the surfaces and along the edges of the basins. Trees and shrubs that grow very close to the filters and the basins must be

cleared because their root systems may penetrate the liners and cause leaks. Slopes for berms should be designed to allow convenient maintenance.

3-2.2.5 Fauna.

The abundance of water will promote insect and animal life in the area around the basins. Fences may have to be constructed around the basins, especially in arid regions, to prevent wildlife from entering the area to drink or bathe since their activities could damage the slopes and liners. The water also may attract burrowing animals that can damage liners and berms; their presence may, in time, increase maintenance needs.

3-2.2.6 Evaporation Rates.

The region's evaporation rate must be considered when siting and designing the facility.

3-2.2.6.1 Arid Regions.

Wash facilities in arid regions must have the wash structures and treatment system designed to minimize the effects of evaporation. Water from the pavement should be directed toward the treatment system; in this way, stormwater can be collected and used as an additional source of makeup water. In hot, arid regions, the pavement should be light-colored to reflect heat; the evaporation rate will be less when the wash water hits a cooler, lighter surface than when it hits a hotter, darker one. Another major point of evaporation is from the basins in the treatment system. A high rate of evaporation from the basins can increase the concentration of dissolved solids in the water. This higher dissolved solids content can result in spotting on vehicles after washing and increased corrosion. The exposed surface area of the basins should be minimized. The basins' depth can be increased to the upper limits to allow them to hold the required volume while reducing the exposed surface area. Wind blowing over the basins also can raise the evaporation rate. Fences and shrubs can be placed around the basins to help block winds. Vented covers also can be placed over the basins to reduce evaporation. Basin liners and the materials used for filters should be light-colored.

3-2.2.6.2 Water-Rich Regions.

In water-rich areas, provisions must be made to handle a heavy water volume. Onsite control to prevent stormwater damage to the treatment system becomes critical when heavy rainfalls are expected.

3-2.3 Geology.

3-2.3.1 Topography.

The site should have some fall if the designer is to consider using a gravity-controlled recycle wastewater treatment system. A 2 to 3 percent slope across the site is desirable, with the high side being adjacent to access roads or tank trails. If the terrain is too flat, the treatment system would require extra pumping in order to recycle the water. This requirement would increase costs for initial construction and for operation.

It is essential that the wastewater flow by gravity from the wash structures to the sediment basins. Should the wastewater be pumped before primary treatment, any oils in the water would become emulsified and thus more difficult to remove. Low-lift pumps can be used elsewhere in the facility if necessary. The entire site should be elevated with respect to the surrounding area. Slopes in the immediate area should fall away from the site to help move stormwater and cold air away from the site. It is desirable that the local topography not funnel water or strong winds toward the site.

3-2.3.2 Soils.

Soil borings must be taken at the proposed site to determine the soil types, the depth of the bedrock, and the depth of the water table. The soil should be able to support concrete, bentonite, and similar sealers that will be applied to the bottoms of basins, sand filters, and facilities such as pump houses and control buildings. Large soil particles tend to slide and shift more than small ones; therefore, in sandy areas, the walls of excavated basins will have to be built with a low-sloped angle to prevent this problem. Excavation of a basin at a site with cohesive soils may be more expensive than a site with non-cohesive soils. However, it may be more expensive to stabilize the slopes at the site with non-cohesive soils. It may also be more cost- effective to use native, cohesive soils for basin construction than other types of liners or imported soil. Bentonite liners may be difficult to seal on non-cohesive soils; later, settling and shifting of the soils may create leaks in the liner. Bentonite liners can also be damaged by hydraulic pressure from groundwater, especially when non-cohesive soils are present.

3-2.3.3 Bedrock.

The site should have deep bedrock since shallow bedrock hinders excavation. An excavation into bedrock may penetrate into fissures that are part of a subsurface water recharge network for a public water supply; this supply could become contaminated by wastewater from the facility. Excavation into bedrock also increases construction costs. If no other site is available, fill material may be used to increase the soil depth at the site. Another alternative would be to excavate material that is easy to remove down to the bedrock, then use the excavated material to build a berm around the basins. The gradient of the berm slopes must be low enough to avoid interfering with operations and maintenance (O&M) and to prevent sheet erosion of the slope.

3-2.3.4 Water Table.

The planner must know the depth of the water table at the proposed construction site. Sites near marshes, swamps, or low areas should be studied to determine if the water table will have an adverse effect on construction or O&M of the facility. The facility must be placed above the maximum height of the seasonal and permanent water tables. Areas with high water tables may require complex drainage systems, usually with high construction costs. Should the basins and filters be constructed when the water level is low and then water rises and surrounds the structures, the hydraulic pressure can damage the liners and cause leaks. Clay lenses or other impervious sub-surface features can create a high, perched water table. Excavation to repair the subsurface structures would be hindered by the high water table; it would also be expensive

because the groundwater would have to be removed from the site to allow personnel to work.

3-2.3.5 Drainage.

It is important that wastewater generated by the facility not contaminate drinking water supplies. Therefore, wastewater from the washing structures must not drain into a surface or subsurface water recharge area for a public drinking supply. Surface and shallow subsurface water should be directed away from the site unless it will be used as a source of makeup water. The area will be wet due to washing, storage, and treatment; in certain climates, ponding and uncontrolled collection of stormwater can cause discomfort to the workers (i.e., from being cold and wet) and speed the rate at which equipment wears. Sites with permeable soils allow surface waters to percolate, which prevents ponding and sheet erosion.

3-2.3.6 History.

It is important to have historical knowledge of the site. Past uses of the site may make it unsuitable; this could be from an archaeological standpoint such as old burial grounds, or from a hazardous standpoint such as old landfills or old firing ranges and impact areas.

3-2.4 Utilities.

The planner must consider all utilities required at the facility with respect to those available at the site. If some of the utilities are not available; the best alternative must be found.

3-2.4.1 Water.

The wash facility should be sited near existing water or supply lines if possible. Water meters should be installed so that the potable and recycled water can be metered.

3-2.4.1.1 Potable Water.

A potable supply must be provided as drinking water for personnel. If it is not feasible to tie the facility into the potable water system, portable equipment can be used to supply drinking water. Signs must be posted informing personnel not to drink the wash water and telling them where drinking water is available.

3-2.4.1.2 Makeup Water.

Potable water is not required for washing the vehicles; however, the water must be free of particulate matter that would interfere with pump operation and cause premature wear of the wash equipment. The water source must charge and maintain a working water level in the treatment system. A dedicated well may be used if that proves more economical than tying into the existing water lines. If the planner considers using an untreated well, the groundwater must be of an acceptable quality and must provide a consistent supply. If the area is water-rich, rain can be used as a source of makeup water. Ponds, lakes, and streams are other potential raw water supply sources for the

facility. The amount of water needed at the facility will depend on several factors: frequency washing, number of vehicles, types of vehicles, and type and size of treatment system provided. The planner must also consider the best source and method of charging a recycle treatment system initially. Once a recycle treatment facility is charged, the only demand for water will be to makeup that lost to vehicle carry-off, evaporation, and leakage.

3-2.4.2 Sanitary.

The facility should be located near the sanitary sewer lines if possible. This arrangement allows the designer to tie latrines at the wash facility into the sanitary lines. Other options such as pit latrines, composting chemical toilets, or septic tanks with field lines are possible; selection will depend on local practices and preference. A location near sewer lines also allows the designer to divert all or part of the wastewater to the installation's sewer plant. If this type of discharge system is used, the planner must determine if the sewage treatment facility can handle the discharged wastewater, including the hydraulic and solids loadings created. The cost of connecting with and maintaining the sewer lines must also be considered when deciding whether to tie the facility into the sewage treatment system.

3-2.4.3 Electrical.

The electrical provisions shall comply with UFC 1-200-02 and UFC 3-501-01. The wash facility should be located near an electrical distribution source. If electrical power is not available at the site, new service must be provided. Electrical distribution will be required to serve the area lighting canopy lighting, power, security, and other appurtenances associated with these facilities.

3-2.4.3.1 Planning.

As a minimum planning should fund the electrical service to the facility as 208/120 volt, 200 amp, 3-phase, 4 wire. The designed electrical service distribution will need to be based on expected loads and available distribution. A few key items that may affect the service. What services are available nearby? What is the expected load? Will there be supporting facilities such as a canopy, observation building, and equipment building? What is the volume of water treated, recycled, and discharged; the type of washing operations; the frequency and; and the number of washing operations performed each year?

Where local utility power sources are unavailable, onsite generation may be provided to the facility in accordance with UFC 3-540-01. If known at planning the funding documents should reflect these costs. Security services and extent of these provisions needs to be determined during planning. Whether these provisions can be provided under the Construction Contract also needs to be determined at planning to insure the proper funding streams are available.

3-2.4.3.2 Electrical Power Distribution.

Exposed electrical power lines shall not span areas of vehicle movement. Proximity of personnel, continuous presence of water, and uncertain vehicle dimensions (e.g.

antennas, etc.) create an operationally hazardous environment for overhead electrical distribution. UFC 3-550-01 provides further guidance for exterior electrical power distribution requirements.

3-2.4.4 Lighting.

The lighting provisions shall comply with UFC 1-200-02 and UFC 3-530-01. The wash facility should be located near existing lighting sources if possible.

Adequate lighting should be provided if nighttime washing operations are required by the installation. For worker safety, overhead lighting is required in the areas of vehicle movement.

- Work-level lighting must be provided at the bath prewash so that users can see the vehicle areas to be cleaned. Provide lighting level of 3 foot-candles minimum, measured at pavement/grade level.
- In the wash area provide a lighting level of 5 foot-candles minimum, measured vertically, on the vehicle from end to end.
- The two types of lighting should not be additive in computing lighting intensity levels since one is a vertical projection and the other is a horizontal projection.

3-2.4.4.1 Minimum Lighting Levels.

All areas of adjacent hardstand such as assembly/staging and travel lanes should have a minimum lighting level of one foot-candle.

3-2.4.4.2 Security and National Fire Protection Association (NFPA) 101 Lighting.

Security and NFPA 101 lighting is required at entrance/exit doors of each building and other locations. A selected portion of the tower fixtures may be used as security lighting.

3-2.4.5 Telecommunications.

Telecommunication provisions shall comply with UFC 3-580-01. Telecommunication services shall be provided at the facilities. Outside Plant Provisions shall be coordinated with the local Network Enterprise Center or Communications Squadron. The extent of work shall depend on the facilities involved. As little as a telephone at a canopy to an Equipment room with Copper and/or Fiber optic cables in a control building. A few factors should be addressed in planning. The first is there an equipment building? This building will need direct digital controls and may need to report to the installation system. Is there a contact protocol requiring remote reporting by telephone or data system? Is there a security system involved and does it require reporting to another system?

It is important that aerial telecommunications services not span areas of vehicle movement. Vehicle antennae, especially on wet vehicles, and must not come into contact with this distribution as this occurrence would pose a safety hazard to the area.

Planning should account for all working clearances being addressed and the design stage has these requirements identified.

CHAPTER 4 DESIGN

4-1 VEHICLE PREPARATION AREA.

4-1.1 General.

CVWFs have two types of paved staging areas, each with different functions. These are designated as the preparation and vehicle assembly areas. Staging involves alignment of vehicles for orderly movement through the CVWF; in addition, vehicles are sorted according to type and washing requirements. Vehicles waiting and being prepared for washing are aligned for direct entry into the designated wash stations. The preparation area provides troops with a location to remove trash from vehicle interiors, plug drain holes, open bilge pump discharge lines, remove camouflage, check tiedowns, and use restroom facilities (when provided) prior to washing the vehicles.

4-1.2 Sizing.

The area and configuration requirements of the staging areas at CVWFs depend on the queuing arrangement, amount of assembly needed, and the number and types of vehicles washed.

4-1.2.1 Preparation Area.

The preparation area should allow at least one vehicle to be staged behind each wash station. Additional vehicles using the CVWF during a major washing effort are queued in a linear fashion along the CVWF entrance road and/or trails leading to the facility. The paved preparation area should be sized to accommodate a minimum of 1000 square feet (92.9 square meters) of paved area per lane. This figure includes the vehicle area and a minimum of 10 feet (3.0 meters) of pedestrian clearance in all directions between vehicles. Since vehicles are aligned in rows according to wash station lanes, the layout of the preparation area can be established based on the gross width of the facility, including vehicle wash lanes, sidewalks, and bypass lanes. The staging area configuration will vary, depending on whether the wash station is linear, skewed, or parallel.

4-1.2.2 Vehicle Assembly Area.

This area can be sized to accommodate a company of vehicles which is assembled as a group prior to exiting the CVWF for the cantonment area. If vehicles are allowed to proceed to the cantonment area individually, the vehicle assembly area requirements can be reduced or eliminated. The layout of this area is based on the gross width dimension of the wash station divided into the required area; however, the area should be designed such that no vehicles in the wash stations are slowed because of a backup of units in the assembly area.

4-1.3 Staging Area Cleanup.

Hydrants should be provided adjacent to the vehicle preparation areas to aid in cleanup of the pavement after a washing effort. Design flow rate for these hydrants should be

25 gallons per minute (gpm) (95 liters per minute). The location of hydrants must be such as to allow hose streams to move soil from all portions of the paved area toward trench drains.

4-1.4 Drainage.

The vehicle preparation areas are sloped to drain from the edge of the pavement toward the trench drains. Trench drains may be required in the assembly areas to facilitate drainage and cleanup. Flushers are included in the trench drains to move the dirt and debris to the collection system. Vehicle preparation areas are generally not curbed; however, curbs may be used at the entrance for traffic control, at locations where vehicles might back off the pavement, or where water would otherwise run off the pavement edge and cause undermining of slab. Curbs used at tracked facilities should be designed to resist damage from tracked vehicles.

4-2 WASH STATION.

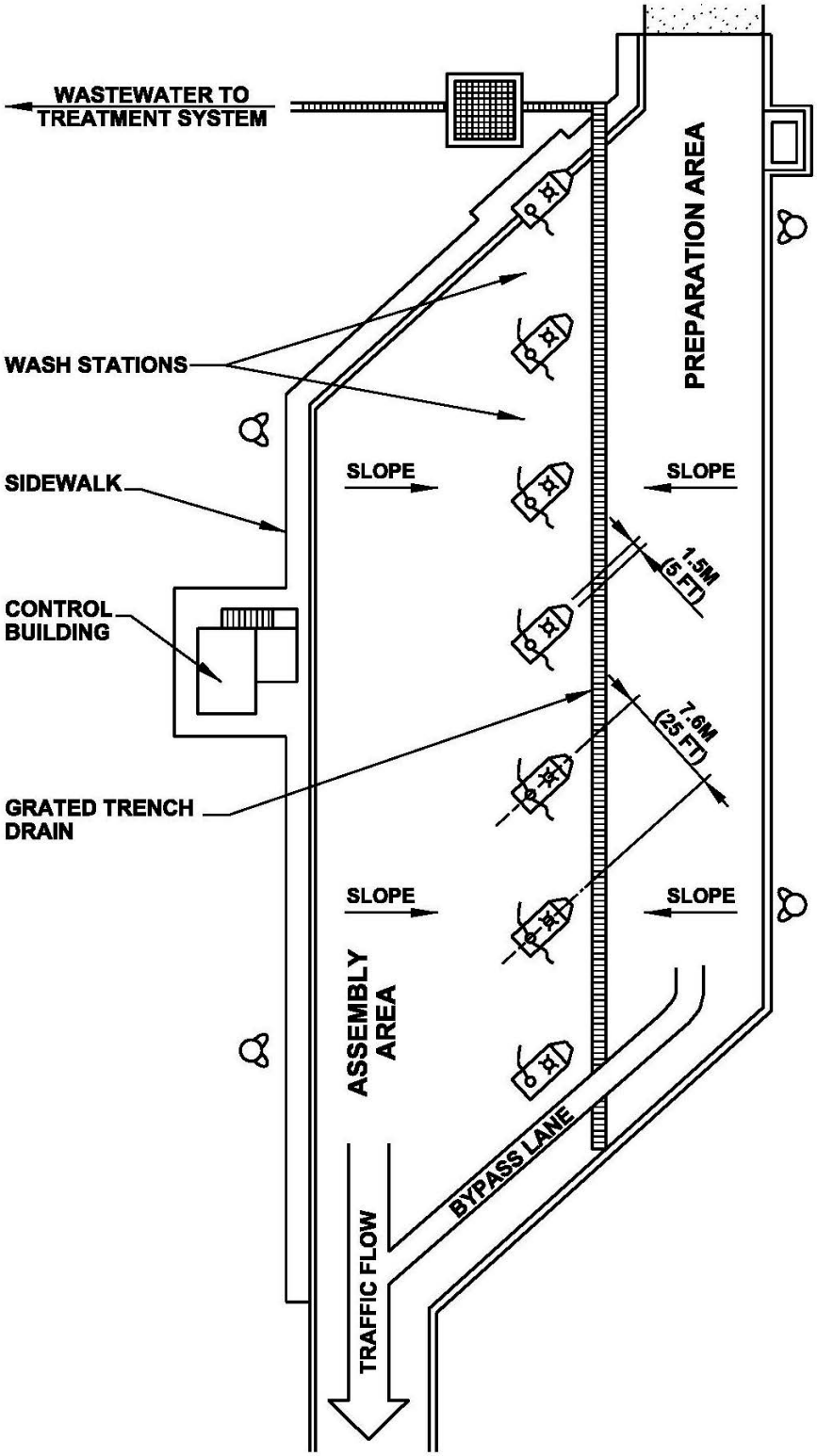
4-2.1 Function.

The wash station is the central feature of the CVWF which permits manual washing of both tracked and wheeled vehicles. The stations consist of concrete islands with towers placed on either side of the lanes. The vehicles enter the lane and stop for washing. Water hoses are hung from towers so that they do not clutter the area of vehicle movement. The stations should be designed such that two persons can use the hoses from two adjacent towers to wash a single vehicle. This design saves time by allowing both sides of a vehicle or piece of equipment to be washed at once. No solvents or detergents are used to wash vehicle at a time to pass vehicles at the facility.

4-2.2 Configuration.

The islands should be spaced in a single, straight line (as in Figure 2-1) or skewed (Figure 4-1) so that traffic lanes are parallel. This design will ensure smooth traffic flow with a minimum of turning, because vehicles move in only one direction. Vehicles waiting to be washed can queue behind those being washed. Since the vehicles always move forward, there is no hazard due to reverse travel. The islands should have a center-to-center spacing of approximately 25 feet (7.6 meters) (Figure 4-2) to allow the widest vehicle to pass easily between the islands. However, the lane width should allow only one vehicle at a time to pass through the station. If the installation will wash very long vehicles, semitrailers, or units in tow which could not be cleaned easily at a standard island, double-tower stations may be desirable. At a double-tower station, a tower is placed each end of the island. A longer island may have to be constructed to accommodate the arms of the two towers. The hose located on each arm is intended to service one-quarter of the oversized vehicle, unlike the hoses on a single-tower island at which are designed to service one-half of the vehicle. Figure 4-3 shows the layout of a double-tower station.

Figure 4-1 Skewed Wash Station Arrangement



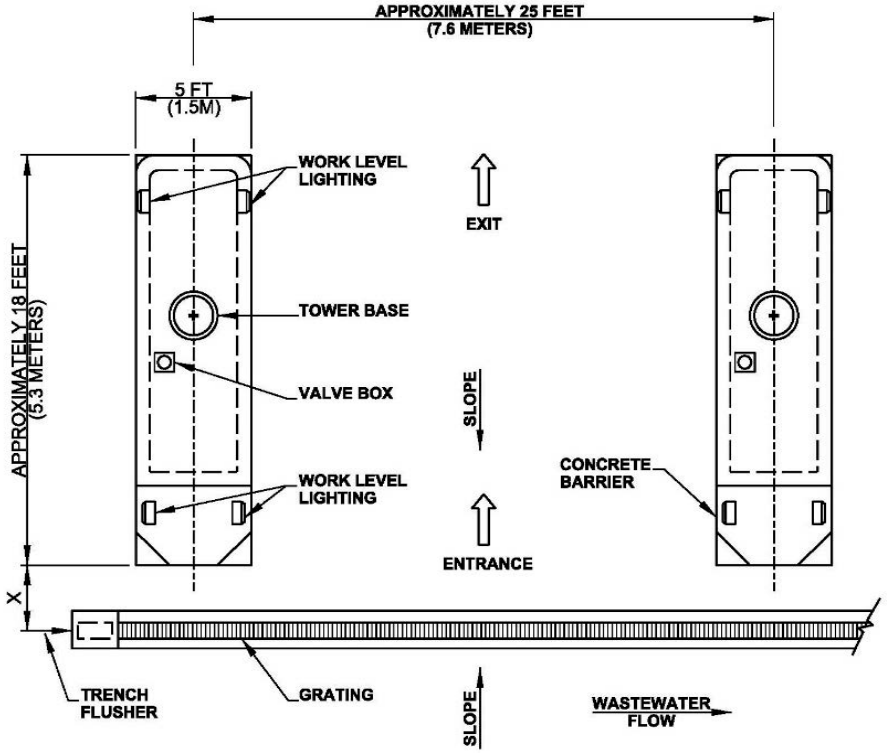
4-2.3 Island Design.

Each island should be approximately 5 feet wide (1.5 meters). Figure 4-4 shows the island in cross section. The top of the island should have a crest to prevent water from pending on the island. The surface of the island should have a broom finish to help provide traction to troops when the area becomes wet. At all wash facilities, concrete barriers should be placed on the entrance ends of each island as shown on (Figure 4-5). These barriers will protect the tower and the person working at that station against damage or injury by the vehicles.

4-2.4 Tower Design.

The tower should be constructed of standard pipe, tapered- metal signal pole or structural equivalent. The tower should support the flexible wash hose and any related lighting. Towers installed on interior wash lanes can support two wash hoses fastened horizontally above the island with swivel-type joints. The exact height of pole and length of the hoses will be site-specific, depending on the orientation of the island and the size of the vehicles to be serviced. Towers installed on outer wash islands only need one hose, since only one vehicle will be served by the island. Figure 4-6 shows the tower in cross section.

Figure 4-2 Wash Island Plan Showing Spacing



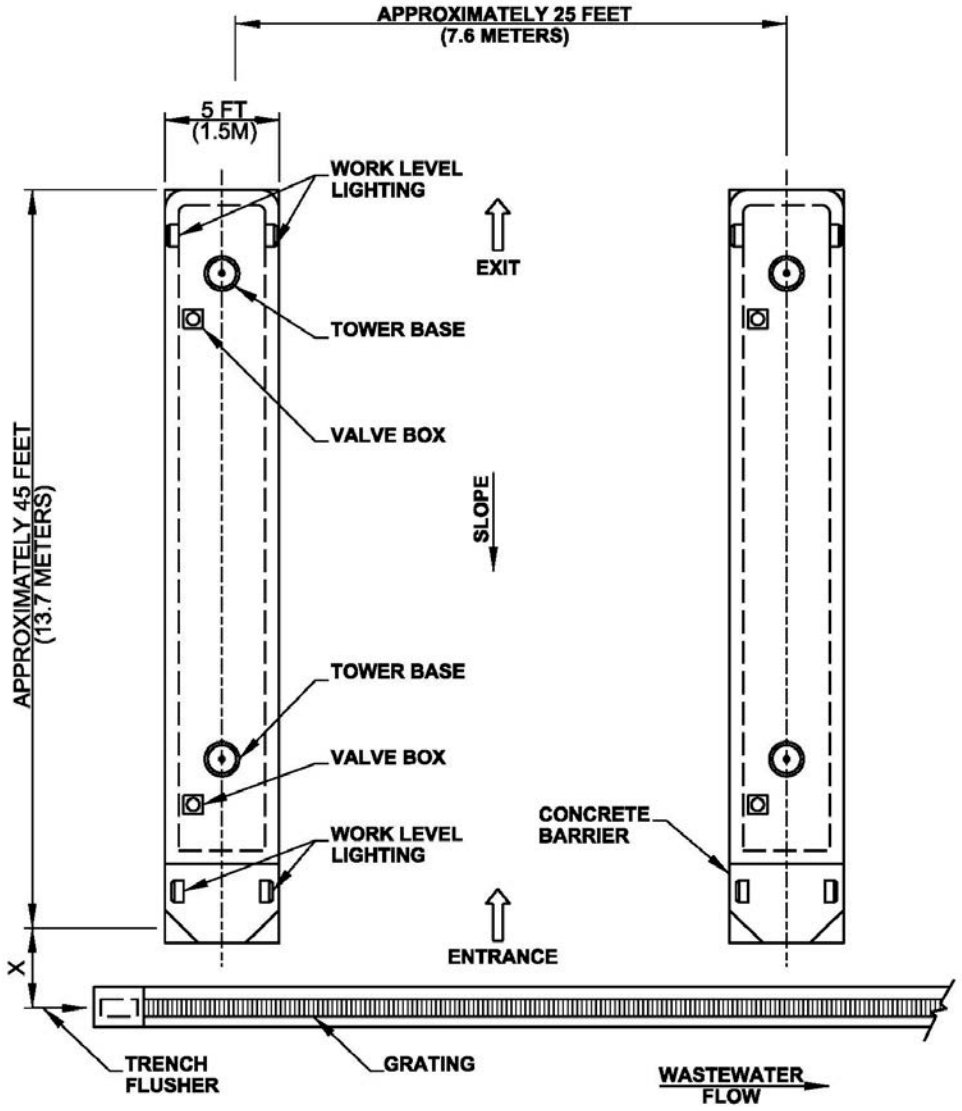
4-2.4.1 Height.

At least 15 feet (4.6 meters) clearance is needed between the pavement and the hose pivot point. If a vehicle taller than this height will be washed at the facility, a higher clearance can be used at one or more wash stations, as required.

4-2.4.2 Hose Pivots.

The hose pivots support the hose and should be properly sized steel beams which support the hose and allow horizontal rotation of the hose. Cushioned stops should be installed on the towers to limit the movement of the pivot to 180 degrees in the horizontal plane. A tie rod or other form of brace should be used to stabilize the pivot in the vertical direction. A system should be included to secure the hose after use. This system shall allow for draining of all water out of the hose and keep it from being run over by the vehicles.

Figure 4-3 Double-Tower Island



4-2.4.3 Water Pressure and Flow Rates.

The recommended design pressure is 75 pounds per square inch (psi) (5.2 atm.). The water pressure is measured at the nozzle. The recommended design flow rate is 25 gallons per minute (95 liters per minute). Pressures and flow rates are given here to facilitate pump selection. Control should be provided to limit maximum pressures at the nozzle to 90 psi. Valving must be installed to allow each island to be isolated from the water supply. Manually operated valves are required to allow troops to control flow from each hose on the island.

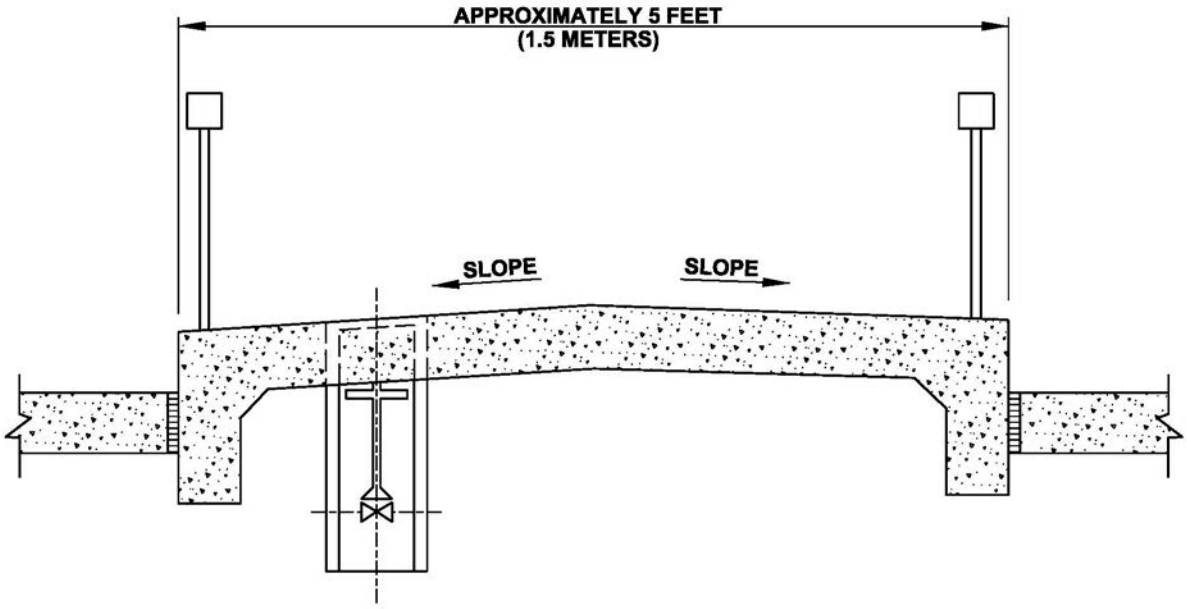
4-2.4.4 Hoses.

The hoses to be specified at the vehicle wash stations are made of reinforced rubber. The reinforcement should be an all-textile braid made of resilient synthetic yams; this material is covered with thick rubber. The hoses must be flexible for ease of handling and rated for a minimum working pressure of 300 psi (20.4 atmospheres). Hoses must be durable, suitable for use in water, and resistant to abrasion, oil, and sunlight. Orifice diameter of the nozzle should be 5/16 inch in order to provide chosen flow at 75 psi (5.2 atmospheres) pressure at the nozzle inlet. Each hose must be long enough at each location to reach the side, front, and back sections of the vehicles being washed.

4-2.4.5 Nozzles.

The nozzles must be durable to withstand frequent punishment and heavy use. The inner diameter of the hose connection at the tower will be determined by the required pressure and flow rate. The hoses should be designed with rubber nozzles built in by the manufacturer.

Figure 4-4 Cross Section of an Island



4-2.5 Protection Against Freezing.

In regions where freezing conditions may occur, the water supply piping, valves and fittings at the wash stations must be self-draining and designed for protection from damage due to freezing.

4-2.6 Water Supply Piping.

Valves which will be frequently operated on the supply piping to the wash stations must be accessible through valve pits, valve boxes, or manholes. Isolation valves within the system can be directly buried.

4-2.7 Paved Area Drainage.

4-2.7.1 Surface Drainage.

All water used for washing vehicles and cleaning the CVWF as well as all precipitation falling on or flowing through the paved area shall be collected through a drainage system that flows to the primary treatment basin. This volume may be captured as makeup water if necessary. The assembly area located after the wash area and the preparation area shall be paved and sloped toward a grated trench drain. Concrete curbing should be installed at all pavement/soil interfaces when the designer deems necessary to contain and direct the runoff to the treatment system. In areas where water is not expected to occur and vehicular control is not required, such as the preparation area, the designer may choose to limit or not use curbing. Other surface water shall be drained away from the facility unless it is to be captured for use as makeup water.

4-2.7.2 Trench Drains.

Open-grated trench drains are provided to move soil-laden wastewater from the paved staging and wash station areas to the wastewater collection system. Figure 4-7 shows a typical trench drain in cross section. The trench should have a circular (U-shaped) bottom with a smooth surface for good open channel hydraulics and abrasion resistance. Grating should be cast iron and able to support the vehicle loads to be imposed. Grate openings should be at least 1 inch wide to allow gravel to pass through. Grating sections should be of a weight and attachment design that allow easy removal for maintenance of flow in the trench drain system.

4-2.7.2.1 Trench Drain Layout.

Trench drains are usually oriented transverse or diagonally across the direction of vehicular traffic. A trench drain system is required the length of each row of wash stations at the entrance end (see Figure 2-1 Standard Central Vehicle Wash Facility Plan, Figure 4-1, Figure 4-2 and Figure 4-3). The location of additional trench drains in the staging areas will depend on the following:

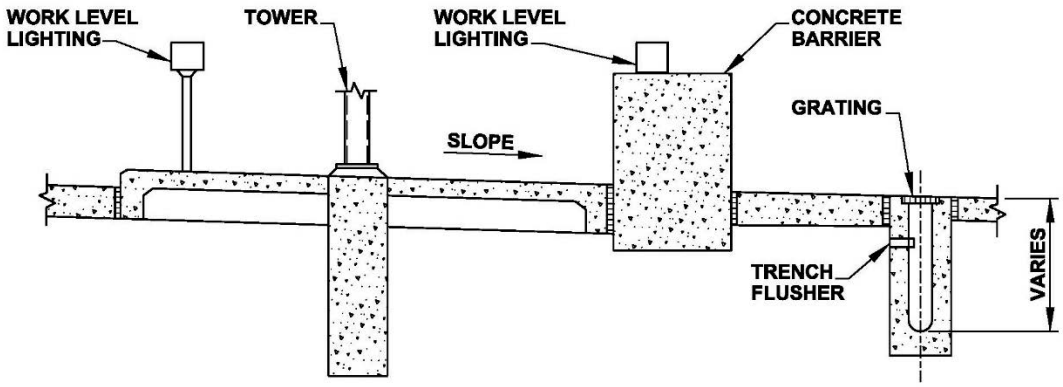
- The amount and distance that soil-laden material must be moved during wash area cleanup operations.

- The location of staging area hose hydrants and their effective area of coverage.

4-2.7.2.2 Trench Drain Flushing System.

The trench flushing system consists of a supply line with motor-operated valve and nozzle injection points along the trench drain. An adequate slope must be maintained in the trench which will move the dirt and debris to the collection system. Flow velocities of at least 5 fps (1.5 meters per second) are required. Trench slopes shall be at least 2 percent. Bottom grades at bends, junctions, slope changes, and section changes in the trench drains should be designed for energy losses. The flushing nozzles are located in the trench just above the normal flow surface and point downward and downstream. Flushing is accomplished intermittently during vehicle washing periods and during cleanup operations at the wash station trenches, and only during cleanup in other staging area trenches. Flush system control by the facility operator is critical and is independent of other pumping supply systems. Flushers are operated only when necessary in order to conserve water and electrical consumption. A well designed flushing system utilizes water drawn from the equalization basin as discussed in Chapter 6.

Figure 4-5 Longitudinal Section of an Island



4-2.7.3 Wastewater Collection System.

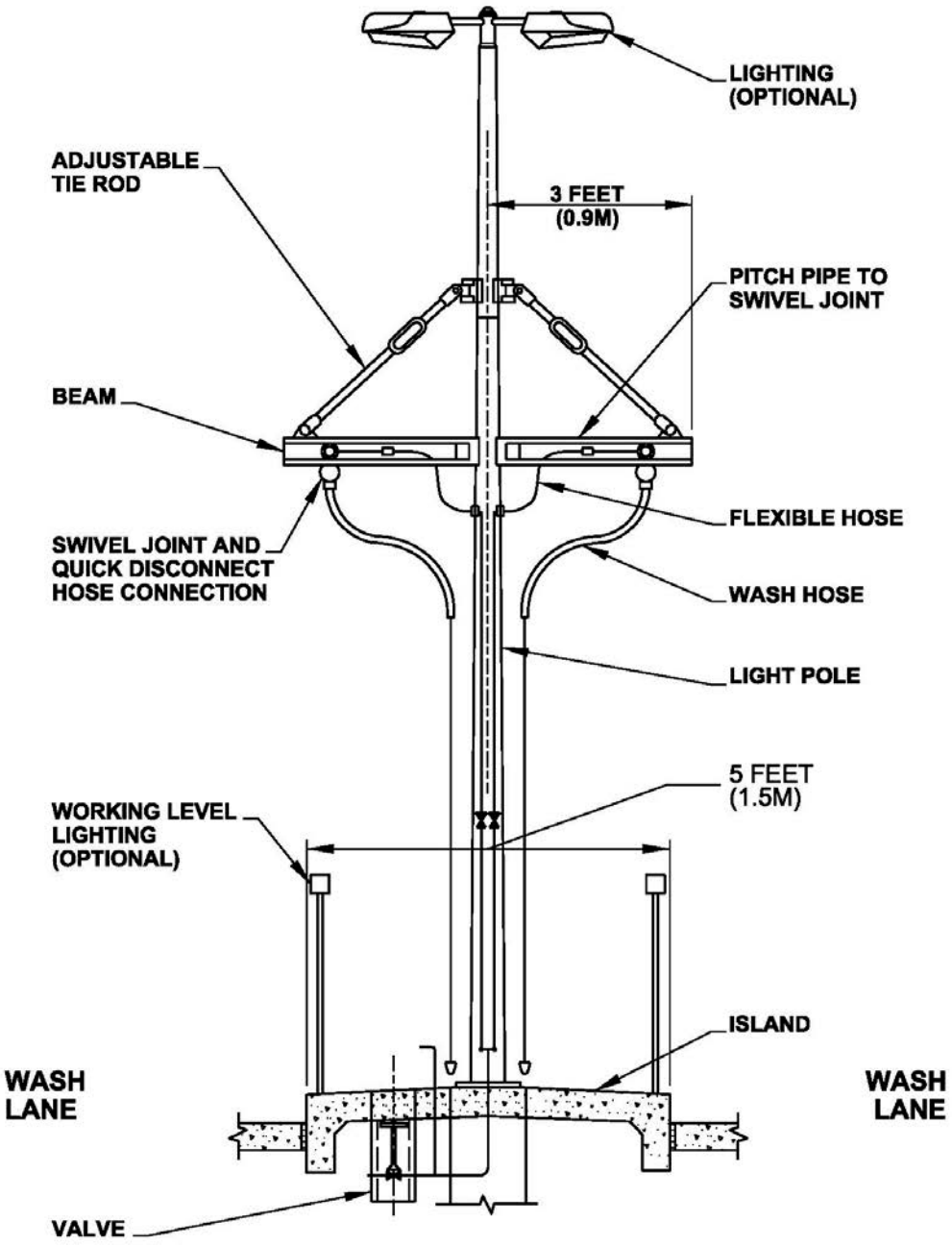
4-2.7.3.1 General.

Wastewater and storm water collected on the paved areas and moved to the trench drains are tied to an open trench or underground piping network, or combination thereof, and conveyed by gravity to the sediment basin for primary treatment. If site conditions and grades permit, the collection system for storm water to the sediment basin should be an open channel for easy cleaning of the open trench. Lines and channels should be as straight as possible. Minimizing the number of changes in direction will avoid mud and debris accumulation. Manholes should be provided for pipe systems at pipe intersections, changes in direction, and changes in slope, and at no greater than 400-foot (121.9-meter) intervals on straight runs. Gravity collection systems without flushers that empty into the sediment basin are designed to maintain a minimum velocity of 5 fps (1.5 meters per second). A minimum of 2 percent slope shall be required on all gravity wastewater lines.

4-2.7.3.2 Material.

Open channels are cast concrete rectangular, trapezoidal, or semicircular cross sections. Semicircular channels limit areas where dirt and debris can accumulate. Gravity pipe systems usually are reinforced concrete, steel, or ductile iron pressure piping. Plastic pipe may be used, as local practices and experience permit, except under pavements.

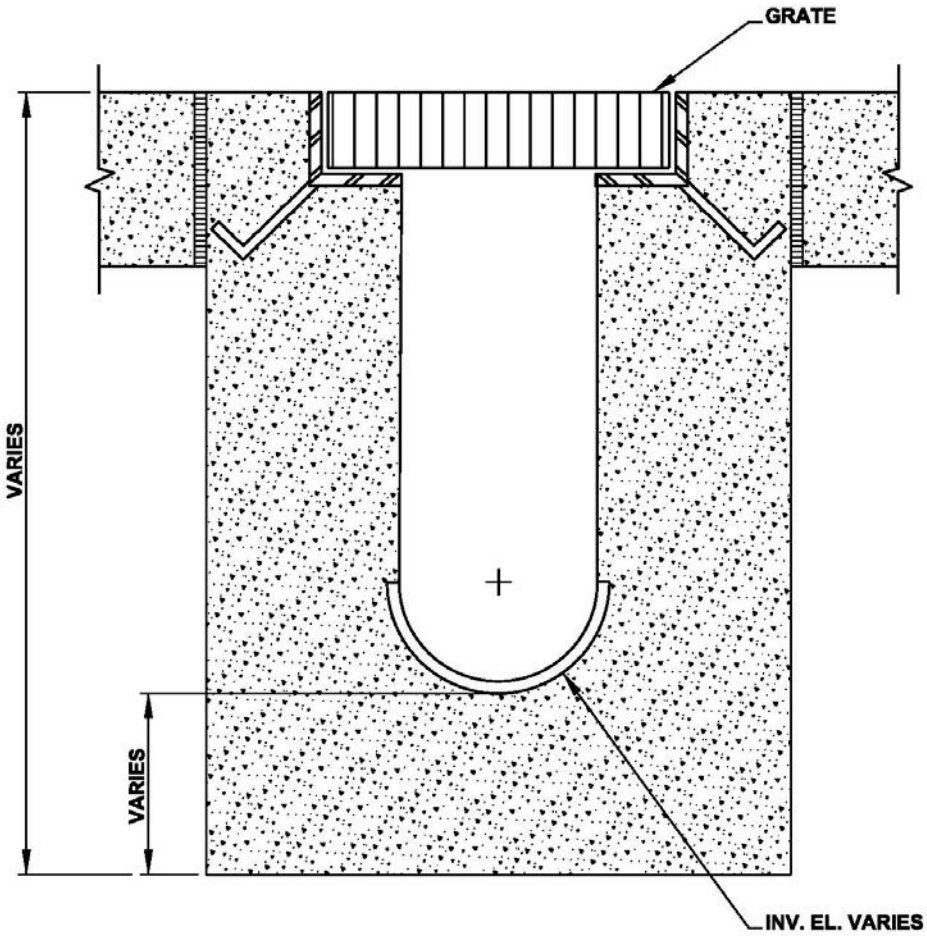
Figure 4-6 Tower Detail in Cross Section



4-2.8 Pavement.

All ground surfaces within the CVWF that will support vehicle movement must be covered with a hard surface and curbing for water and vehicle control. Pavement is required to keep the clean vehicles from driving and parking on surfaces where they become soiled. It also ensures that vehicles do not track dirt from unpaved areas into places reserved for clean vehicles. Concrete is recommended in areas of tracked vehicle movement, including pavements over which both tracked and wheeled vehicles will maneuver. Asphalt paving will suffice in most areas where only wheeled vehicles will operate or in areas of straight tracked vehicle movement. The paving and base should be designed to meet the needs of the vehicles that will use the facility. Concrete should be used around critical drainage structures, such as at wash stations. Roads and trails leading to motor pool areas from the wash facility shall be paved to prevent clean vehicles from be-coming soiled again. Roller-compacted concrete should be considered for all paving areas except at critical drainage structures, where form-worked concrete should be used. When water recycling is to be used, light pavement color should be utilized to decrease the evaporation volume.

Figure 4-7 Cross Section of a Trench Drain



4-2.9 Interior Wash Equipment (Optional).

Low-flow, interior wash equipment should be provided at islands, at user request, for washing truck beds, cab floors, jeep interiors, and other such areas. This equipment is used for washing personnel compartments only and is not intended for cleaning engines. Engine cleaning is prohibited at these locations. The outlet should provide a water pressure of 40 psi (2.8 atmospheres) and a flow rate of 5 (19 liters per minute). A 3/4 inch heavy duty utility hose is attached to the outlet. A sign shall be posted warning personnel not to wash engine compartments.

4-2.10 Lighting.

Adequate overhead and working-level lighting must be provided at CVWFs where users will be washing vehicles at night. On overhead tower structures provide lighting for the staging areas. Towers may be high-mast or low-mast, but must be located so as to provide total wash area coverage without interfering with traffic. Wash station towers may have lighting fixtures for this area as shown on Figure 4-6. A selected portion of the tower fixtures may be used as security lighting. For additional requirements see section 3-2.4.4 lighting.

4-2.11 Physical Security.

Physical security consists of locks on building doors. The CVWF usually is not fenced unless the user requests it for safety and protection against vandalism. Fencing of the basin areas is recommended.

4-2.12 Signage.

Signs must be posted warning personnel not to drink the wash water and directing them where potable water is available. Traffic flow signs as well as pavement markings should be provided to ensure safe, effective use of the facility.

4-2.13 Solid Waste Collection.

Commercial dumpsters should be located strategic points along the edge of the preparation area for disposal of solid waste. Dedicated concrete pads adjacent to the pavement are preferred to avoid damage to dumpsters and moving vehicles. Extra dumpsters may be required at the wash stations.

4-2.14 Operation and Controls.

Equipment operating, maintenance, and repair manuals should be specified to be provided by the contractor at completion of the construction contract.

4-2.14.1 Operator.

The requirement for an operator will depend on the size and complexity of the CVWF. The operator is responsible for shutting off the equipment in times of emergency and at the end of the washing operation. This person controls the pumps and valves, oversees cleanup, reports any maintenance problems, and assures safe operations. At facilities

which have recycled water systems, the operator will also be responsible for monitoring the treatment process.

4-2.14.2 Control Building.

A building shall be provided to house controls for the wash facility in one central location. A master control panel shall be installed to permit the operator to shut off all washing operations at one point. This design allows the operator to shut down the facility quickly and efficiently if required. The building shall provide protection for the operator during inclement weather. Insulation, heating, ventilation, and air-conditioning may have to be provided for the control building at some installations. Latrines and potable water for the troops can also be included in the control building. A telephone should be installed in this building to allow the operator to report O&M problems and emergencies. UFC 3-101-01 Architecture and UFC 3-110-03 Roofing should be consulted for more specific information on building and roof design. Figure 4-8 shows a recommended layout, for the control building.

4-2.14.2.1 Location and Design.

The control building must be located such that the operator can easily see washing operations at all wash stations. The entire treatment system also should be visible from the control building. Latrines for troops and operators and a lockable storage space can be included in the building as required. An efficient design places the control panel in a second-story room above the latrine and/or storage rooms (Figure 4-9). This allows the operator to have a good view of all washing and treatment operations. The operator should be able to operate the control panel and still have a clear view of the operations. Depending on the orientation of the facility and the control building, tinted glass or sunscreens may have to be installed to reduce glare which may inhibit the operator’s view of the wash facility or control panel. Area and control-room lighting must not interfere with the operator’s visibility during nighttime operations. Provide projection calculations during design to insure compliance.

4-2.14.2.2 Size.

The control building must be sized to house wash facility controls, building electrical and mechanical equipment, storage, and latrines for the wash facility in one location.

4-2.14.2.3 Protection.

If the control building is to be located adjacent to vehicle movement, protective barriers must be installed at its comers. Other protective barriers such as guard rails may also be required.

Figure 4-8 Example Floor Plan for the Control Building

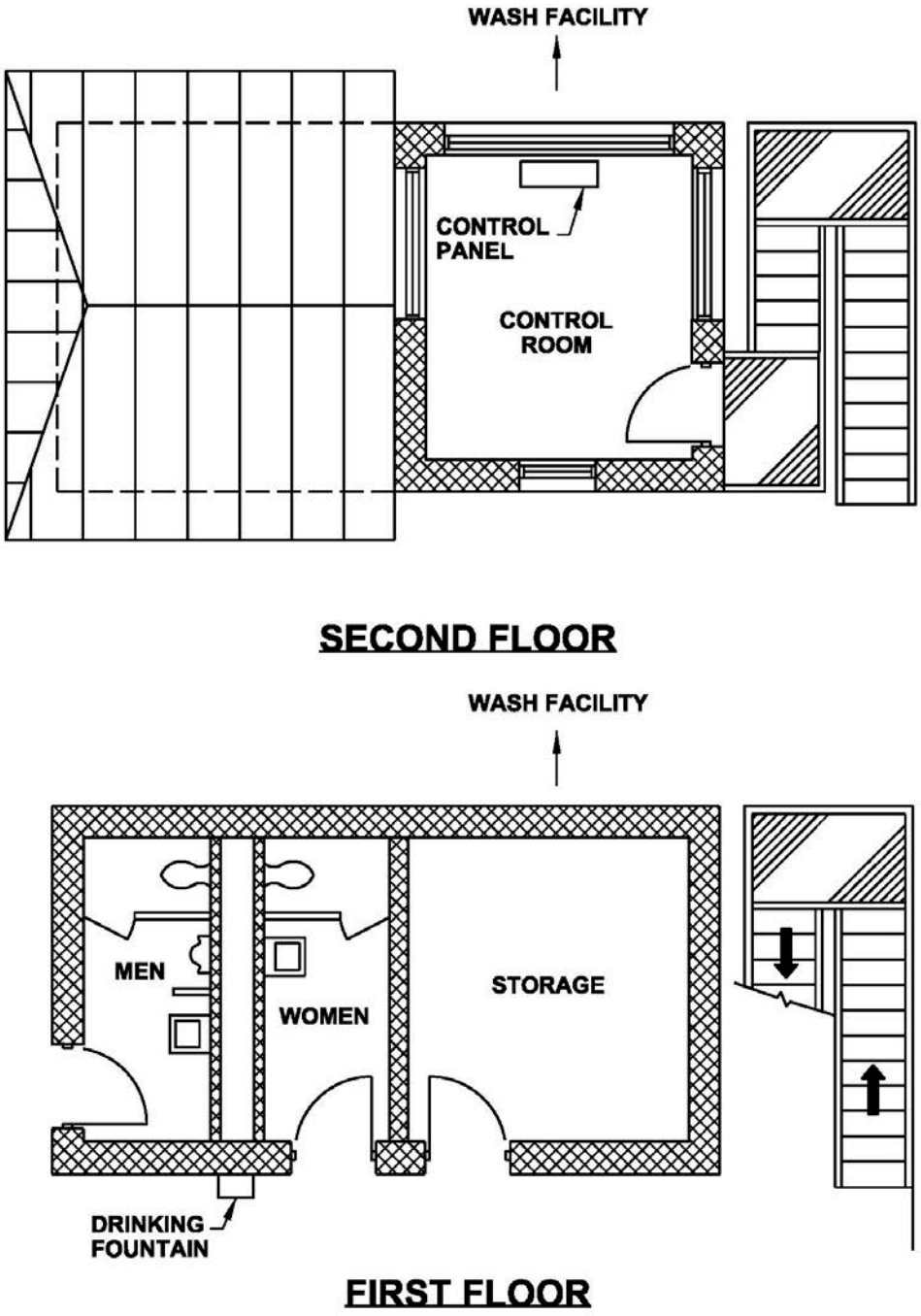
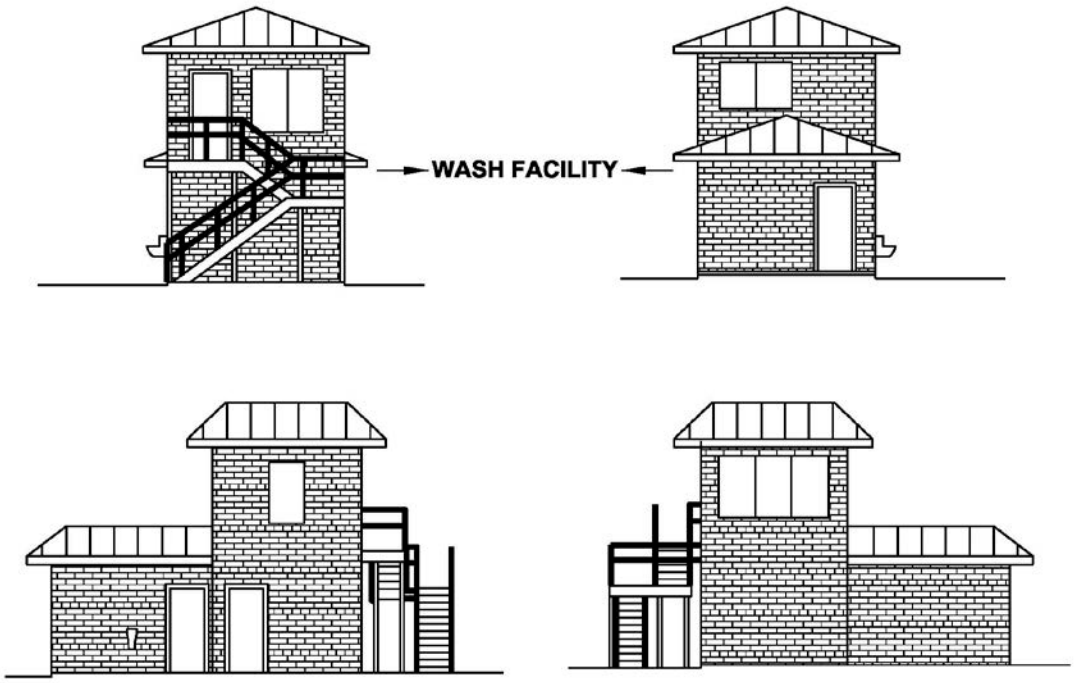


Figure 4-9 Control Building Exterior



CHAPTER 5 OPTIONAL PREWASH

5-1 TYPES OF PREWASHES.

The prewash is designed to remove a large amount of dirt from vehicle exteriors in the most efficient way. The prewash should be flexible enough to handle the number and types of vehicles expected to use the facility. After the prewash, most vehicles will require additional washing at the wash stations so that troops can do a more detailed cleaning, reaching into crevices where a prewash might not clean. Not all vehicles will require cleaning at a prewash. Lightly soiled and smaller vehicles, such as jeeps, may proceed directly to the final wash stations.

Two types of prewash facilities have been constructed for washing tactical vehicles: baths and spray stands. The bath is a water-filled basin with water cannons mounted at each of the four corners of each lane. As vehicles are driven through the bath, persons stationed at the water cannons spray them with high -pressure water to remove the dirt. Spray stands emit high- pressure streams of water from many small nozzles directed toward vehicles driving through the facility. The bath is the recommended prewash, since it removes the bulk of the dirt, including that under the vehicle, and is the most efficient water conservative method. The spray stand is neither as efficient nor as effective as the bath for gross removal of soil from tactical vehicles.

5-1.1 Bath Prewash.

The bath is a water-filled basin through which vehicles drive. Three actions in the bath operate at the same time to remove dirt from tracks, from wheel wells, and tank side skirts. First, the water in the bath provides a soaking action that allows the dirt to be more easily removed. Second, troop operated water cannons placed at each corner of the bath lane spray high- pressure streams of water at the vehicles. Third, raised pipe flexors built into the bottom of the bath flex the tracks and wheels of the vehicles to aide in loosening embedded dirt. This, flexing motion is accomplished by driving the vehicle back and forth through the bath. The combination of wave action and turbulence helps remove dirt from under skirts and wheel wells. Under light to average soiling conditions, one pass through the bath may be sufficient to remove the dirt. However, for heavier soiling, vehicles may require two or more forward and reverse passes over the flexors. An additional advantage of a bath prewash over the spray stand system is that various types and shapes of tactical vehicles can be cleaned without modifying the equipment. Also, the bath is more efficient at water usage than is the spray stand, so treatment systems can be smaller. Finally, the bath can more efficiently clean “skirted” vehicle types such as the M-1 battle tank.

5-1.1.1 Types of Bath Lanes.

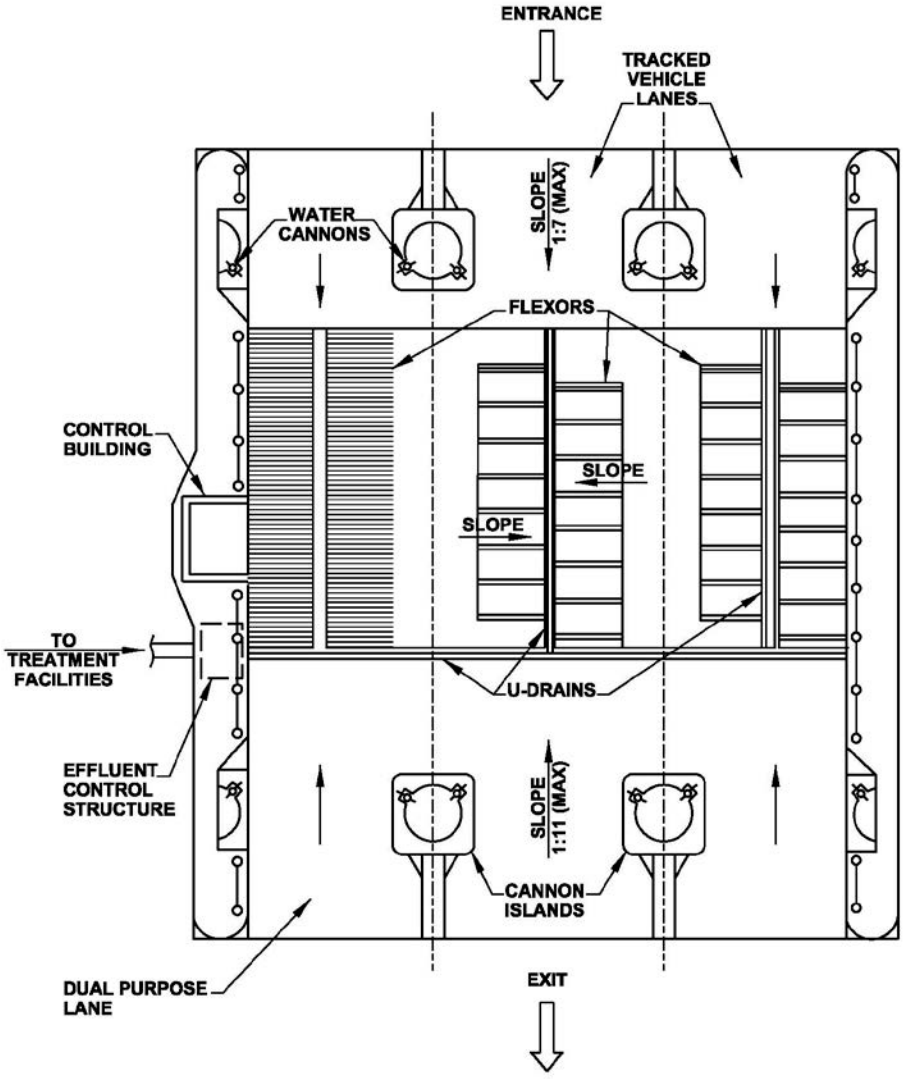
Two types of lanes have been designed and developed to accommodate all type tactical vehicles. Tracked vehicle lanes are designed for use by tracked vehicles only. Large, offset flexors on the bottom of the tracked vehicle lane allow maximum flexing of tracks but make it difficult for wheeled vehicles to traverse and maneuver. Dual- purpose lanes can be used by both tracked and wheeled vehicles. In the dual-purpose lanes, the smaller pipe flexors, which are not offset, are easily traversed by wheeled vehicles.

However, the smaller flexors are not as effective as the track lane flexors for cleaning tracked vehicles.

5-1.1.2 Configuration.

Dual-purpose lanes can be used in conjunction with tracked lanes at the same facility. Figure 5-1 shows a prewash design that uses both types of lanes. It is recommended that no more than three lanes be combined to form one bath. Multiple baths can be linked with walls between them. This configuration will provide maximum flexibility for the installation, since not all bath facilities will need to be filled to wash vehicles if a small group arrives. If tracked and dual- purpose lanes are combined to form one facility, the tracked lanes should be located as close as possible to the sediment basin. Most of the sediment leaving the bath will be removed from the vehicles in the tracked lanes. This layout will reduce the distance that wastewater with high suspended solids content must travel prior to primary treatment. Figure 5-2 presents a tracked lane in cross section. Signs may be required to direct users to the proper type of bath lane.

Figure 5-1 Example of Combined Bath Lane Facility, Plan view



5-1.1.3 Lane Width.

The recommended effective width of a lane is 22 feet (6.7 meters).

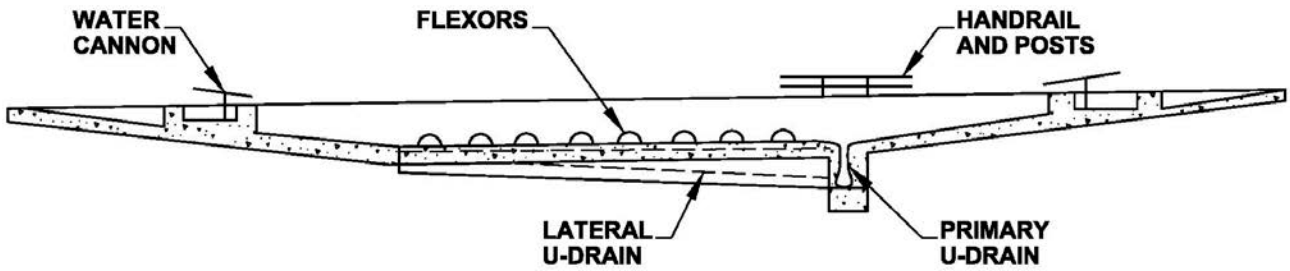
5-1.1.4 Bath Bottom Length.

The length of the bath bottom is based on the track perimeter of the largest tracked vehicle expected to use the bath. A typical lane is 50 feet (15.2 meters) long from the bottom of the entrance ramp to the bottom of the exit ramp, including the width of the trench drain opening.

5-1.1.5 Water Level.

The water level in the bath should be adjustable. A range of 0 to 3.5 feet (0 to 1.10 meters) is recommended for maximum flexibility. Depth of water is measured at the deepest point in the bath (Figure 5-2), excluding the depth of the trench drain. Not all vehicles can operate in a 3.5-foot (1.10-meter) water level; in these cases, it must be possible to lower the water level. Depending on the types of vehicles using the bath and the different units' requirements, an operator can regulate the level within the recommended range. An extra 1.0 foot (30.5 centimeters) of freeboard should be added to the walls of the bath. A staff gauge or other water level indicator should be placed in the bath or painted on the side wall to guide the operator when adjusting the bath depth.

Figure 5-2 Tracked Bath Lane, Cross Section



5-1.1.6 Water Cannons.

The bath prewash is equipped with two stages of stand-mounted fire-fighting-type hardware with nozzles, each of which can deliver the required design wash water pressure and flow to the exterior tracks or wheels of the vehicle being washed. Each bath lane is provided with a total of two primary (entrance) cannons and two secondary (exit) cannons, one at each corner of the lane. Each lever-directed cannon system consists of water supply riser, manually operated flow control valve, play pipe, and nozzle. During the first stage, a vehicle enters the bath slowly from the entrance staging area and troops aim the primary cannon water stream at it for gross removal of solids from wheels, tracks, idlers, and behind skirts and fenders. During the second stage, parts of the vehicle with soil not dislodged at the primary cannons or by submergence and flexing in the bath are exposed to the high-pressure, high-volume water stream from the secondary cannons prior to exiting the bath. To allow flexibility of lane usage, each water cannon system is designed to deliver and operate in the

required flow and pressure ranges, regardless of whether a lane is dual-purpose or tracked.

5-1.1.6.1 Water Pressure and Flow Rates.

The recommended the water pressure is 100 psi (6.8 atmospheres) at the nozzles. The recommended nozzle flow rate is 80 gpm (300 liters per minute). A flow control valve shall be installed on each cannon to allow troops to stop and start the water flow. As discussed in Chapter 4, pressure and flow rates are provided to facilitate pump selection and control, and to handle different soiling conditions.

5-1.1.6.2 Height.

The center line of the nozzle on the cannon should be 50 inches (127 centimeters) above the pavement adjacent to the island as shown Figure 5-5.

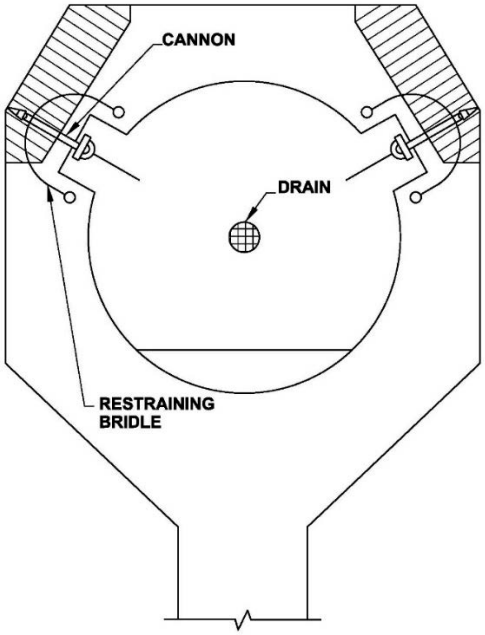
5-1.1.6.3 Nozzles.

The nozzle tip shall provide a stream of water with a zero-degree spray-angle nozzle. The inner diameter of the nozzle orifice should be ½ inch (12.7 millimeters). The nozzle must be able to deliver pressures and flow rates within the recommended ranges with minimum losses.

5-1.1.6.4 Motion Restriction.

Adjustable restraining bridles (Figure 5-3) should be placed at each water cannon position to limit both horizontal and vertical movement. Without the restraints, personnel could accidentally spray each other during cleaning operations which could result in injury.

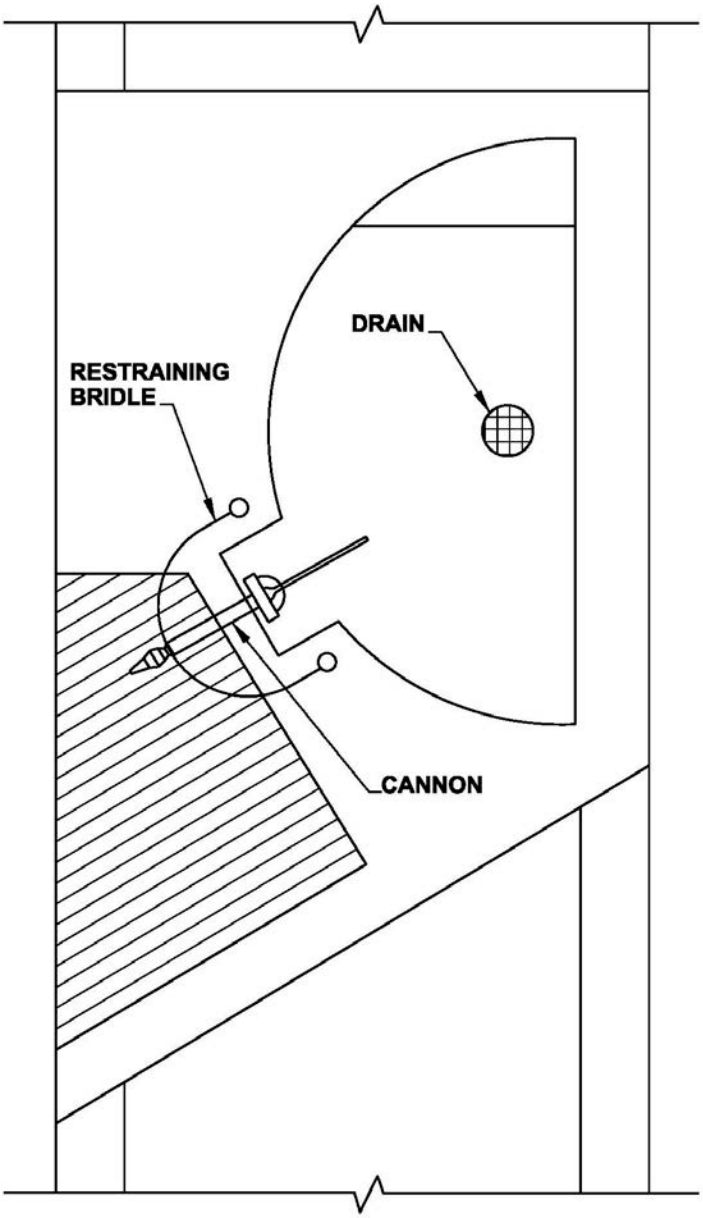
Figure 5-3 Example Inner Wash Island



5-1.1.7 Cannon Island.

Water cannons are mounted in concrete islands constructed at each corner of the bath lane. Figure 5-3 shows two example configurations. The concrete islands should be located on the entrance and exit ramps of the bath. Two cannons should be placed in each inner cannon island (Figure 5-3). The outer islands should have one cannon per island (Figure 5-4). The islands must have drainage so that troops will not be standing in water. All corner sections within the bath should be filleted to avoid the buildup of debris. Cannon island shall be designed such that they do not impede the movement of the cannons or the wash water flow stream. If the user requires, hose connections may be included in the island design for clean-up purposes. Figure 5-5 shows a cross section of the wash island.

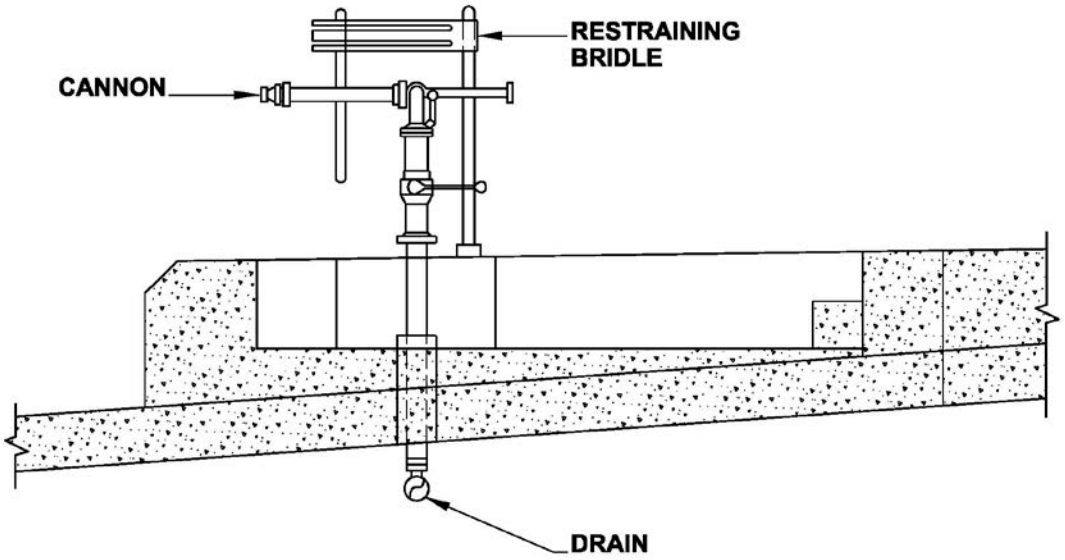
Figure 5-4 Example of Outer Wash Island



5-1.1.8 Flexors.

Flexors are grout or concrete filled, steel piping installed on the bottom of the bath lane to improve removal of encrusted dirt from under the skirts, around drive wheels, and other areas of the vehicles that cannot be cleaned by the water cannon flowstream. By driving the vehicles back and forth over the flexors, much of the dirt can be loosened and removed. The turbulence created from this action also removes dirt from hard-to-reach areas in the undercarriage, and behind side skirts. The spacing and height of the flexors cause the tracks and wheels to move in an up-and-down motion. This movement loosens dirt from the tracks and from under wheel wells and skirts. The space between the flexors also serves as a collection channel sloped toward bath lateral trench drain.

Figure 5-5 Example Cross Section of a Cannon Island



5-1.1.8.1 Tracked Vehicle Lanes.

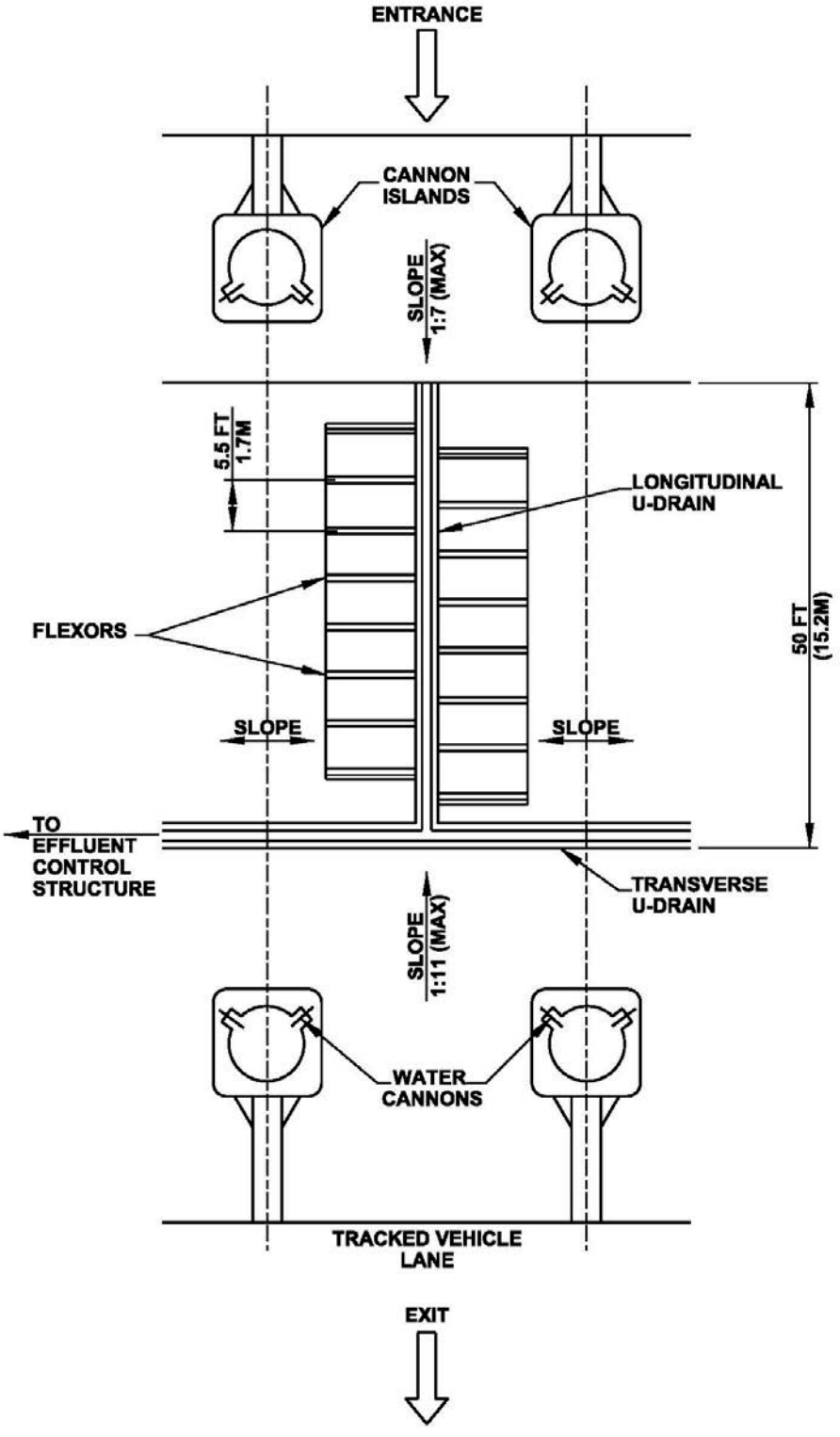
The recommended center-to-center flexor spacing is 5.5 feet (1.7 meters). The flexors are offset (Figure 5-6) to allow the vehicle's running gear to achieve the maximum flexing motion possible. Outer lanes of the bath should have the flexors extended to the side walls to prevent dirt from building up between the ends of the flexors and the walls. Each flexor in a tracked vehicle lane should be 9 inches (22.8 centimeters) high. The method of connecting or imbedding the flexors to the bottom of the bath must be able to withstand the impact of all types of vehicles using the bath.

5-1.1.8.2 Dual Purpose Lanes.

The design of flexors in dual-purpose lanes will be similar to those in the tracked lanes. The flexors should be spaced 18 inches (45.7 centimeters) apart. The flexors shall be installed at right angles to the lane and extend from the edge of lateral trench drain in the lane to the side walls of the bath. This design prevents dirt from collecting between

the wall and the flexor. The flexors are not offset (Figure 5-7) in order to allow better vehicle control. Each flexor shall be 3 inches (7.6 centimeters) above the floor level and constructed in such a way to withstand the impact of both tracked and wheeled vehicles.

Figure 5-6 Tracked Bath Lane



5-1.1.9 Entrance Ramp.

The slope of the entrance ramp is measured from the top of the first flexor in the bath lane. The maximum allowable slope into the bath is 1:11 (9 percent).

5-1.1.10 Exit Ramp.

The maximum allowable slope for the bath exit ramp is 1:11(9 percent).

5-1.1.11 Ramp Slope.

Slopes selected will affect the volume of water required to fill the bath and the resulting amount of wastewater to be treated. Therefore, the maximum slopes allowable should be selected except where local conditions require flatter slopes.

5-1.1.12 U-Drains.

Open u-drains shall be used to move soil-laden wastewater from the bath area to the collection system (Figure 5-8). The bottom of the bath should slope toward these drains at a minimum of 2 percent to help move mud and debris into the collection system (Figure 5-9).

5-1.1.12.1 Configuration.

A lateral u-drain is installed along the centerline of each bath lane. Each lateral drain is connected to the transverse u-drain that runs perpendicular to the lanes. This transverse drain discharges directly into the bath outlet control structure. Figure 5-10 shows how these drains are arranged.

5-1.1.12.2 Fill/Flush System.

A fill/flush system with motorized valves is provided in the bath to allow for timed filling of the bath and movement of dirt and debris to the outlet structure when the bath is drained, flushed and cleaned. A flusher supply discharge should be placed into the uppermost end of each u-drain. The flushers will provide increased flow in the u-drains to prevent sediment deposition. The recommended flushing rate is 600 gpm (2280 liters per second) for the lateral u-drains and 900 gpm (3420 liters per second) for the primary u-drains and should be set to provide 5 fps (2.4 meters per second) velocity in the u-drain. Flushing time is arbitrarily set at 15 to 25 minutes, depending on soiling conditions. The flow rate for filling may be increased in order to fill the bath in a reasonable amount of time; a fill time of 30 minutes or less is recommended. The fill/flush procedures are controlled by the wash facility operator (see chap 4.) The system of pumps and supply piping is designed to be independent of other systems. The source of fill/flush water is the equalization basin.

5-1.1.12.3 Design.

U-drains are to be designed to handle the peak solids and hydraulic loadings that occur in moving wastewater to the effluent structure. A minimum grade of 2 percent is required in the drains along with 5 fps velocity to prevent settling.

5-1.1.12.4 Materials.

U-drains should be lined with concrete or other impervious material such as plastic, metal, or vitrified clay. The liner should have a smooth, circular finish to reduce roughness in the trench.

5-1.1.13 Outlet Control Structure.

A moveable weir on the outlet structure is used to regulate the depth of water in the bath (Figure 5-11). This weir is located at the interface of the structure and the bottom of the bath and is designed to be raised or lowered to vary the water depth. A valve or gate is located in the structure at the intersection with the transverse u-drain to allow wastewater to discharge into the structure. Weirs, valves and gates may be motorized or manually operated. The structure should be designed to minimize solids deposition.

5-1.2 Vehicle Spray Stands.

A spray stand operates much as a commercial car wash in that the vehicle is driven into the facility and sprayed by high-pressure water from many small nozzles. This method is not suited, nor recommended, for the irregular-shaped tactical vehicles, because M-1 tanks and other vehicles with heavy side skirts cannot be cleaned effectively. The spray does not effectively remove dirt from the treads, under the skirts, and other places that are difficult to reach. Spray stands also require larger amounts of water than comparably sized bath prewash facilities. Therefore they are not recommended for use at CONUS installations.

Figure 5-7 Dual Purpose Lane

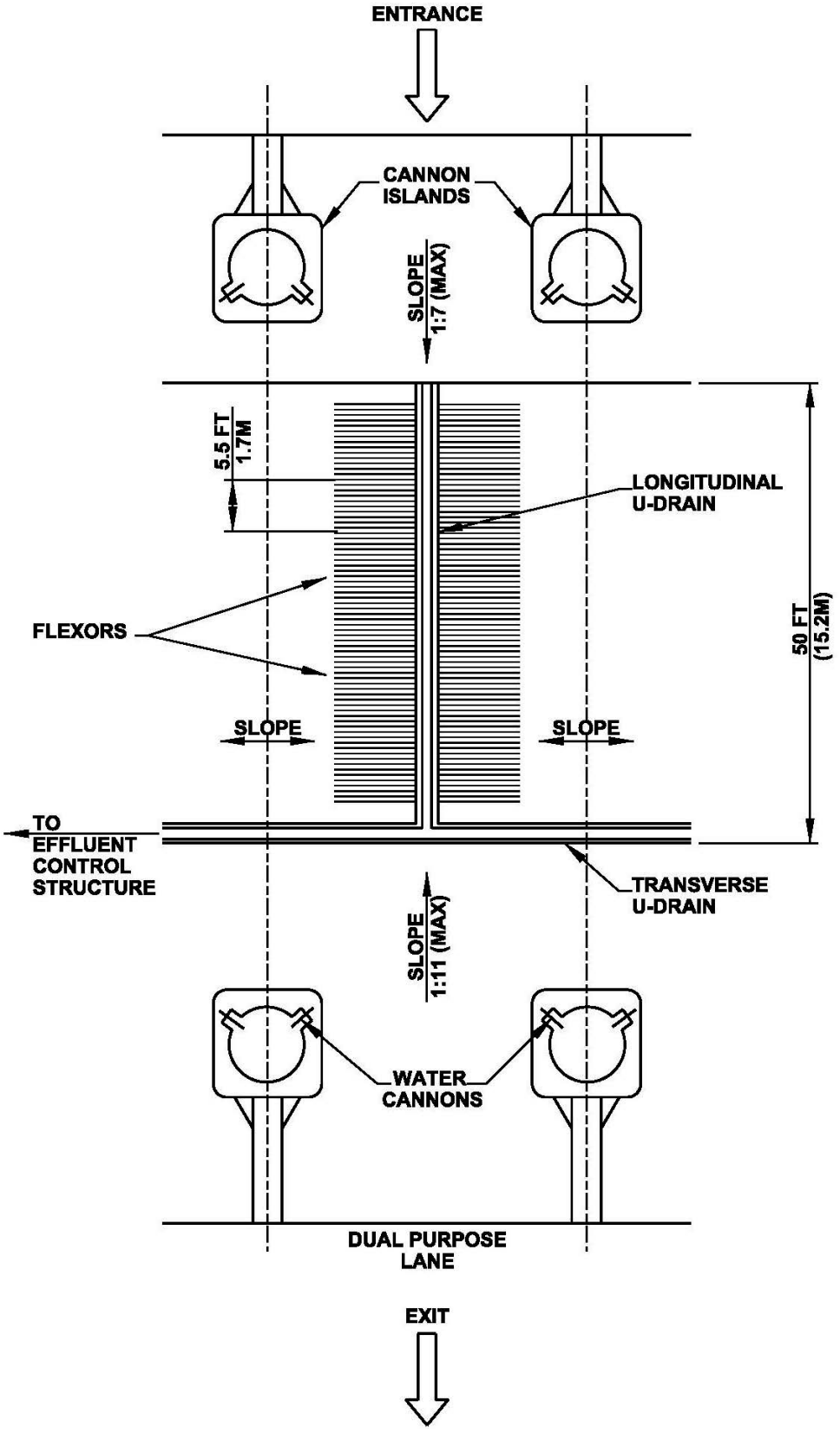


Figure 5-8 U-Drain

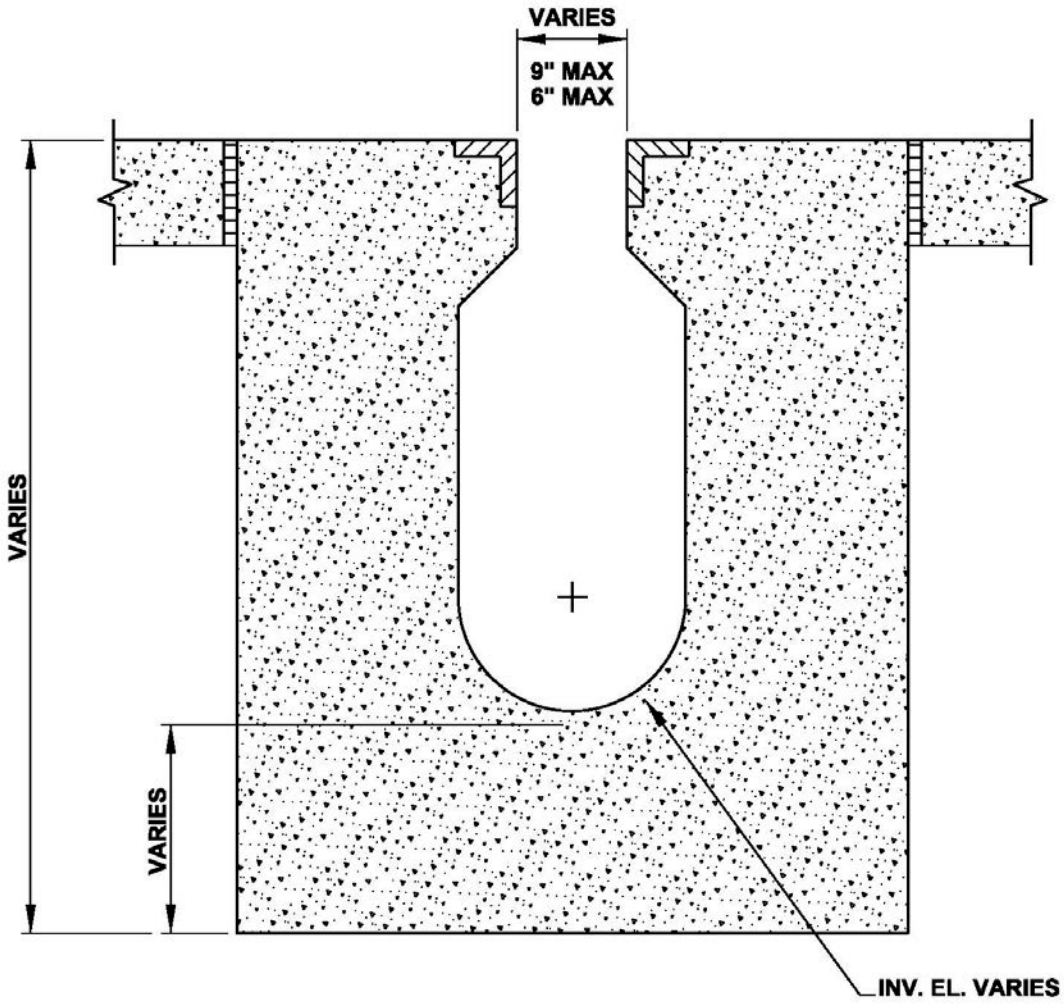


Figure 5-9 Bath Cross Section

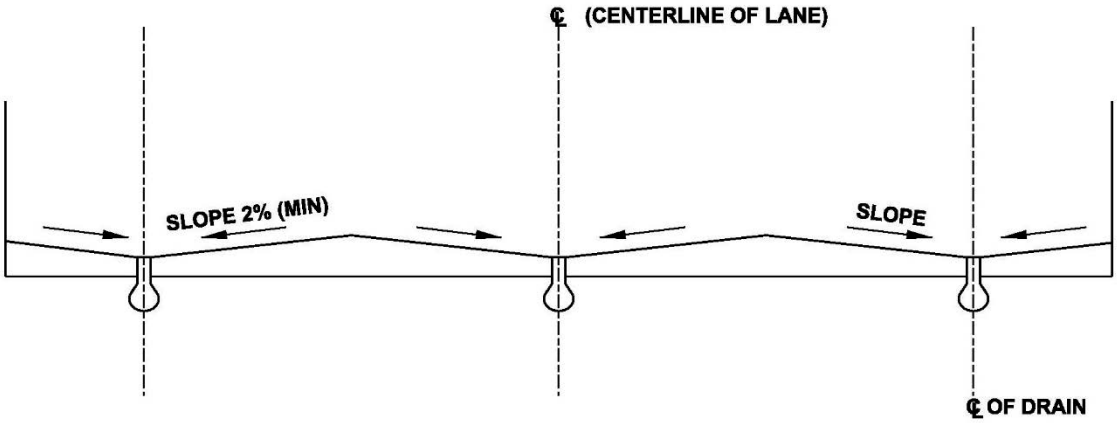


Figure 5- 10 Configuration of U-Drains in the Bath

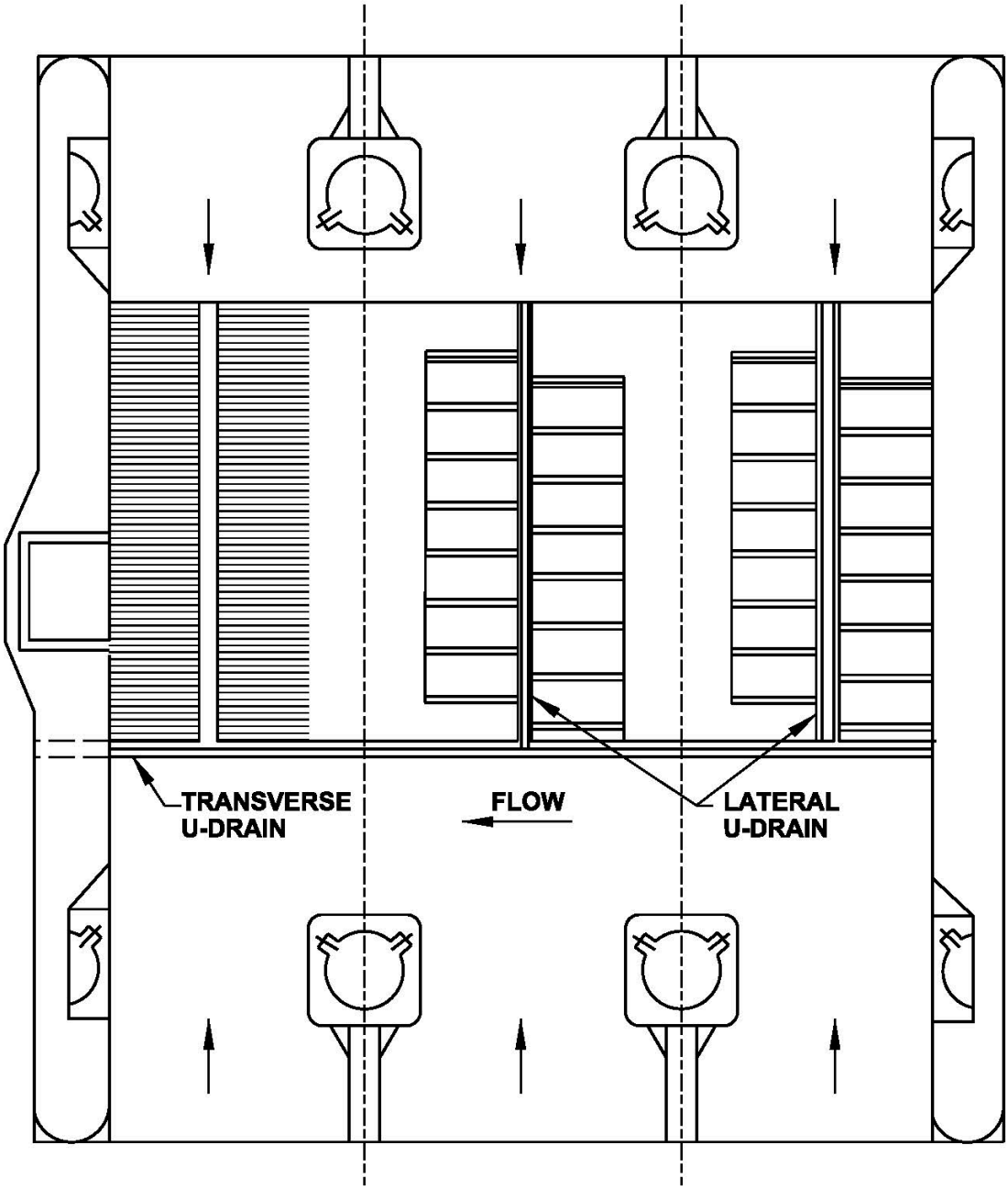
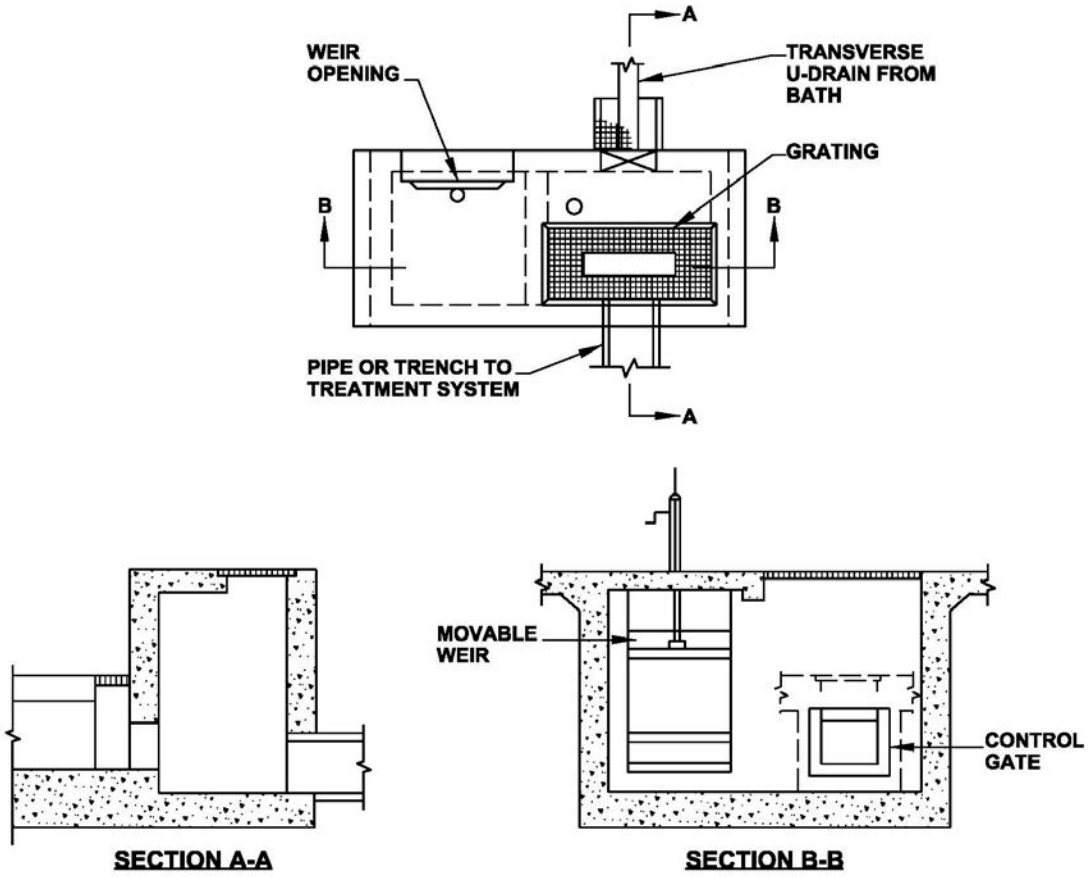


Figure 5-11 Water Level Control Structure



5-1.3 Bath Prewash Support Facilities.

5-1.3.1 Wash Water Supply Lines.

Wash water supply lines transport water under pressure, from source to the washing structures. Supply piping shall be ductile iron, steel or other material resistant to damage from water hammer. Plastic pipe is not acceptable for use in the supply piping. Frequently operated underground valves shall be accessible via manholes or valve boxes. In regions that have freezing temperatures, the system must be self-draining to prevent freezing. Adequate valving should be incorporated to allow for isolation of individual wash stations or wash positions.

5-1.3.2 Wastewater Conveyances.

The wastewater conveyances from the washing structure to the treatment system should be open trenches with a slope sufficient to produce 5 fps (1.8 meters per second) velocity. The conveyances to the treatment system shall be as straight as possible; limiting the number of turns will minimize solids deposition which can build up and block the pipes and trench drains. If closed conduit is used due to site constraints, such as the need to pass under a road, manholes must be provided at each change in pipe direction and slope and at each pipe intersection (see chap 6).

5-1.3.3 Bypass Lane.

A bypass lane is provided to allow lightly soiled vehicles to bypass the prewash and advance to the wash stations. Experience has shown that wheeled vehicles bypass the prewash most often. The recommended lane width is 22 feet (6.7 meters). The bypass lane must have positive drainage to prevent the buildup of water and sediment. When a prewash is provided, a bypass lane around the wash stations must also be provided. This enables the vehicles leaving the prewash which do not require additional washing to bypass the wash stations and advance to the final assembly area.

5-1.3.4 Lighting.

Adequate lighting should be provided if nighttime washing operations are required by the installation. For additional requirements see Section 3-2.4.4 lighting.

CHAPTER 6 WASTEWATER TREATMENT

6-1 GENERAL CONCEPTS.

6-1.1 Overview.

The wastewater generated at a CVWF is widely variable in quantity and quality. The frequency and duration on the system will be site-specific. In addition, CVWF wastewater properties differ greatly from those of a typical sewage waste-water. The suspended solids concentration in a sewage wastewater is 200 to 400 milligrams per liter. In contrast, suspended solids in CVWF wastewater will range from 100 to more than 20,000 system must first undergo primary treatment in a sediment basin milligrams per liter.

Typical sewage treatment collection systems and plants are not equipped to handle the high suspended solids loading generated at a CVWF. A typical sewage treatment wastewater will flow through the collection system without depositing in the sewers because of the low solids content. However, the solids in a CVWF wastewater will deposit readily in the collection system if proper precautions are not taken. This buildup occurs primarily because of the large amount of solids and the fact that they are generally heavy compared with those in a sewage wastewater. These precautions include steeper slopes, higher velocities and a flusher system in the collection system. The wash facility will discharge a large volume of silt, clay, sand, and gravel, and an array of solid debris, such as ordnance, rags, rocks, and ration cans. This type of material does not normally occur in such large volumes in a sewage treatment wastewater. The wastewater from a CVWF also will contain higher levels of grease and oils than a typical sewage treatment wastewater. Therefore, oil removal equipment must be installed at a CVWF waste treatment facility. The biological oxygen demand (BOD) and chemical oxygen demand (COD) are usually in the 200 to 400-milligram per liter range in a sewage treatment waste stream compared with 20 to 100 milligrams per liter in CVWF wastewater.

6-1.2 Treatment System.

The water used to wash vehicles at CVWFs must be reasonably clean but is not required to be drinking water quality. All wastewater to be recycled or discharged to an offsite treatment system must first undergo primary treatment in a sediment basin to remove gross sediment, free oils and grease.

- A recycle system is a closed-loop system in which wastewater is treated, circulated, and reused. Secondary treatment of this wastewater is considered essential to minimize pump O&M, meet all regulations, and protect the environment and health of the users. The waste water overflows from the sediment basin to a secondary treatment system consisting of either an equalization basin, followed by intermittent sand filters or a lagoon system, and wash water supply basin. A recirculation loop may be needed to meet state quality standards.

- In a non-recycle (or discharge) system, the sediment basin is followed only by an equalization basin, if required, to bring the discharge to a quality and quantity that complies with requirements of the offsite treatment plant.
- A water supply basin may also be required in a discharge system if the water source cannot meet the immediate demands of the wash facility. If water is not recycled, a good quality, reliable water-source must be used. If a discharge system is being considered, the designer should consider the flow and quality requirements of the installation's sewage treatment plant authority and design the onsite treatment system and conveyance accordingly.

6-2 DESIGN PARAMETERS.

6-2.1 Criteria.

In designing the wastewater treatment system for the CVWF, the hydraulic floor will dictate the size of the collection and treatment system needed. Local water supply and weather conditions also affect the choice of treatment systems. In regions with a limited water supply, strict water conservation and reuse techniques need to be reviewed before deciding to recycle the water. Factors to consider in designing the treatment system are the wash period, cleanup time, water usage factor, wash, stormwater, water flow demand, and wastewater volume.

6-2.2 Wash Period (T_w).

The wash period is the continuous time, in hours, that the CVWF is expected to operate each time the facility is used. This time is not the minimum or maximum time that individual vehicles spend at the facility; it is the time during which the facility is expected to be operated (see Chapter 3). The wash period does not include the time required to fill and drain the prewash bath (when included) or to clean the facility. The installation must establish an operating schedule of the CVWF based on projected facility demand.

6-2.3 Cleanup Time (K).

The recommended design time to drain the prewash bath and clean up the facility is one (1) hour.

6-2.4 Water Usage Factor (U_f).

The usage factor is the estimated percentage of time that water will be flowing at maximum capacity for any component at the facility. This factor is used in determining the overflow rate into the sediment basin. The range is between 20 and 90 percent. Usage factors vary between component parts of a CVWF; a prewash bath will normally require the use of a different usage factor than a wash station.

6-2.5 Storm Water.

Rain that falls onto the pavement should be directed toward the treatment system since this stormwater may contain residual contaminants from the handstands. Stormwater runoff from adjacent unpaved areas should be directed away from the wash facility. The treatment system should be large enough to treat stormwater collected on the paved areas of the wash facility or captured on the basins; but not necessarily concurrently with water generated during a peak use period. Excess water generated from a storm event can be treated during low use periods. Stormwater flow is estimated by the Rational Method as discussed in TM 5-820-1. The area of each surface type must be estimated first. After the treatment system is sized, the computations used for each surface type should be compared with those used for the estimate and appropriate adjustments made to sizing the basin.

6-2.6 Stormwater Bypass.

A stormwater bypass should be provided at the head end of the treatment system just before the sediment basin. Stormwater diversion prior to treatment should be considered standard practice only if the CVWF is in a shutdown mode and the wash facility has been cleaned up. This diversion should be operated after each day's shutdown and when it is expected that the facility will not be in use for long periods of time, such as over a winter season.

6-2.7 Washwater Demand.

The following section defines the washwater demand parameters and computations for use in sizing the various conveyances, wash facilities and treatment facilities in a CVWF.

6-2.7.1 Parameters.

V_B = Volume of tracked baths plus volume of dual-purpose baths filled to maximum operating depth, in gallons

N_{wc} = Total number of water cannon nozzles at the bath

$F_{(i)}$ = Design flow rate per demand location, in gpm (1pm)

i = Demand Location

$N_{(st)}$ = Total number of wash hoses at the wash stations

N_{tl} = Total number of flusher points in additional trench drains at preparation areas.

N_{ud} = Total number of flusher points in u-drains at the baths

C = Coefficient of runoff

I = Rainfall intensity for region

A = Area of rainfall for surface type

N_{t2} = Total number of flusher points in trench drains at the wash station area

N_{int} = Number of vehile interior wash points at the wash stations

N_y = Number of yard hydrants in wash area

6-2.7.2 Water Demand Calculations.

Water demands in gpm (1 pm) are calculated using the following formulations.

Demand	Formulation
1. Bath flush, each occurrence	$Q_1=V_B/D$
2. Bath water cannons, vehicle washing	$Q_2=N_{wc}\,F_{wc}$
3. Wash Stations, vehicle washing	$Q_3=N_{st}\,F_{st}$
4. Flushing, additional trench drains	$Q_4=N_{tl}\,F_{tl}$
5. Flushing, bath u-drains	$Q_5=N_{ud}\,F_{ud}$
6. Flushing, wash station trench drains	$Q_6=N_{t2}\,F_{t2}$
7. Wash Station, interior washing	$Q_7=N_{int}\,F_{int}$
8. Yard hydrants, clean-up	$Q_8=N_yF_y$
9. Stormwater runoff, paved areas	$Q_9=C_p\,I\,A_p$
10. Stormwater, on basins	$Q_{10}=C_b\,I\,A_b$

6-2.7.3 Maximum Flow.

The pipes, trench drains, and weirs at the facility must be designed to handle the maximum (Q_{max}) flow rate expected at any given instant. The designer must consider all of the water and solids from each source expected at any instant. The maximum flow is usually expected to occur during cleaning operations when the bath is flushed, the trench flushers are on, and the wash station hoses and water cannons are in full use. The usage factor adjustment is not applied, since this is the peak situation and all systems are operating. The maximum flow rate is the greater of either the sum of Q_1 thru Q_8, contributions or the sum of Q_9 and Q_{10}

$$Q_{max}=Q_1+Q_2+Q_3+Q_4+Q_5+Q_6+Q_7+Q_8 \qquad \text{(eq 6-1)}$$

or

$$Q_{max}=Q_9+Q_{10}$$

Note: The designer must determine which combination of flows are applicable to any particular conveyance feature; not all flows will be present in all conveyances, trench drains, or overflows.

6-2.8 Water Volume.

6-2.8.1 Parameters.

Water volume computations are based on the following parameters:

K = Cleanup time (generally 1 hour)

T_w = Wash period

T_t = Wash period including cleanup

T_s = Storm Duration (10 year, 24 hour)

B = Number of times the bath is filled from the water supply basin per wash

period. (Bath volumes taken from the equalization basin are not counted since these volumes do not receive complete treatment through the secondary treatment system. The number of times that the bath is drained and filled will depend on the length of the was period and the visual quality of the bath water)

U_i = Usage factor (from 20% to 90%) source

6-2.8.2 Volume Calculation.

Volume	Formulation
1. Volume from bath flush	$V_1=V_BB$
2. Volume from bath water cannons	$V_2=Q_2T_t$
3. Volume treated at wash station hoses	$V_3=Q_3T_t$
4. Volume from additional preparation area flushers	$V_4=Q_4K$
5. Volume from bath U-Drain flushers	$V_5=Q_5K$
6. Volume from wash station trench flushers	$V_6=Q_6T_t$
7. Volume from interior wash points	$V_7=Q_7T_w$
8. Volume from yard hydrant	$V_8=Q_8K$
9. Volume of stormwater runoff-pavements	$V_9=Q_9T_s$
10. Volume of stormwater falling on basin surface	$V_{10}=Q_{10}T_s$

6-2.8.3 Average Volume (V_{ave}).

V_{ave} is an estimate of the total volume of water used during an average wash period. The average wash period is the period of time during which the vehicles are being washed in typical washing operation. Usage factors are applied to each source of water, since not all water cannons, hoses, and trench flushers will be operating at all times. V_{ave} (eq 6-2) is used to estimate the size of the water supply basin and the equalization basin or polishing lagoon:

$$V_{ave}=U_1V_1+U_2V_2+U_3V_3+U_4V_4+U_5V_5+U_6V_6+U_7V_7+U_8V_8+U_9V_9+U_{10}V_{10} \quad \text{(eq. 6-2)}$$

Note 1: V_1, V_5, and V_6 are included in the equation only if these volumes are withdrawn from the water supply basin. Volumes withdrawn from the equalization basin are not included in the formulation.

Note 2: V_9 and V_{10} are not part of V_{ave} in a standard design. Including V_9 and V_{10} as part of V_{ave} is the designer's option.

6-2.8.4 Maximum Volume (V_{max}).

V_{max} is an estimate of the total volume of water used during the peak use period of the facility. The same equation (6-2) used to calculate V_{ave} is also used to calculate V_{max}; the difference is that the wash period used to calculate the individual volumes, V_2 through V_8, is the length of the peak washing operations, not the length of the average

washing conditions. Usage factors are still applied in the equation to compensate for the time during which the nozzles are not operating. The V_{max} value is the primary volume used in sizing the water supply basin and the equalization basin or settling lagoon. V_{max} is also used in the sizing of the intermittent sand filters.

6-2.8.5 Water Balance.

The designer must perform a water balance during the preliminary design phase. The purpose of the water balance is to ensure that basins such as the equalization basin do not overflow and that the water supply is not totally drained. Thus, the designer must make provisions to handle the peak use water volume in each basin during the washing operations. Based on the results of the water balance, the designer may be required to increase, or may be able to decrease the size of the basins.

6-3 PRIMARY TREATMENT.

6-3.1 Function.

All wastewater from the CVWF must undergo primary treatment. A concrete sediment basin with an oil skimmer device is provided to separate and remove contaminants such as grease, oil, and sediment by gravity. Free oil shall be removed in this basin prior to pumping which could cause oils to emulsify. Wheeled vehicle access shall be provided to this basin for removing the large volumes of sediment that accumulate in this basin. The bottom of the basin should be sloped approximately one percent away from the entrance ramp to assist in dewatering when the basin is emptied. Sediment basins are designed with oil recovery, inlet and outlet control structures, and drains.

6-3.2 Number of Basins.

In a wash facility, with or without bath, a sediment basin with only one cell may be provided, however, it must be designed to treat the entire volume of water and sediment expected. Maintenance procedures must insure minimizing down time when the single basin is cleaned. A sediment basin with two cells should be provided if the wash facility cannot be shut down for scheduled cleaning and repairs. Providing a two-celled sediment basin allows one cell to be isolated for cleaning and repairs while the other one remains in service for primary treatment. The detention time of the waste water may be reduced in the basin if only one cell is operable due to closure of the other, but the wash facility may still be utilized. During normal operations of a facility with a bath, one cell is used to treat the volume of waste wash generated from vehicle washing water from the wash, while the adjacent cell is used to treat the volume of water from the bath flush and clean-up activities. The functions of the two cells should be alternated frequently, to distribute the sediment loads evenly between basins.

6-3.2.1 Single-cell Configuration without Bath.

At small facilities without bath, a single-basin system as depicted in Figures 6-1 and 6-2 should be provided. A single sediment basin system should function hydraulically, such that the inflow volume is equivalent to the overflow volume. If a large surge of water is

expected, then sufficient storage volume must be allowed in the basin to ensure that a minimum detention time of 2 hours is maintained. The basin volume must account for the accumulated sediment storage volume between cleanouts. The outlet structure is a weir constructed across the width of the access ramp. The location of overflow weir ensures a constant water level in the basin.

6-3.2.2 Dual-Cell Configuration without Bath.

At larger facilities, without bath, where washing down time during basin cleaning may not be desired or practical, dual cells similar to Figure 6-1 and Figure 6-2 should be provided. Cells would have a common wall and be provided with common inflow and outflow control structures.

6-3.2.3 Dual-Cell Configuration with Bath.

A dual-cell system for use with baths in large facilities is shown in Figure 6-3 and Figure 6-4. Before bath(s) are to be emptied into the sediment basin, the operator should assure that the water level in one of the basin cells in the sediment basin is at low level. The volume of bath water will be stored in this cell. The adjacent cell continues to provide primary treatment for wastewater from the washing facilities. This configuration allows the entire surge volume of wastewater from the bath to be held for the proper detention time and not become short circuited in the sediment basin. The volume of each cell is designed to hold the storage of sediment between scheduled cleanouts plus the entire volume of a bath release and clean-up water.

6-3.2.4 Single-Cell Configuration with Bath.

For small facilities with bath, a single-cell configured similar to that depicted in Figure 6-3 may be provided if the wash facility can be taken out of service during the cumulative period of time to drain the bath(s) and draw down the sediment basin.

6-3.3 Siting.

Sediment basins are sited to receive gravity flow of wastewater from the wash facility. The basin should be close to the washing operations to avoid long conveyance distances and severe depths of conveyances being placed at the required grades. Basins should be oriented along the axis of prevailing winds with the outlet end and oil skimmers located downwind so that surface currents will carry free oils toward the removal equipment. The basins must not be readily accessible to troops but should be visible from the control building and easily accessed by the CVWF operators.

Figure 6-1 Single Cell Sediment Basin, Plan View

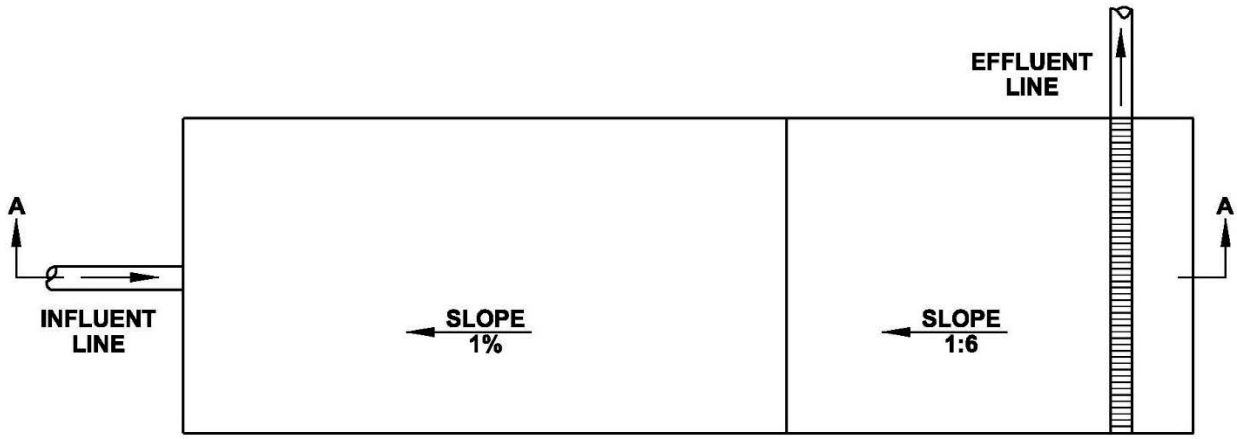
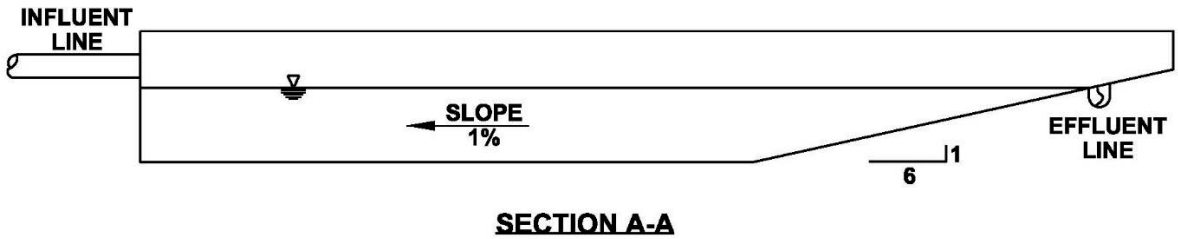


Figure 6-2 Single Cell Sediment Basin, Cross Section



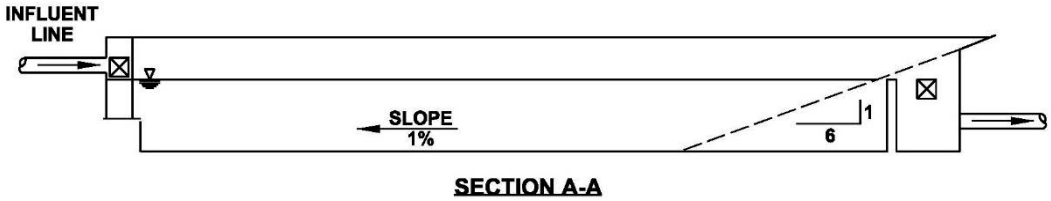
6-3.4 Sizing.

The size of each cell in the sediment basin will be based on the volume of water to be treated and the volume of sediment to be stored in the basin between cleanings. The user must determine how often the sediment will be removed from the basin. It is recommended that each cell of the basin be cleaned at least once per year; however, the exact number of basin cleanings will depend on variations of soiling, user requirements, and other considerations unique to the installation. In addition to the water and sediment depths, from 1 to 2 feet (0.3 to 0.6 meter) of freeboard must be provided. Figure 6-4 shows typical water and sediment depths. Each cell should have a minimum length-to- width ratio of 3 to 1 to allow for the proper settling time. The turning radius of cleaning equipment, such as a front-end loader, should be considered in determining the width of the cells.

Figure 6-3 Dual Cell Sediment Basin, Plan View



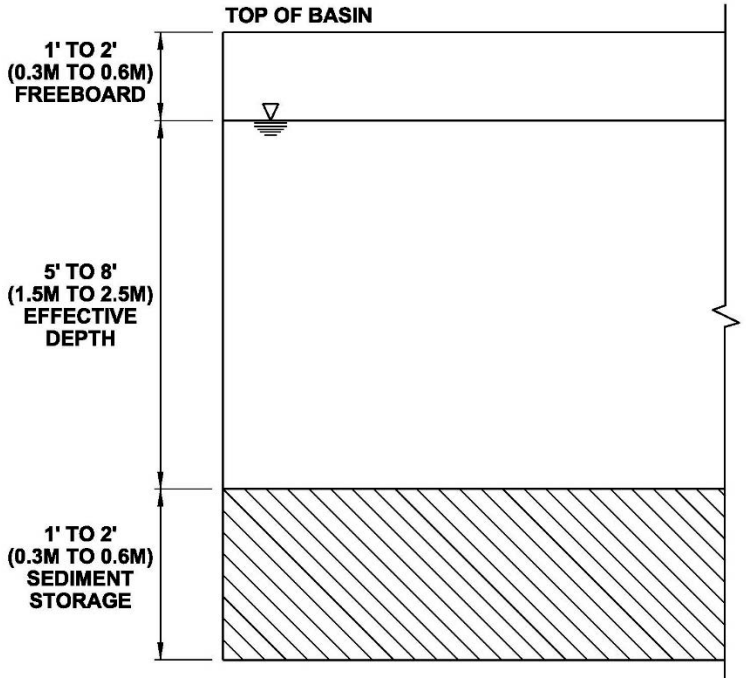
Figure 6-4 Dual Cell Sediment Basin, Cross Section



6-3.4.1 Velocity.

A uniform horizontal flow-through velocity of from 0.5 to 2 feet per minute during washing operations is desirable. The lower range is preferred for predominantly silt and for clay-type soils; the higher rated applies predominantly to sandy soils.

Figure 6-5 Typical Design Water and Sediment Depths



6-3.4.2 Sediment Volume (V_{sed}).

Each basin must store the volume of sediment expected to accumulate between basin cleanouts. The value used to predict sediment volume (V_{sed}) must be based on the expected vehicle soiling and number of basin cleanings per year. Heavy soiling can be expected on vehicles returning from training exercises in off-road areas that have wet field conditions and cohesive soils. The sediment volume will vary between installations and even within the installation due to different soil types in the training areas, training schedules, climate and weather conditions. Table 6-1 lists estimates of the amount of dirt removed from different tactical vehicles each time it is washed. Experience may indicate that a value outside of this recommended range be used to estimate the sediment volume.

Table 6-1 Estimated Volume of Material per Vehicle

Vehicle Type	Average Heavy Soiling cu ft/vehicle (m^3/vehicle)	Average Light Soiling cu ft/vehicle (m^3/vehicle)
Tracked	2.0 (0.06)	1.5 (0.04)
Wheeled	0.6 (0.02)	0.5 (0.01)

Equation 6-3 can be used to determine to predict the total annual sediment volume. If dual-cells are provided, each basin will store half of the total sediment volume expected over the time period between cleanouts, assuming cells have been evenly alternated. Equation 6-4 is used to calculate the required basin volume.

6-3.4.3 Water Volume.

For a single-cell sediment basin, the cell should be sized for a detention time of from 2 to 4 hours with cells operating in parallel; or from 1 to 2 hours with one cell in operation. Wastewater having a high cohesive soil content will require settling times at the upper limit of the range; settling times for noncohesive soils should be at the lower end of the range. One method of determining optimal detention time (T_D) and settling velocity is to perform bench-scale settling tests for the soil conditions at each training site. Another method is to use Stoke's Law in computing trap efficiency. The basin should have a total effective water depth of 5 to 8 feet (1.5 to 2.5 meters).

6-3.4.3.1 Sediment Basin Overflow Rate.

The basin overflow rate is an estimate of the flow rate of wash water used during a wash period (T_w (Equation 6-5). It is determined by reducing the maxi- mum flow rate by usage factors. This flow rate is used when determining the detention time and sizing the cells for the sediment basin. The designer must use discretion as to whether the trench flushers in the wash area will be operable while the vehicles are being washed. The trench flushers in a bath will not operate during washing. The designer also must

use engineering judgment as to what percentage of time the trench flushers (if any) in the vehicle preparation area will be operable while the vehicles are being washed.

$$Q_{over}=U_2Q_2+U_3Q_3+U_4Q_4+U_5Q_5+U_6Q_6+U_7Q_7 \quad \text{(eq 6-5)}$$

6-3.4.3.2 Single Cell System.

In a single-cell system, the cell should be designed to store the water for the designed detention time and should also hold the sediment volume collected between cleanouts. Equation 6-6 gives the water and sediment volumes needed for sizing a single cell at a facility without a bath. If a bath is provided, the bath volume, V_1, must be added to the equation. This equation calculates only water and sediment volumes; it does not include the freeboard which must also be added. Also Q_9, stormwater flow, would not be normally considered an additive flow. The basin should be sized to handle the greater of two volumes, maximum wash water volume or stormwater volume.

$$\text{Volume} = (Q_{over}+U_8Q_8)*T_D+V_{sed} \quad \text{(eq 6-6)}$$

6-3.4.3.3 Dual-Cell System.

In a dual-cell system, each cell must be sized to store the maximum volume expected at any given time. The volume of each cell will depend on the larger of:

$$\text{Case 1: Volume} = 0.5\ V_{sed}+Q_{over}T_D+V_1$$

$$\text{Case 2: Volume} = 0.5\ V_{sed}+0.5\ Q_9T_s$$

6-3.5 Sediment Basin Influent Structure.

The influent line should empty into the deep end of each cell of the basin, opposite a ramped entrance that provides access for the cleaning equipment. A structural baffle or energy dissipater may need to be installed at the influent end to disperse the wastewater and solids across the width and to help prevent water and solids from short-circuiting to the effluent structure. The inlet invert must be placed higher than the maximum water level in the basin to prevent deposition of solids in the influent line or inlet structure. Motorized gates may be used in a two cell basin to make it convenient for the operator to switch the influent flow from one cell to the other or to use both.

6-3.6 Sediment Basin Effluent Structure.

The effluent structure must be located opposite the influent end in order to maximize the detention time in the basin. Protective baffles, fixed or removable, may be installed in front of the effluent opening to prevent discharge of floating debris and oil. A section through the overflow trench for a basin without bath is shown in Figure 6-6. The effluent structure for a basin with bath consists of adjustable, motorized gates used to regulate the height of the water in the basin (Figure 6-7). This arrangement allows the operator to alternate treatment from one cell to the other or use both cells in parallel.

6-3.7 Sediment Basin Construction.

Sediment basins are constructed of concrete in order that a front-end loader can enter the basin at the ramp and remove the sediment without damaging the liner. In addition, a concrete basin prevents oil and other wastes from seeping out of the basin into the surrounding soils.

6-3.8 Sediment Basin Drainage.

The sediment basin must be provided with a drainage system which allows the captured sediment to dewater for easier removal from the basin, controls the discharge of large volumes after draining the prewash bath facilities, permits other routine maintenance to the structure and/or equipment, and permits preparation for winter shutdown.

6-3.8.1 Draining System.

Drain down of the basins for cleaning is accomplished through a drain line with a manually operated valve as depicted in Figure 6-8. Drain down of water trapped in the sediment is aided by gravel packed drains placed along the center wall or in the bottom of each cell. The pumping system shown in the figure is an alternate since, at this point in the treatment system, the main stream flow is by gravity and drainage may occur below the hydraulic grade line. The immediate return of the water drained from the sediment basin to the treatment process is desirable in order to facilitate the removal of any disturbed sediment and oil.

6-3.8.2 Valving.

The valving depicted in Figure 6-8 allows lowering the water level in the sediment basin to the expected maximum sediment level and dewater the captured sediment. Gravel packed drains or trenches are located around the inside perimeter of the basin or in the floor and consist of a perforated pipe encased in filter fabric and gravel. Valving and pumping facilities may be placed at either end of the sediment basin. Drains shall be located below the bottom of the basin or otherwise protected so that, during removal of sediment, they will not be disturbed or damaged. The trench method can be used at either the influent or effluent end of the sediment basin.

Figure 6-6 Typical Effluent Structure with an Overflow Trench, Sedimentation Basins without Bath

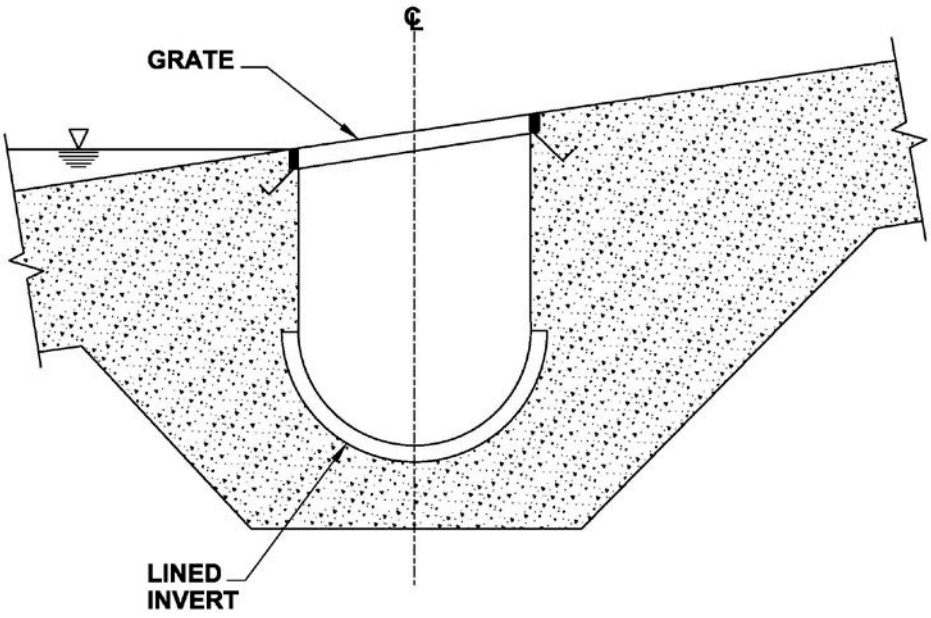


Figure 6-7 Typical Effluent Structure with Motorized Gates, Sediment Basins with Bath

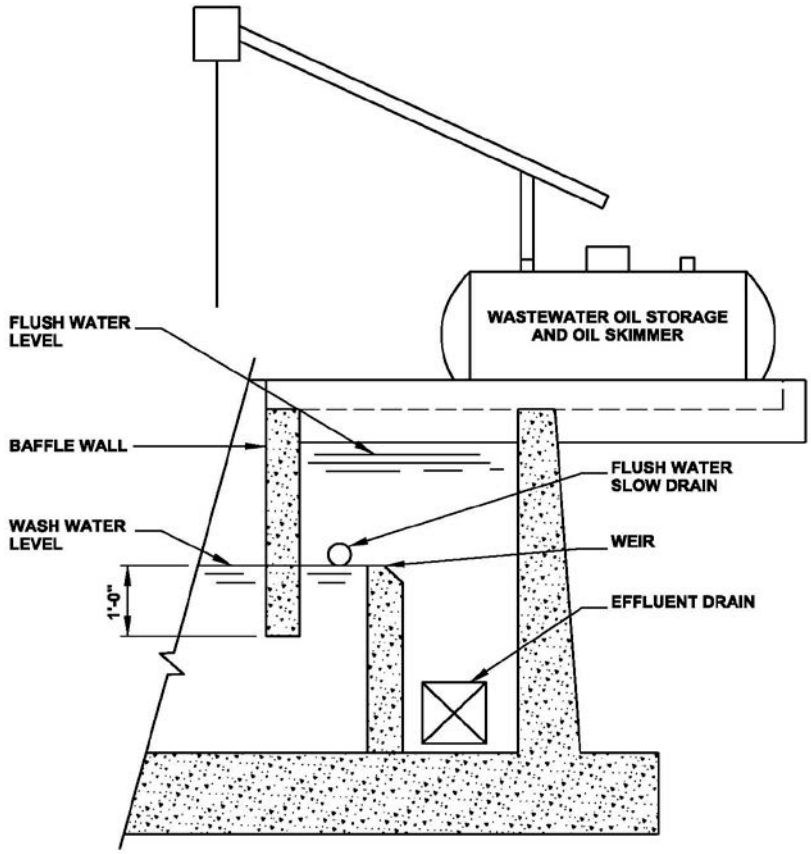
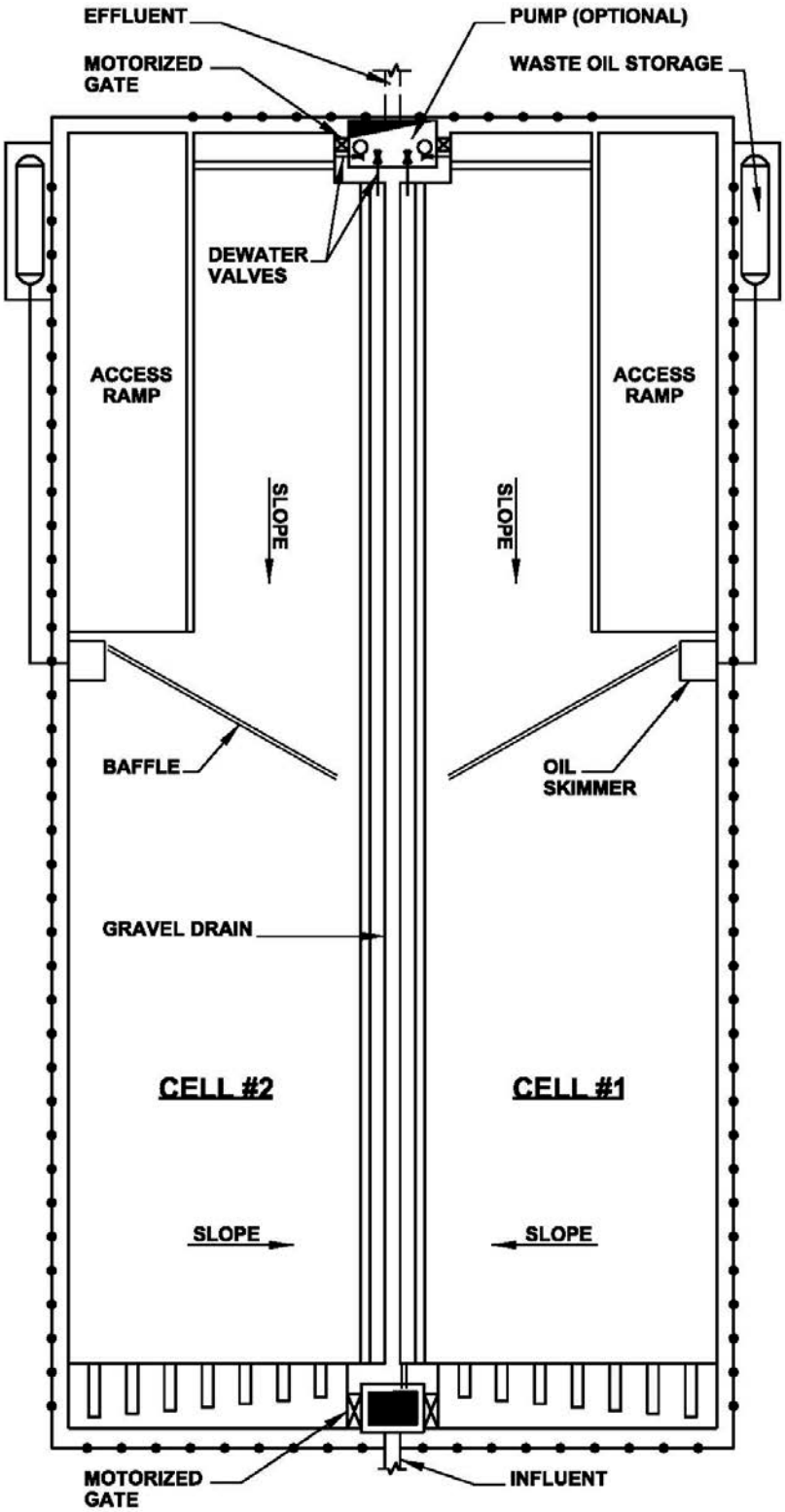


Figure 6-8 Sedimentation Basin Drain System



6-3.9 Sediment Removal.

Sediment basins are not equipped for continuous removal of solids and therefore, the basin should be sized to allow solids accumulation over at least one year based on the estimated solids removed from the vehicles. To remove the accumulated solids, the basins are first drained of water to the maximum extent possible with slow drains, sediment dewatering drains, and/or pumps as described in the previous section. The solids are then removed using front-end loaders and dump trucks that access the solids zone via the concrete ramp. The material is hauled away for proper disposal in accordance with local, State, and Federal regulations.

6-3.10 Oil Removal.

Free floating oils and greases carried into the sediment basin as a product of vehicle washing are lighter than water and therefore rise to the surface. The oils and greases are removed using motorized surface tube-type oil skimmers in each basin. The skimmings are stored in an above-ground or underground waste oil storage tank located near the sediment basins. Skimmers are usually located at the downwind end of the basins. Floating or fixed baffles which extend below the effluent weir elevation may be provided to direct oils toward the skimmer and to prevent the carryover of oils past the effluent weir.

6-3.11 Waste Oil Storage.

Waste oil storage tanks are designed, constructed and installed in accordance with current U.S. Environmental Protection Agency, State, or Local regulations for above ground or underground storage tanks. Storage tanks should be 500 to 2000-gallon (1893- to 7570-liter) capacity, depending on the estimated amount of oil recovery and frequency of cleanout. Positive spill containment should be provided at the cleanout port and directed back to the sediment basin.

6-3.12 Maintenance.

Routine maintenance of the sediment basin and appurtenances will be minimal. Sediment should be removed from each cell at least once per year. The waste oil storage tank should be emptied before its capacity has been reached. Provide appropriate site gauges and/or high level alarms. Oil skimmer devices must be strategically located, easily accessible for servicing and durable. Daily inspection of the oil skimmer unit is required to insure continuous, trouble-free operation.

6-3.13 Other Considerations.

Sediment basins should have pipe rail or fencing mounted on the wall in accordance with OSHA requirements for safety considerations; or the grade surrounding basins located lower than top of wall to provide a safety barrier. Hydrostatic pressure relief should be provided where generally high water tables exist and basins should be designed to prevent flotation when empty. Access ramps should be serrated for vehicle traction. Inlet and outlet ends should be readily accessible to operators, through an

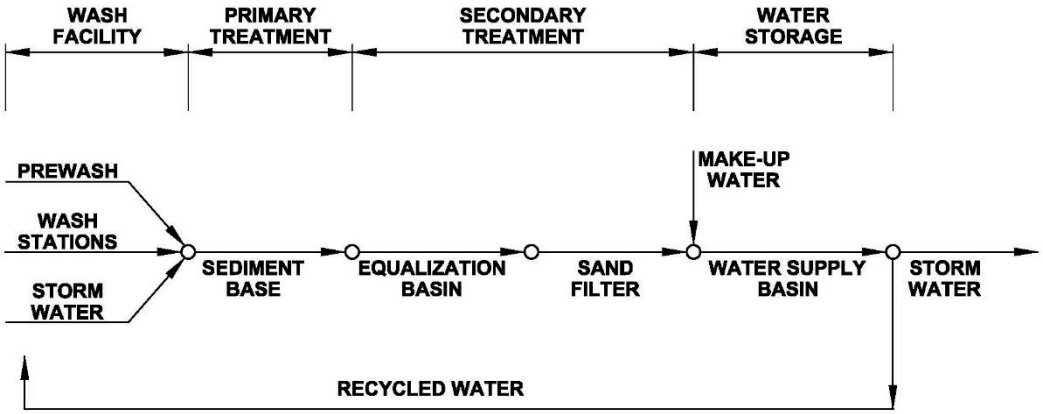
access road around the basins. Lighting should be provided at the inlet structure and at the outlet structure.

6-4 SECONDARY TREATEMENT.

6-4.1 Onsite Secondary Treatment.

At installations where an adequate, dependable, low-cost wash water source cannot be found, and favorable site and weather conditions exist, a recycle water system should be used. The water source must adequately supply clean water on demand during the peak wash periods. The quality of effluent from a sediment basin usually is not adequate for discharge to a sewage treatment plant, even if treating non-cohesive soils and therefore, cannot be used as recycled water. For recycling, secondary treatment is required. If an adequate water source is available and recycling would not be economical, the wastewater may be discharged to an existing sewage treatment plant for further treatment. In this case, onsite sediment basins followed by an equalization basin would still need to be provided. Two alterative onsite secondary treatment systems are available for treating waste washwater to a quality suitable for reuse in vehicle washing, namely, intermittent sand filtration.

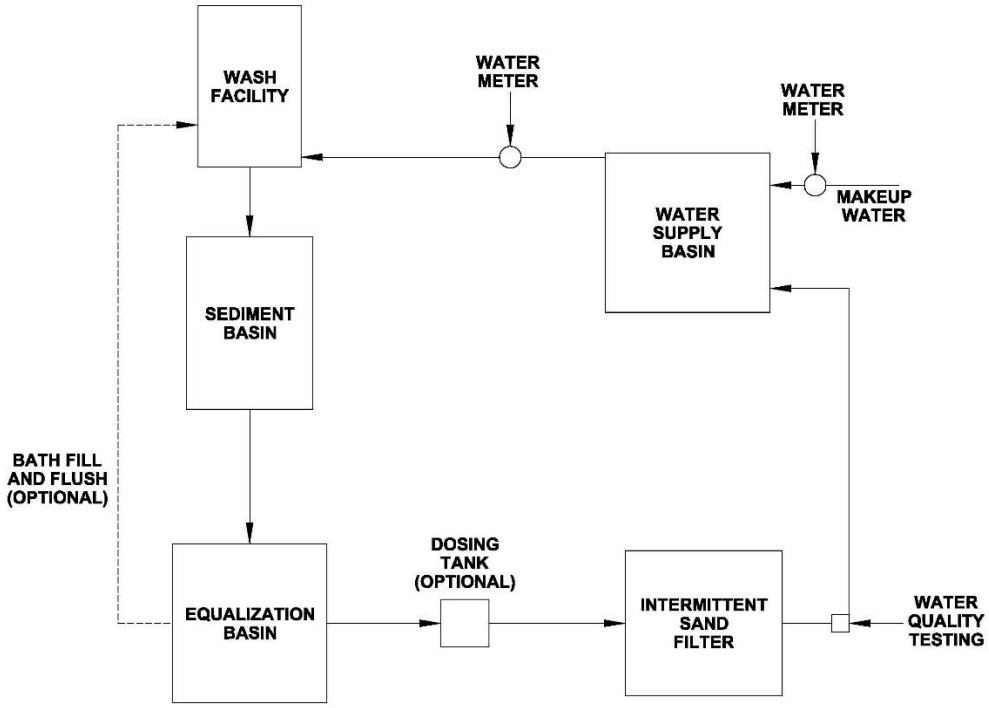
Figure 6-9 Components of an Intermittent Sand Filter System



6-4.2 Objective.

Secondary treatment removes suspended matter, microorganisms, impurities, and minor residual oils from the product water. These materials are carryovers from the primary treatment process and consist mostly of colloidal materials such as clays and fines that have not been removed during sedimentation. The removal of these suspended solids is essential to produce a relatively clean, clear, acceptable product for recycling as wash water.

Figure 6-10 General Schematic of an Intermittent Sand Filter Recycle System



6-4.3 Intermittent Sand Filter System.

This system, depicted in Figure 6-9 and Figure 6-10, consists of three components: equalization basin, optional dosing tank, and intermittent sand filter. All three units are located downstream of the sediment basin in the order listed.

6-4.3.1 Equalization Basin.

The equalization basin (Figure 6-11 and Figure 6-12) serves two main functions. First, it is considered a part of secondary treatment because it provides storage and flow dampening of the sediment basin effluent so that this water can be delivered at a controlled rate to the intermittent sand filters for final treatment. The basin buffers the fluctuations in wastewater flow and quality caused by variable use of the wash facilities. It also compensates for the difference between basin in- flow and intermittent sand filter application rates. By regulating the dose of water to the intermittent sand filter at designated intervals and rates, the filter size can be minimized. Second, the equalization basin provides a quiescent zone for settling of fine, suspended solids that have been carried over from the sediment basin. This function improves the overall suspended solids removal efficiency of the treatment process. Unfiltered water from the equalization basin should be used as a source of water for filling the bath prewash and for trench drain flushing, thereby conserving the water supply. When equalization basin water is used in this way, separate delivery pumps and piping are required, but the size of intermittent sand filters and water supply basins are usually reduced.

6-4.3.1.1 Siting.

The equalization basin is located at a lower elevation than the sediment basin and the wastewater should flow by gravity from the sediment basin to the equalization basin.

6-4.3.1.2 Sizing.

The size of the equalization basin will be based on several factors, including the volume of water from the sediment basin, the number and capacity of intermittent sand filters, the frequency of dosing the filters, and the volume of sediment expected to collect between cleanouts. The designer must ensure that the size of the equalization basin is compatible with the influent volume from the sediment basin and the effluent to the dosing tank or intermittent sand filters. If it is too large, it will not be cost effective. If the basin is too small, it will overflow. An extra 2 to 3 feet (0.6 to 0.9 meter) of freeboard should be included above the maximum loading volume.

Figure 6-11 Example Equalization Basin, Plan View

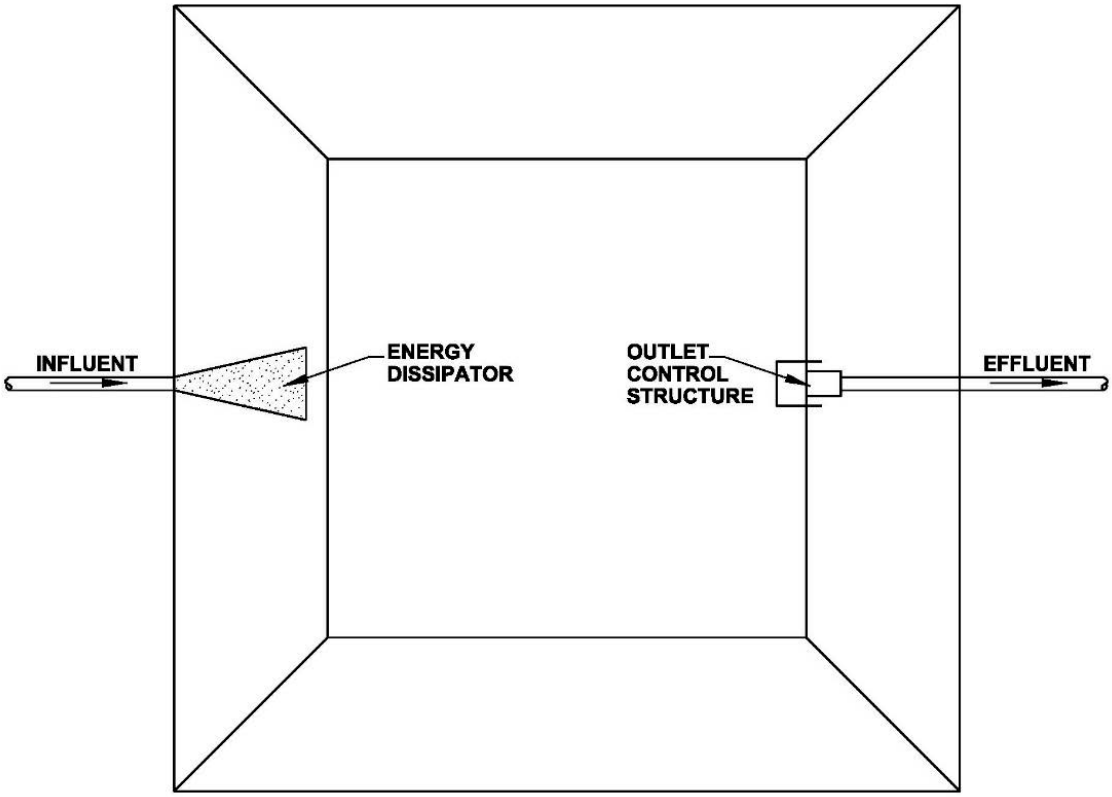
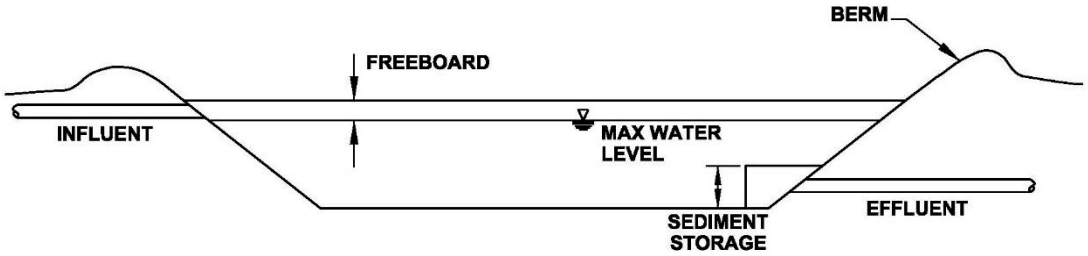


Figure 6-12 Equalization Basin, Cross Section



- Water Volume. The basin's size should be based on V_{ave}, for a one week wash period or V_{max} for a peak use period, whichever is greater. A safety factor ranging from l.25 to 2.0 times V_{ave} or V_{max} should be incorporated to help insure adequate water volume at all times. The effective depth of the basin should be 5 to 8 feet (1.5 to 2.4 meters). Deeper basins should be considered in arid regions to reduce water surface areas, thereby minimizing evaporation.
- Sediment Volume. A depth of from 1 to 2 feet (0.3 to 0.6 meter) should be allowed for sediment storage at the bottom of the basin and this volume added to the water storage requirements.
- Dead Storage Volume. A depth of 2 to 4 feet (0.6 to 1.2 meter) should be allowed directly above the sediment volume for dead storage. This additional volume allows for submergence of the basin effluent control structure and provides a minimum water volume to optimize settling.

6-4.3.1.3 Influent Structure.

A concrete trough should be installed at the inlet to prevent liner erosion. The inlet pipe should he higher than the maximum water elevation in the basin to allow free discharge of wastewater. If the wastewater Influent line were submerged, sediment could collect and eventually clog the line.

6-4.3.1.4 Effluent Control Structure.

The effluent structure should be located opposite the Influent structure thereby maximizing the water detention time in the basin. If cohesive soils are present, float supported baffles may be required to increase the detention time and minimize short circuiting of wastewater in the basin. Stormwater diversion prior to treatment should be considered as standard procedure only if the CVWF is in a shutdown mode. This diversion should be in operation after each day's shutdown and when it is expected that the facility will not be in use for long periods of time, such as during winter.

6-4.3.1.5 Construction.

In-ground equalization basins are designed and constructed with water-tight walls and bottom. Several liner materials, or combinations, can be considered for water- tight construction. However, local experience with earthen basins may suggest that no lining is needed. In-ground basins should be de- signed and constructed in accordance with

and with approval by the state regulatory authority in which the facility is located. The most cost effective, environmentally acceptable basin construction should be provided.

- Concrete. A concrete liner is permanent and can resist freeze/thaw cycles. If a concrete lined basin is used, the foundation must support the weight of the structure, concrete, sediment, and water at maximum depth. Concrete can crack and deteriorate and can be relatively expensive to install and repair compared with other types of liners. The slope of the walls will depend on the method of construction. Expansion/contraction joints are required and may be difficult to seal tightly.
- Bentonite and Natural Clay. A bentonite or natural clay liner can be installed only over certain soils. Non-cohesive soils that contain large amounts of fines without coarse lenses (sands and gravels) are susceptible to movement which can cause leakage in bentonite and clay liners. A site without shallow bedrock and without a perched water table is desirable for installing these types of liners. When these materials are used, the slope of the walls will vary, depending on local conditions such as the soil's angle of repose. Sediment removal equipment could damage a bentonite liner, since movement of the bentonite can cause leakage. Therefore, a concrete ramp and floor must be installed to provide access for removing the sediment. Leaks may occur at each point where the bentonite and concrete interface. The inlet must have an energy dissipater such as a concrete trough with rocks to prevent erosion of the bentonite walls. Bentonite-treated basins must be protected from stormwater erosion to maintain their integrity.
- Synthetic Materials. Various types of synthetic rolled material can be used to line the equalization basin. A synthetic liner is installed in the same way that a landfill is lined. A proper base is pre- pared and the liner is positioned, then covered with soil. Equipment can move over the bottom of the basin if the soil covering the liner is thick enough to protect it, a proper base is under the liner, and the walls are not sloped too steeply. A concrete ramp and floor can be installed in the basin before the rolled material is placed. A concrete trough must be used to channel the Influent over rocks and other obstacles to dissipate the energy of the falling water. If a synthetic liner material is selected, it should be resistant to petroleum products and sunlight such as high density polyethylene (HDPE).

6-4.3.1.6 Sediment Removal.

The equalization basin design should include means for dewatering and gaining access to the basin. Basins should be designed for infrequent sediment removal in the range of from 10 to 20 years based on solids carryover from the sediment basin. Sediment storage should be from 1 to 2 feet (0.3 to 0.6 meters). In selecting the liner, designers should consider the method and equipment the facility will use to remove sediment. The liner used should sustain the least damage to its bottom and side walls during cleanout. A ramp with a slope of 1 to 6 (17 percent) may have to be constructed to allow cleaning equipment access to the basin.

6-4.3.2 Dosing Tank.

A dosing tank or device is a storage structure or component located after the equalization basin and before the filters. The purpose of the dosing tank is to discharge settled water to the intermittent sand filters at the desired dosing rate and frequency. The first choice for delivering influent to the filter surface is by gravity flow; however, if this design is not possible, automatic operation is an important alternative. Automated delivery is done using flow-activated valves, dosing siphons, timer-controlled valves, or pumps. It is suggested that a dosing siphon or electronically triggered valve be provided in the dosing basin in conjunction with the distribution piping. The most economical dosing siphon in sewage systems is the type with proper bypass pipes and valves; however, electronic float-actuated valves with manual over-ride mechanisms are also effective. Both approaches require a minimum elevation differential between equalization basin water level and filter surface. Water flows by gravity from the equalization basin to the filter pump wet well and then is pumped to the filters via a filter valve control box or valve house.

6-4.3.3 Intermittent Sand Filters.

Intermittent sand filters provide an economical, effective method of treating water prior to reuse at the wash facility. Filters provide a final polishing step by further reducing residual BOD5 and suspended solids that maybe in the water. This step renders the water suitable to be pumped and reused for washing. The mechanisms involved in removing suspended solids by filtration are complex. Some straining occurs at the filter surface; however, most solids removal in granular filters of the type used at CVWFs occurs within the pore space of the filter media particles and by absorption of impurities onto the filter media surfaces. Additional straining between media particles in the filter also contributes to overall solids removal. Although the primary purpose of the filters is to remove suspended solids and provide a polishing step prior to recycling, they also are effective in reducing BOD5, nitrogen compounds, and algal populations through a combination of physical and biological processes without the addition of chemicals. The effluent quality filtration is such that any discharge or reuse is environmentally safe and will cause no increased pump wear. Adequate product water is achieved with minimal O&M costs and personnel. This type of sand filter does not require backwashing.

6-4.3.3.1 Configuration.

The surface of an intermittent sand filter may be divided into two, three, or four cells. The cells may share a common underdrain collection system, but will have separate distribution systems. Each cell should be physically separated by surface partitions to prevent wastewater from spilling over from one cell to another. At the designer’s option, the partitions may also completely separate the 36-inch (0.9 meter) sand layer between cells; a minimum of 12-inch (0.3 meter) penetration is recommended.

6-4.3.3.2 Siting.

Intermittent sand filters can require large areas. Therefore, the most desirable topographic and location criteria would include a level site that is free of trees,

woody vegetation, and rock; a deep groundwater table; good natural drainage away from the filters; and proximity to the main pump station and water supply basin. Open filters should be located away from or protected against windblown dust from unpaved tank trails. Site conditions may require windbreaks such as fences, trees, or shrubs to prevent wind erosion of the filter media and/or prevent dust from settling on the filter surface. It is desirable that the site be high enough above the maximum water elevation in the water supply basin to allow for gravity flow into the water supply basin.

6-4.3.3.3 Sizing.

The size of these filters and their pumping system is determined by three factors: daily dosing rate, dosing frequency, and dosing rate.

- Daily Dosing Rate. This rate is the maximum wastewater volume per day per unit area (in acres) which is applied to the surface of the filter and depends on the loading rate. Typically the application rate is between 490,000 and 980,000 gallons per acre per day (524 and 1048 liters per square meter per day), which is the equivalent to flooding the filter to a depth from 6 to 12 inches (15.2 to 30.4 centimeters) every 8 hours. The daily dosing rate of the filter currently is chosen according to soil conditions. Soil type (S_t) for the installation (chap 3) should he used in evaluating the design loading rate. CVWFs serving installations with mainly sandy soil (S_t=1) and little or no suspended clay in the training areas may be designed at higher loading rates. However, since some clay-type soils (S_t=5) occur at most installations, design should he adjusted toward the lower end of the recommended loading rate.
- Dosing Frequency. The daily dosing volume is applied to the filters in three intervals to maintain wetness of the filter and also allow the filter to "breathe" between doses, thus maintaining the aerobic biological treatment which results from intermittent dosing. Normally, a filter will have more than one cell and each cell must be dosed every 8 hours, but the actual dosing interval may be alternated from cell to cell. A dosing sequence using equal dosing per day per filter to he delivered by an automatic dosing device or pumps is recommended. Using the available filters on an alternating basis, with rest periods between doses, effectively reduces the hydraulic dosing rate. This procedure is achieved by using electronic timers to control the application of wastewater to the filters.
- Dosing Rate. This value is the flow rate to the filter during each of the three dosing intervals. Dosing flow to the filter should be 95 to 190 gpm per 1000 square feet of filter surface area (6 to 8 inches [15.2 to 20.3 centimeters]) applied for 20 to 40 minutes to give the desired daily loading rate.
- Filter Surface Area. The total filter surface area is calculated by dividing the average weekly flow by the daily loading rate x 7 as the

filter can be designed to operate 7 days per week unattended. The total filter surface area is then divided into two or more filter cells. This design minimizes the size of the wastewater distribution network on the filter surface and lowers the effect of taking one filter cell off-line for servicing. Because the distribution lines must be easily removable for servicing the filter surface, it is useful to limit their length and size. Small filters also minimize pump capacity and velocity of flow through the distribution systems. Cell sizes of approximately 1/4 acre (1012 m^2) are desirable; however, they may be larger.

- Example Sizing. Assume that a CVWF requires an average weekly wash water flow of 1.6 million gallons per day for 5 days/week; soiling conditions indicates a loading rate of 650,000 gallons/acre/ day.

  Further assume that two filters will be used, each divided into four cells:

  Cell Size = 1.76 acres/ filters*4 cells/filter

  = 0.22 acres/cell

  Dosing frequency: one of the eight cells is dosed every hour.

  Volume per filter dose = 8,000,000gal / 21 doses= 380,950 gal per dose.

  Volume of dose per filter cell = 380,950 gal / 8cells = 47,620 gal.

  Dosing rate = 150 gpm / 1000 square feet x 0.22 acre (9,583 square feet) = 1438 gpm.

  Pumping time to dose each cell = 47,620 gal/I 438 gpm = 33 min.

6-4.3.3.4 Distribution System.

The designer may choose one of several distribution systems to apply waste water evenly over the surface of the sand. Whichever system is chosen, the de- signer must ensure that it will be easy to remove and replace for cleaning. One design uses perforated plastic pipes placed on the surface of the sand in a grid pattern (Figure 6-13). The drilled orifices in the pipes should be at least 0.16 inch (4 millimeters) in diameter or larger to prevent the openings from clogging. The pipes must be sized to distribute the water as evenly as possible. Another distribution system uses wooden troughs placed on the surface of the filter (Figure 6-14) and positioned so as to apply water to the surface of the filters as evenly as possible (Figure 6-15). The number of distribution troughs needed will depend on the area of the filters and the volume of water to be filtered. Plastic pipes with drainage holes may have to be installed in the troughs to extend the distribution system and apply the water uniformly over the surface. The holes in the pipes should be the same size as those in the grid system. The filter distribution system used should he capable of being disassembled when maintenance of the filters is required and the supply pipe to the distributors should he buried.

Figure 6-13 Distribution System Using Grid Arrangement

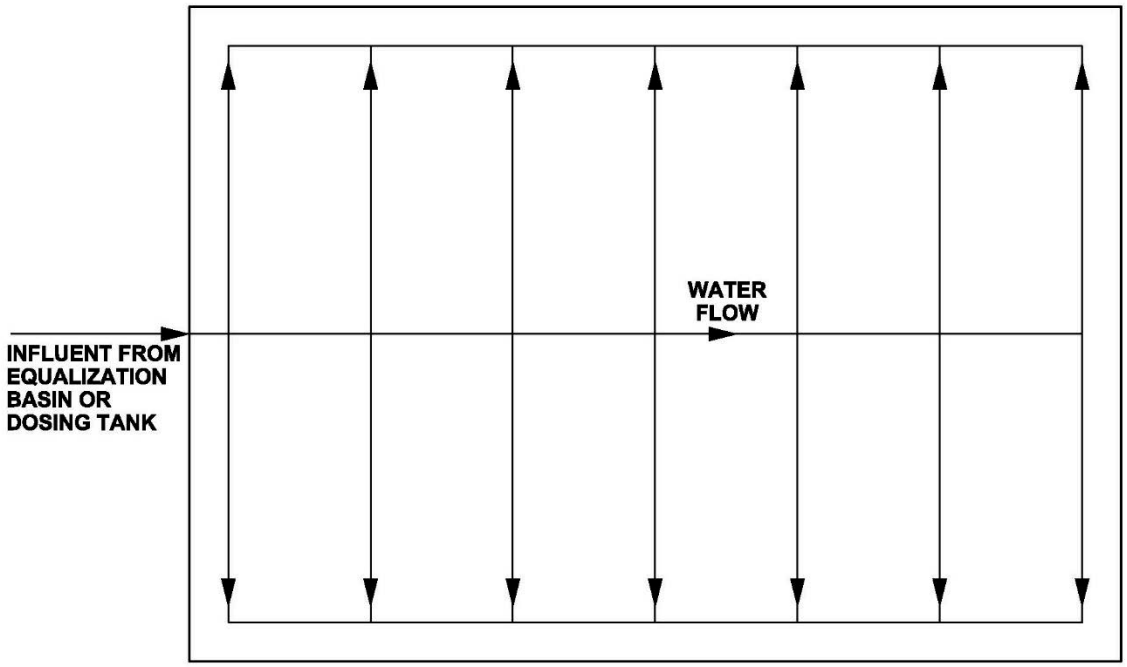
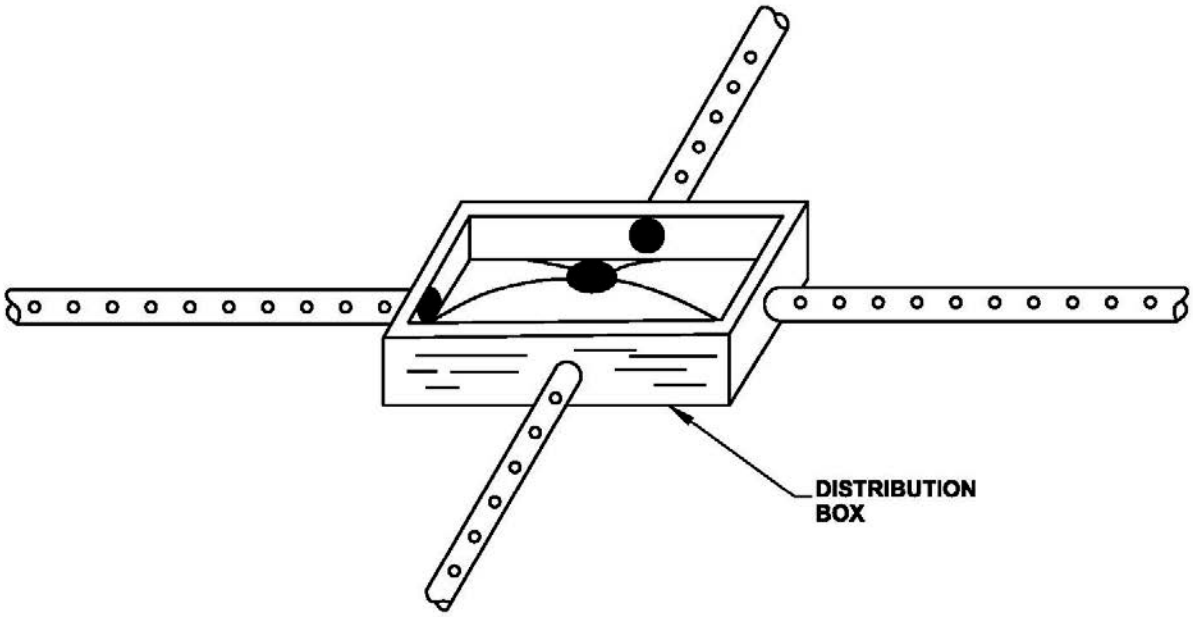
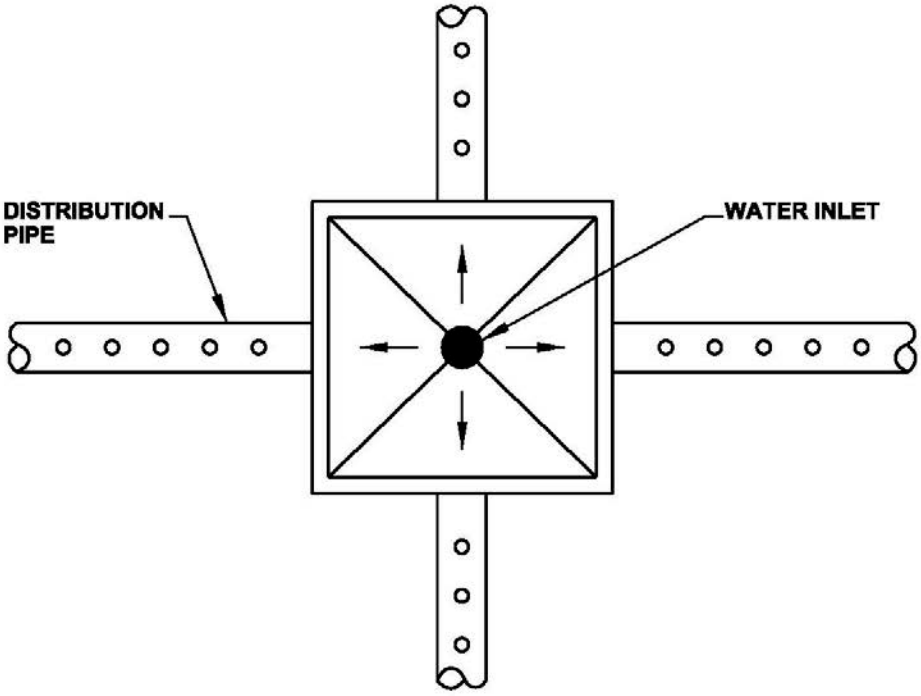


Figure 6-14 Distribution Box





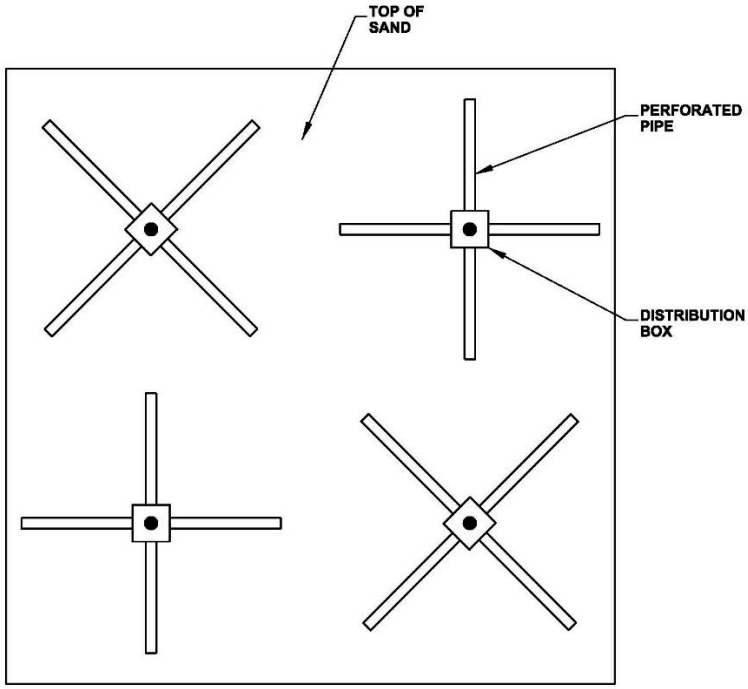
6-4.3.3.5 Underdrain System.

Perforated collection pipes for the filters are installed near the bottom of the filter embedded in gravel just above an impervious layer. Water will percolate downward through the sand and collect in the pipes (Figure 6-16). These underdrains should be placed on a minimal grade (less than 0.25 percent) to provide gravity flow. The designer must consider the surface area of the filters and design the collection system to also handle stormwater falling on the filter.

6-4.3.3.6 Materials.

Local sands and gravels should he used whenever possible. The material may have to be washed and screened to obtain clean and properly sized aggregate. The top 36 inches (0.9 meter) of the filter should contain sand with less than 1 percent of the fines passing the number 200 sieve. The D_{10} should be between 0.2 and 0.4 millimeters with a uniformity coefficient (D_{60}/D_{10})1 of less than 3.5. The next layer contains 4 inches (10.2 centimeters) of 0.5-inch (1.3- centimeter) aggregate. The next layer is 3- inches (7.6- centimeter) of 1-inch (2.5- centimeter) aggregate. The bottom layer consists of 11 inches (27.9 centimeters) of aggregate ranging in size from 1.5- to 2.0- inch (3.8-to 5.1-centimeter). The depth of the bottom layer should be measured from the bottom of the lowest collection pipe. The bottom and walls of the filter must be relatively impervious. Liners of clay soil or geotextile membranes should be provided similar to those described for the earthen basins (para 6-26). Figure 6-17 shows an intermittent sand filter in cross section.

Figure 6-15 Distribution System Using Distribution Boxes

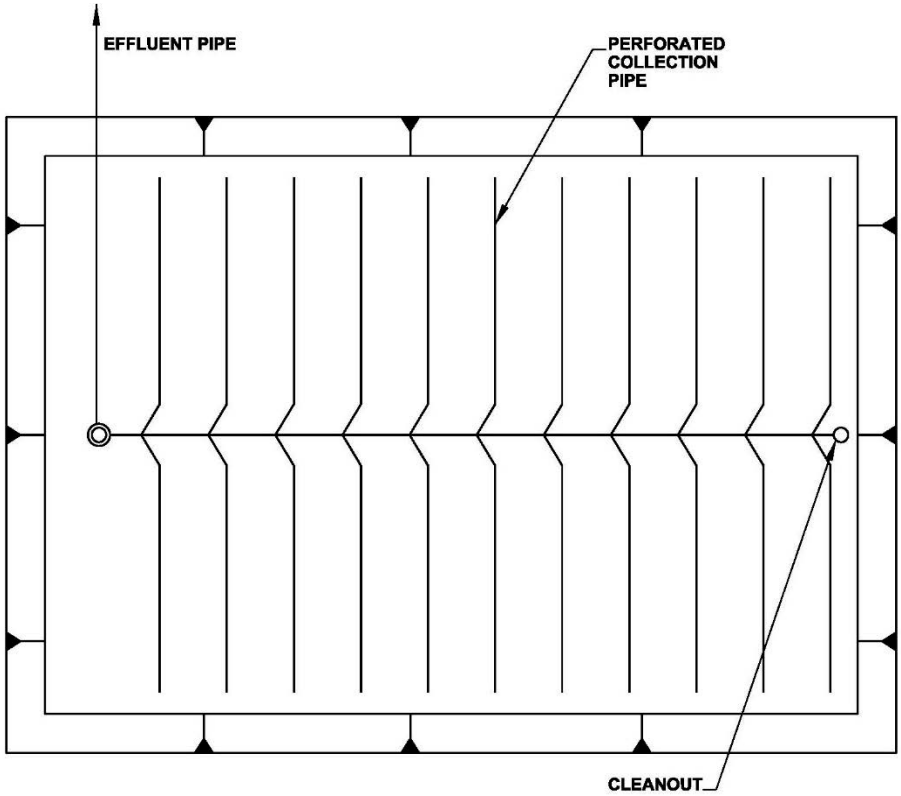


6-4.3.3.7 Filter Maintenance Considerations.

The filter sand and the filtered matter support the growth of weeds and grass. Weed control is not required since low grasses and weeds can protect the surface sand from direct sun rays. This shades the sand and reduces evaporation. However, trees and other plants with root systems that could clog or otherwise interfere with the filtering process should be removed.

- Winter operations are mostly similar to those during warm weather except that cleaning the filters during cold weather is more difficult. Cold season filtering should be started with a clean, raked filter surface. If the CVWF (and therefore the filters) will not be used during freezing months, the distribution piping including header, distribution main, and laterals must be designed to be fully drained to prevent damage due to freezing. The underdrain network must also be designed to be fully drained or to prevent water from collecting in the filter and underdrain to a depth at which freezing damage can occur.
- Where wind-blown dust and dirt could be transported to the filters from unpaved tank trails or erosion-prone areas, natural or artificial screens may be considered.
- When a filter is observed to be plugged or approaching a plugged condition, it will be necessary to rejuvenate the filter surface. Two approaches are recommended. The first consists of raking the media surface to remove debris and breaking the surface incrustation that results from the drying of fines and debris. The filter is raked manually with a garden rake or a small tractor rake or disk attachment. When raking no longer appears to rejuvenate the filter surface due to the buildup of filtered matter in the top layer of the sand media, then it is necessary to remove and replace the solids-laden layer. The sand is removed manually or with mechanical devices. A four-wheel-drive garden tractor equipped with a hydraulically operated scraper, bucket loading device, and either flotation-type or dual rear tires works well. The decision to discard or reuse the spent filter sand will largely depend on local availability of this material. When sand costs are high, the removed sand should be stockpiled, washed, and recycled. This approach is especially attractive in wet climates. It is also possible that filter effluent could be used to clean the sand.
- The designer must consider the above maintenance aspects of intermittent sand filters and include in the design measures for access, cleaning equipment, intermittent sand filter layers, distribution piping design and ease of removal, and freeze protection.

Figure 6-16 Collection System



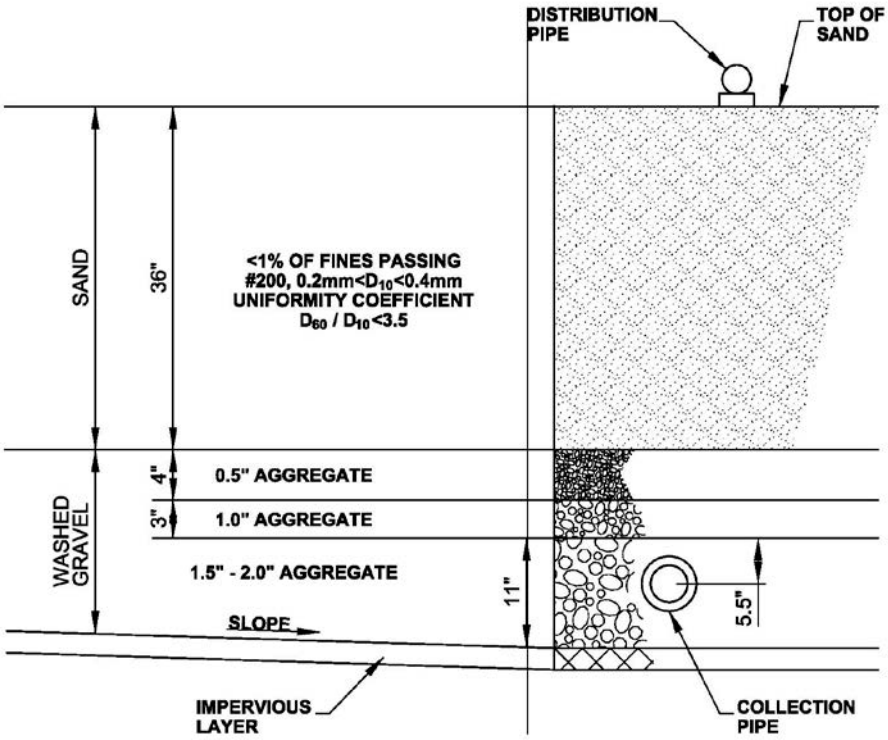
6-4.3.3.8 Monitoring.

The effluent stream should be monitored for quantity and quality at a point between the intermittent sand filters and the water supply basin. If the water quality meets the standards of the regulatory agency, it is allowed to flow into the wash water supply basin. Otherwise, it is rerouted to the equalization basin for further treatment. The effluent also should be tested periodically for grease, oil, BOD_5, COD, hydrogen-ion concentration (pH), total dissolved solids (TDS), and suspended solids (SS) levels.

- A recycle system should be monitored at least weekly for the first year of operation. This time span will give the installation a good profile of the treatment system's operation. After the first year, the system may need to be monitored once per month or every other month. These data should be compared with the initial profile data to confirm that the system is working properly.
- If primary treated and equalized water is discharged to a sewage treatment plant, the system should be monitored weekly for the first 3 to 4 months to assure the plant operator that the biological, solids, oils, or hydraulic load being discharged from the wash facility are in compliance.
- A system that discharges to the environment will require permitting in accordance with the state regulatory agency. The agency must be

consulted to determine the monitoring frequency required. Measurements and laboratory tests should he performed in accordance with the instructions in Standard Methods for the Examination of Water and Wastewater.

Figure 6-17 Intermittent Sand Filter Cross Section



6-4.4 Lagoon System.

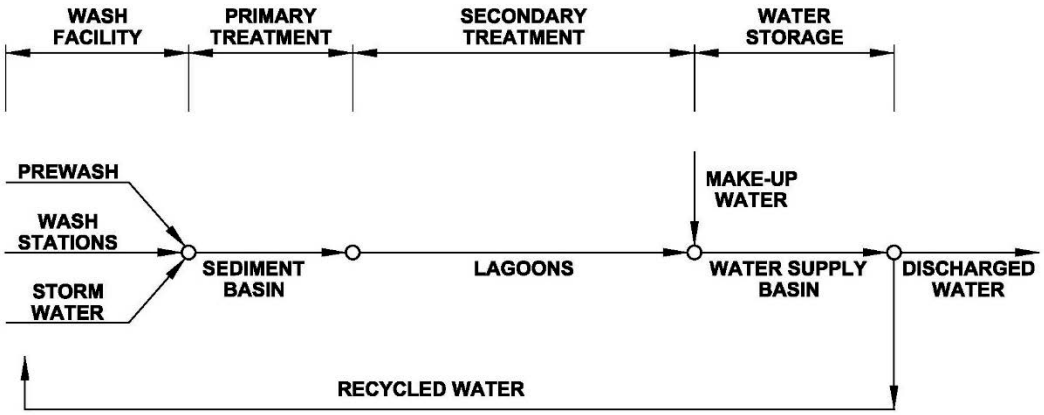
Using lagoons as a secondary treatment system for wastewaters from a CVWF is not the recommended standard. The use of lagoons instead of intermittent sand filters requires Office of the Chief of Engineers (OCE) approval prior to programming and design. Lagoons can be used for secondary treatment only if ponds exist in the vicinity of the CVWF and they are environmentally, hydraulically and structurally acceptable; and if they are more cost effective than sand filters; and long term settling test confirm the ability of lagoons to produce acceptable water quality. However, past designs have used the lagoon treatment system for secondary treatment at CVWFs as described below.

6-4.4.1 Description.

A lagoon system, like an intermittent sand filter system, includes a sediment basin for sediment and free oil removal (Figure 6-18). If the wastewater is to be recycled, an equalization basin and wash water supply basin are also required. The polishing lagoon is sized to give a minimum of 14 days detention time for the wastewaters after pre-treatment. This minimum detention time is calculated at peak hydraulic flow conditions into the lagoon. Sediment storage within the lagoon must be provided for the design life

of the lagoon. This storage volume is calculated by multiplying the anticipated flow by the sediment load in the flow by the design life. Figure 6-19 shows the basic lagoon arrangement.

Figure 6-18 Components of a Lagoon System



6-4.4.2 Components.

- Influent Structure. The influent structure is located and designed so that it is not sub- merged.
- Effluent Structure. The effluent structure is designed to prevent the overflow residual floating oils and solids.
- Liner. Liner performance should be resistant to the action of petroleum products.
- Oil Removal. Continuous oil removal in the lagoon is not required.
- Stormwater. Stormwater capacity is designed into the lagoon based on rainfall for the site. It should be assumed that washing operations at the CVWF can occur during a design storm event.
- Waste Discharge (recycle only). The lagoon should have the capability of discharging 50 percent of its capacity to control dissolved solids that will have accumulated in the wash water. This amount can be reduced to 30 percent in areas where the rainfall meets or exceeds the evaporation rate. The lagoon should be monitored for dissolved solids each month of operation.
- Maintenance. The lagoon should be monitored for deterioration of water quality and for leakage.

6-4.5 Discharge System.

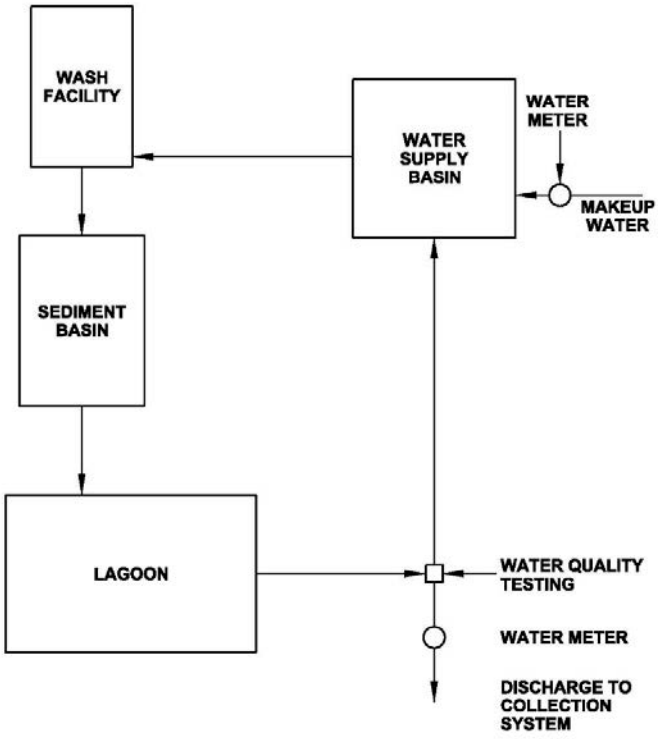
A total discharge treatment system removes dirt and debris from the wastewater before discharging the entire volume to a secondary treatment system, usually a sewage treatment plant Figure 6-20 shows the unit process in a discharge system, and Figure 6-21 is a schematic depicting the treatment sequence. Primary

treatment is required to remove free oils and prevent sediment deposition in the conveyances and causing a blockage. This treatment also prevents large volumes of sediment and oil slugs from entering a sewage treatment plant which is usually not designed to handle this type of waste. If it is not feasible or practical to discharge the wastewater to a sanitary sewer system, the water may have to be discharged to stormwater surface drainage channels or storm sewers. If one of these methods is used, the water must be treated to produce an effluent quality complying with the installation's National Pollutant Discharge Elimination System (NPDES) permit since this type of discharge is classed as a point source. The discharges must be regularly monitored and reported.

6-4.5.1 Equalization Basin.

An equalization basin may be required if the sewer lines or plant cannot accept the total instantaneous volume of pretreated wastewater. If the water volume is to be introduced slowly to the discharge location, an equalization basin should be constructed to hold wastewater until it is discharged. The basin should be designed as previously described.

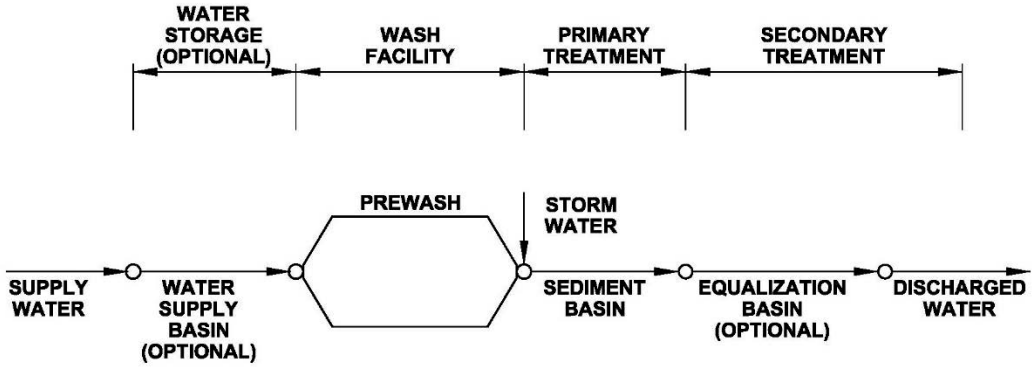
Figure 6-19 General Flow Schematic of a Lagoon System



6-4.5.2 Water Supply Basin.

A water supply basin may be required in a non-recycle system if the wash demand exceeds the available source of supply. This should be planned, designed and constructed as previously described.

Figure 6-20 Components of a Total Discharge System



6-5 WATER SUPPLY BASIN.

6-5.1 Introduction.

Filtered water from the secondary treatment facility (sand filter or lagoon) flows by gravity into the wash water supply basin. This is a lined basin which stores the filtered wash water supply for the vehicle wash area. Maximum and minimum operating levels are monitored by level sensors in the wash water pumping station. The basin is sized to store, at a minimum, the quantity of water required to wash the maximum number of vehicles for which the facility is designed during the design wash period. Makeup water for the CVWF is added into the water supply basin. If necessary, excess water can be discharged from this basin; however, the basin should be sized to hold the water demand volume plus storm water from a one hour duration 10-year storm event.

6-5.2 Capacity.

The effective water volume of the basin should be based on V_{ave} for a one week wash period or V_{max} for a peak use period, whichever is greater. A safety factor ranging from 1.25 to 2.0 times V_{ave} or V_{max}, should be incorporated to help insure adequate water volume at all times. The basin should include 3 feet (1.0 meter) of freeboard above the highest water level, including an allowance for stormwater. There is no need to provide for sediment storage in this basin since the water in the basin should not contain sediment. A depth of 2 to 4 feet should be allowed for dead storage at the bottom of the basin. This additional volume allows for submergence of the effluent control structure. Figure 6-22 and Figure 6-23 show different views of a water supply basin. The designer must ensure that the size of the water supply basin is compatible with the influent volume from the secondary treatment or water source and with the effluent volume to the wash facility. If the basin is too small, there will not be enough wash water, but if it is too large, it will not be cost-effective. The effective depth of the water supply basin should be 5 to 8 feet (1.5 to 2.5 meters). Deeper basins should be considered in arid regions to reduce water surface areas, thereby minimizing evaporation.

6-5.3 Liner.

The water supply basin may be lined with concrete, clay, or a synthetic material, if required, such as those described for the equalization basin (para 6-26 above). In areas with high evaporation rates, light-colored basin liners might be considered to lower solar heat gain and decrease the evaporation rate.

6-5.4 Influent Structure.

An energy dissipation device or treatment should be installed at the inlet to dissipate the energy of the influent water and prevent liner erosion. The inlet should be close to the maximum water elevation in the basin to prevent water from backing up into the pipe and surcharging the sand filter drain system.

6-5.5 Service.

There should be little, if any, solids deposition in this basin, so there is no need for a ramped service entrance into it. There should also be no oil in this basin, so no oil removal equipment is needed.

6-5.6 Security.

Fences may have to installed around the basin to prevent animals from entering the area to drink or bathe.

Figure 6-21 General Flow Schematic of a Total Discharge System

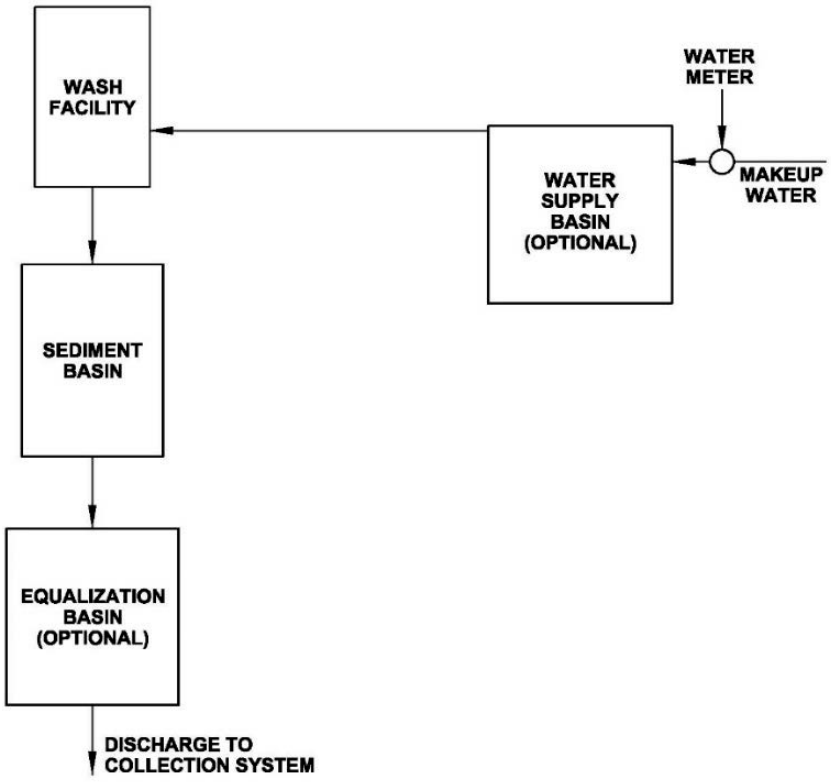


Figure 6-22 Water Supply Basin, Plan View

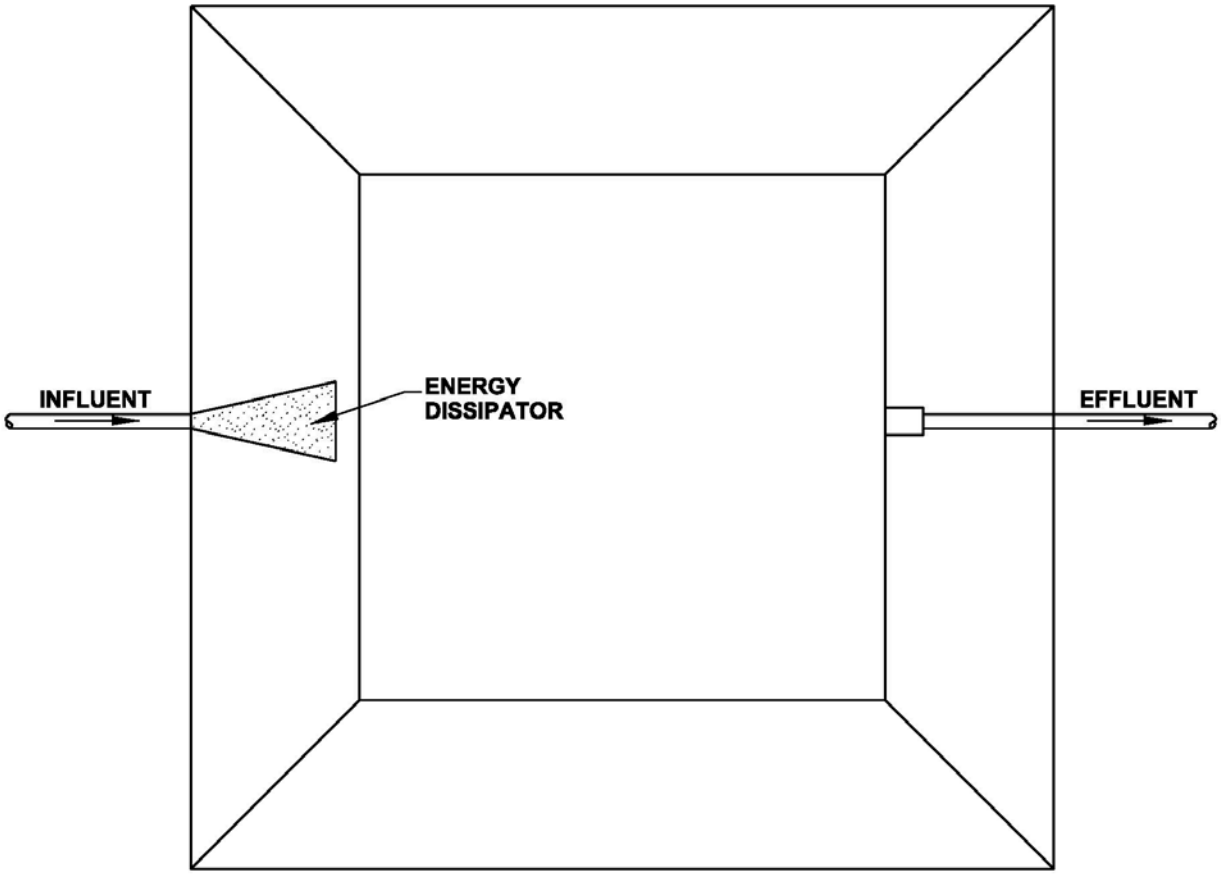
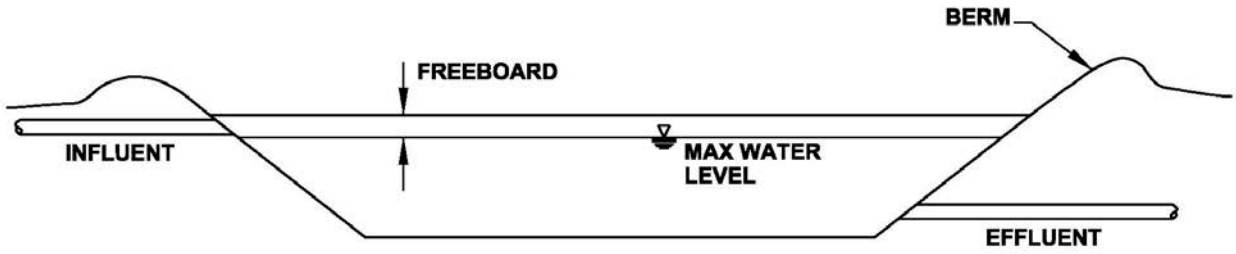


Figure 6-23 Water Supply Basin, Cross Section



CHAPTER 7 OTHER DESIGN CONSIDERATIONS

7-1 WATER SOURCE.

All treatment systems will require a reliable source for charging the CVWF initially and for make-up, regardless of the form of secondary treatment. The volume of water required will depend on the type of wash facility constructed, type and configuration of the treatment system, frequency of use, losses, and the local climate. If a recycle system is provided, the designer must determine the most feasible and economical method of filling the system initially, and then maintaining the water level in the system by adding makeup water from the water source. Makeup water will be required to restore the system to a working level as water is carried off by the vehicles or lost to evaporation and overspray. All original source and makeup water should be added at the water supply basin, if provided. This water should be uncontaminated, reasonably clean, and should not require treatment before being introduced into the system. All sources of water available at the installation should be considered for use, singly or in combination, as sources of water at a CVWF including dedicated wells, surface water, tapping into the existing potable water supply or captured rainwater.

7-1.1 Type of Facility.

A wash facility that has a prewash will require more makeup water than a facility with only wash stations because of increased water lost by vehicle carry-off, overspray and evaporation. Water losses from carry-off can be as high as 160 gallons per vehicle. Losses due to overspray and evaporation can be as high as 10 percent from water cannons and 5 percent from hoses at wash stations.

7-1.2 Type and Configuration of Treatment System.

The type and configuration of the treatment system is another factor to consider when estimating the volume of makeup water required. A discharge system will require that the total water demand including makeup be taken from the developed water source. In a recycle system, only the water lost to overspray, evaporation and vehicle carry-off will need to be replaced from the water source. Treatment systems with basins that have large surface areas may have greater water losses due to evaporation than basins with smaller surface areas. This loss will increase the volume of makeup water required, as discussed below.

7-1.3 Climate.

The evaporation rate at the installation must be considered when calculating the volume of make-up water needed to maintain the total demand. The volume of rainfall at the installation as well as the amount lost to evaporation should be calculated to determine the volume of water needed from the water source. Water balance computations should be performed by the designer to assure adequate supplies of water throughout the entire washing season.

7-2 PIPING.

Wastewater should be conveyed by gravity whenever possible for economy. Pumping should be avoided because residual oils may become emulsified and difficult to remove, solids cause wear on pumps and pumps add significant capital and operating costs to the facility. Conveyances, whether gravity sewers or open channels, must be constructed to grades which will provide adequate scouring velocity to prevent solids deposition. All pipes must be designed for peak hydraulic and solids loadings, including that contribution from stormwater runoff from hardstands. Because of the external and internal abuse and because of inaccessibility, piping systems must be durable. Leakage or infiltration allowances normally associated with gravity piping should not be used; gravity lines should be watertight. Other factors such as soil corrosion and freeze protection need to be addressed also. Open-channel flow should be used whenever possible for ease of maintenance. If siting problems or severe slopes make open-channel flow impractical, the designer should use large-diameter pipes. Locate manholes at each change in slope or direction and at each pipe intersection. Design long, straight sections of pipe to minimize the number of manholes required. All frequently operated, buried valves should be accessible through pits or manholes.

7-3 HOSES, WATER CANNONS, AND NOZZLES.

Hoses must be of a size and weight which a person can handle, but yet be durable enough to withstand the abuse of repetitive use, vehicular traffic, and internal abrasion from fines in the water. Nozzles and water cannons undergo similar treatment. The industry is lacking for equipment that can stand up under the continuous use given at a CVWF; therefore the designer must be very selective when selecting hoses, water cannons and nozzles.

7-4 CONTROL SYSTEMS.

The process controls for a CVWF can be very complex to a Contractor who has never seen a wash facility. Material specifications for controls are standard. The logic of the control system is special to the design. It is very important that the designer clearly describe within the plans and specifications how the components are to function.

7-5 SYSTEMS OPERATING MANUAL.

Complete manuals should be prepared by the designer de- scribing the various components of the CWF and how they were designed to be used. The manual should establish standard operating procedures including staffing, scheduling, safety, records keeping, and other operational responsibilities. All the control systems should be illustrated and step-by-step instructions provided for not only standard procedures, but also special procedures. The manual should also establish maintenance responsibilities for all the elements in the CVWF. Preventive maintenance will be performed by the operators. Tools for their use must be made available along with spare parts for critical items. Training of operators is very important. Providing them with the written documents previously described is a start, but the best training can be done through hands-on operation under the instruction of the designer. The amount of training time will depend on the size and complexity of the CVWF, whether it has a

prewash and whether it has a recycle water system. For the simplest CVWF, training could be accomplished in a day; for the most complex, the training period could be up to a week.

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CHAPTER 8 DECENTRALIZED WASH FACILITES

8-1 OVERVIEW.

Installations and Commands are encouraged to review total operations of the units in their command and how they relate to vehicle wash requirements. Commands may have less aggressive vehicle wash requirements or have limited land resources for a large water resource and treatment system. Self-contained units are now available which can be adapted to a local area for the treatment requirements of the command. New self-contained systems can be adapted to the requirements of the local unit such as a National Guard or a Reserve component. Or the Installation may have multiple Commands which can be decentralized to allow for single unit washing capability during hours which would not be fit into the Installations hours of operation. Although a large Centralized Washing Operation is more pertinent to heavy mechanized training operations, the addition of a Net Zero Design to the egress side of the “bird bath” would enhance thru-put and drastically reduce water consumption. A decentralized washing system would be the ideal design for all other military units, weekend Reserve operations or National Guard operations on an as needed basis.

Alternative systems that are now readily available are:

- Self-Contained, Closed Loop Systems (No Discharge to Sanitary System).
- Energy efficient; Meet low consumption energy use.
- Water efficient; Meet low consumption water use.
- Satisfying Net Zero goals.
- Minimizing waste stream wash debris.

This chapter covers performance consideration for design build and design bid build for self-contained, low energy and water consumption systems which can be decentralized and use minimal area for washing requirements.

8-2 PLANNING.

8-2.1 Planning Considerations.

In addition to Master Planning considerations included in Chapter 3, Consideration for Decentralized Washing Operation are not only Installations concern, but now have been expanded to include all DoD Resources. Each agency has unique wash requirements. Installations not only have heavy DoD requirements but have multiple missions and commands to provide for. Further, Installations have requirements for Installation maintenance and repair that require;

- Utility Operations
- On-site Contractor Operations

- Road Maintenance and Snow Removal
- Landfill Operations
- Emergency Repair Operations

8-2.2 Requirements.

These requirements do not meet the needs of large centralized wash operations but would support equipment that require normal cleaning to be performed. This will involve utility vehicles and trucks that need to be cleaned on a regular basis. Likewise, Reserve and Guard units which are not on large installations require cleaning after training missions and prior to and after deployments. Decentralized facilities can easily be customized for specialty washing situations. This includes equipment with specialty coatings or wash requirements. When reviewing requirements, agencies should perform site survey and utilize the check list of guidelines in Appendix D.

An overall assessment and historical usage data needs to be considered while Agencies perform preplanning and planning to decide the best type of facility for their washing needs. Wheeled Vehicles are more compatible to a Decentralized Wash Facility. Self-contained washing stations using rapidly cleaned and recycled wash water designed for rapid throughput is a sensible alternative to a Centralized Wash Facility. The Net Zero concepts for energy, water, and waste water are required considerations. The planning phase must assess the overall facility needs and balance these needs with energy and water conservation. The use of decentralized facilities which are smaller, self-contained, less expensive move toward these goals and must be part of the consideration for the washing requirements of the command.

8-3 DESIGN CONCEPT FOR DECENTRALIZED VEHICLE WASH STATIONS.

8-3.1 Overview.

Decentralized Wash Facilities need to be flexible to account for the varying needs of military units whether Regular, Reserve, Guard or other installation functions. Since a decentralized station uses a much smaller area than the Centralized Facility covered in Chapters 1 through 7, there will be less demand for utilities and overall site development. Concept considerations for the Decentralized Wash Facility are discussed below.

8-3.2 Conceptual Design.

In many cases the method of washing military vehicles can be achieved through more economical and environmental friendly solutions, but may require more hands on washing by the vehicle user. Hence, serious consideration must be given to the needs for cleaning and the ability of the user to perform cleaning operations.

8-3.2.1 Type of Command or Function.

The type of Command and or installation must be considered prior to selecting whether a large Central Facility or a smaller Decentralized Facility. The Planning and Design Team should analyze the throughput requirements for vehicle washing. The decentralized type of facility could provide a faster cleaning process than a large central platform facility. A decentralized facility is more compatible with a broader range of vehicles found on installations and in reserve and guard commands. Hence, more vehicles may be cleaned such as utility trucks, dump trucks, construction equipment, etc.

8-3.2.2 Vehicle Type and Quantity.

In the modern force, the type of vehicle to be washed is different than previous years. Current vehicles are more mobile and are wheeled in many cases. The central facility utilizes stationary washing platforms (Chapter 5) while the decentralized facility utilizes hand held high pressure cannon operations. The central facility utilizes high pressure stands and undercarriage high volume water cannons, designed for heavy track vehicles. The decentralized facility utilizes operator hand held specially adapted hand held water cannons to clean vehicles. This is a more hands on approach but is adapted to allow for more close observation of cleaning with a tool that meets most cleaning needs. The decentralized facility may be designed with multiple lanes which can be calculated with the formulas in Chapter 3 with the following modified wash durations.

- Tracked Vehicles 12 minutes
- Heavy Trucks 8 minutes
- Humvees 6 minutes
- Construction Equipment 12 minutes
- Utility Trucks 10 minutes

8-3.2.3 Available Funding.

The design team needs to assess whether the action is funded by MILCON, O&M or other funding type. The use of a Decentralized Facility provides for expansion capability and with lower funding requirements can be adaptability to installation or command funding.

8-3.2.4 Design Method/Contract Type.

A Decentralized Facility can be a Design Bid Build contract type (AE or In- House), or a Design Build Contract. The decentralized wash facility in design build considerations can utilize the design parameters noted in Paragraph 8.4.

8-3.2.5 Total Water Requirements.

The Central Wash Facility utilizes large land area with retention ponds for water make up water and waste water treatment. It is specific in the requirement for

treatment and is an extensive design. Designs Teams and Planners must be careful not to modify the requirements set forth in this UFC for Central Wash Facilities because make up water cleaning and reuse parameters have specific requirements.

The Decentralized Facility utilizes the concept to have a self-contained treatment process requiring a small amount of make-up water and includes water treatment methods noted in Paragraph 8.4. The concept of a self-contained method with rapid water treatment in intended to decrease the amount of make-up water, separate oil and heavy metals, and utilize settlement and water treatment methods. The small amount of make-up water can be harvested with natural water collection and storage methods. (Net Zero)

8-3.2.6 Energy Requirements.

A smaller Decentralized Facility will reduce the reduce energy requirements when compared to the large, centralized equipment. The Decentralized Facility will require a minimum 208/120 Volt, 200 amp 3-Phase Service. No less than 200 amps for each 2 lanes of wash stations should be planned. The exact power requirements will vary depending on equipment requirements or optional features, i.e. lighting, heating, AC, etc.

8-3.2.7 Land Area Available and/or Required.

A Decentralized Facility will require a concrete wash platform with a centrally sloped, precast/monolithic concrete collection basin. The basin should be capable of handling heavy settling and oil separation. The decentralized facility will also require an equipment room. It is recommended that the building be constructed of split faced concrete block as metal buildings not conducive to the wet environment created by a wash facility. The general layout is shown in Figure 8-3. The Design team must also identify approach and departure lanes and a small area for a solids holding waste bin. The land requirements for the Central Vehicle Wash Facility are covered in Chapter 3.

8-3.2.8 Waste Water Discharge Requirements.

The concept requirements for Decentralized Wash Facility Waste Water will depend on state requirements for water discharge. With that being said, the concept of a self-contained Decentralized Facility is to eliminate wash water discharge. All wash water should be recycled by pre-treating at the source then treating it with a water treatment/purification system directly at the wash facility.

8-4 DESIGN & CONSTRUCTION: “DECENTRALIZED” NET ZERO WASH FACILITY.

8-4.1 Design Features.

The goal of the "Net Zero" design should be considered to allow users a way to wash their equipment faster, better, safer; while drastically reducing water consumption.

8-4.1.1 Capabilities.

The Net Zero wash facility design must address all phases of the cleaning process by effectively removing mud or debris from the equipment or vehicle. Then the suspended solids must be separated from the water so that the water can be recycled or safely discharged to sanitary facilities.

- The design must utilize a safe, efficient cleaning process that minimizes cleaning time, maximizes thru-put and allows for quick, easy operation of the wash facility.
- The wash water from the cleaning process should be collected & pre-treated in the pre-cast or monolithic poured drive down collection pit (DDP). By using a multi chamber design, the heavy solids and free-floating oils and greases are removed so that the water can be treated and safely recycled or discharged to sanitary sewer.
- In a “Closed Loop” recycle design that requires NO discharge to sanitary, the wash water must be treated and purified to ensure the recycled water remains compliant with applicable standards. A minimum of 10% of the water must be treated and purified, on a daily basis, then returned back into the system.
- Extracted solids (mud) from the DDP must be dewatered to the point it can pass a “paint filter” test. After initial testing, the solid waste can be returned to landfill in most cases. This process drastically reduces the cost of tainted solids removal and Hazardous Waste Exposure. (Local/State testing & regulations apply)
- The design must take into account the level of water treatment required. Water will be exposed to skin or inhaled so pathogens and other organisms that could harm humans or wildlife should be eliminated.

8-4.1.2 Equipment.

Each component of the “Closed Loop” design is essential to the overall performance of the wash facility. The main equipment components of the system are:

8-4.1.2.1 Pre-Cast/Monolithic Drive Down Collection Pit (DDP).

Pre-treatment is one of the most important features of any recycle system. The DDP must be able to remove heavy solids (i.e. mud, rocks, dirt, etc.), separate and treat “free floating” oils/greases from the wash water and provide a minimum of 80 gallons per minute (GPM) to supply the water cannons. The processes used for pre-treatment may include tumbling, gravity separation, and weir wall separation. The DDP should be multi-chambered for maximum solids separation and dwell time.

8-4.1.2.2 Water Wands.

In lieu of traditional “fire hoses” which are ineffective, hard to handle, and pose serious safety hazards, hand held “water wands” will be the preferred method to effectively clean and “de-muck” vehicles covered in heavy solids (mud).

8-4.1.2.3 Water Treatment System (WTS).

Often called Water Recovery Systems, WTS's are used in closed loop design when water quality is paramount. In the first stage of the water treatment process, suspended solids, emulsified oil/grease and heavy metals must be removed from the wash water leaving a clear phase of water for recycle or when necessary, discharge to sanitary. Suspended solids are removed to sub-micron levels, emulsions are broken & coagulated and heavy metals are oxidized and removed from the water. WTS's used several different methods for treatment that can be customized based on the specific application. The overall process can include a combination of such methods as settlement, oxidation, filtration, flocculation, or coagulation.

The WTS must be easy to use and maintain with a minimum use of consumables, drastically reducing operation and maintenance costs. As the heart of a recycle design, it must control all phases of the circulation processes. Water treatment systems are typically packaged systems that can be procured through a performance specification. Equipment manufacturers can provide insight into each specific case and may be consulted in the specification of the equipment assuming none of the language is proprietary to the system.

8-4.1.2.4 Water Purifier.

The final stage of water treatment, in a closed loop design, is a water purification system that can provide fresh water to the wash rack to make up for evaporation and carry-off. The system must be able to physically remove pathogens, particulates and turbidity from the treated water.

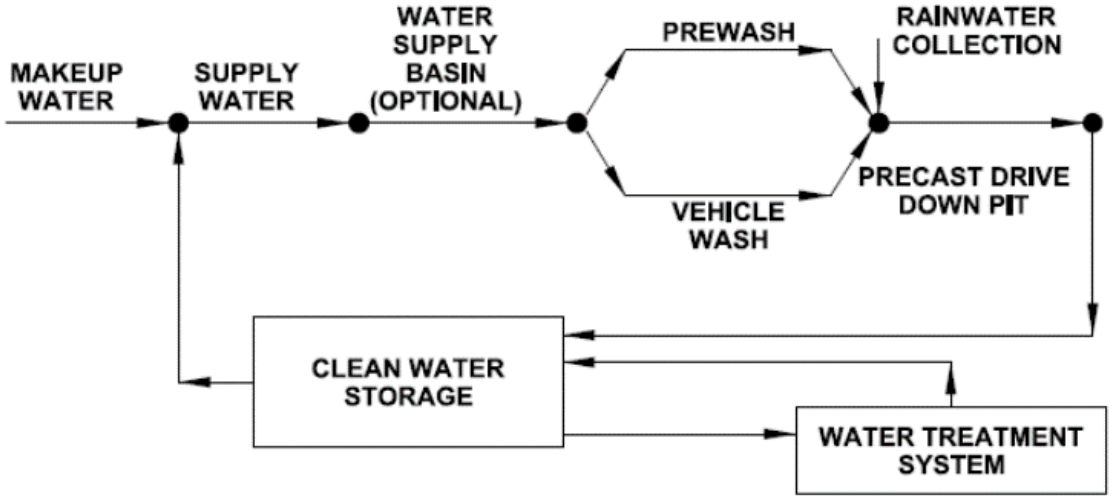
8-4.1.2.5 Dewatering Containers.

In this design, the heavy solids are de-watered, with specifically designed hoppers or "roll off" containers, sufficiently enough for the solids to be safely returned to "landfill" (after proper testing). After passing through a filtering screen specifically designed to the type of soil at each location, the water drains back to the drive down pit to be treated and reused.

8-4.1.3 Design Configurations.

Designs must be available in different configurations allowing for flexible use at multiple locations depending on the needs or requirements of the user. Because of the smaller footprint, this wash facility can be strategically placed to maximize efficiency, minimize traffic patterns and increase thru-put.

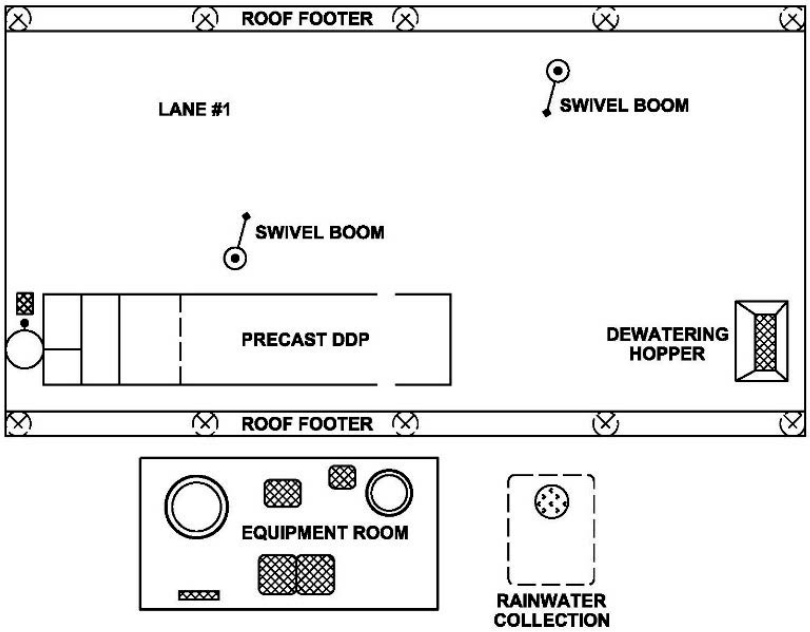
Figure 8-1 Decentralized Wash Facility Layout



8-4.1.3.1 Single Lane Design.

Up to 50 vehicles and/or items of equipment in less than 8 hours. With anticipated water use less than 500 gallons of fresh water to replace evaporation and carry-off.

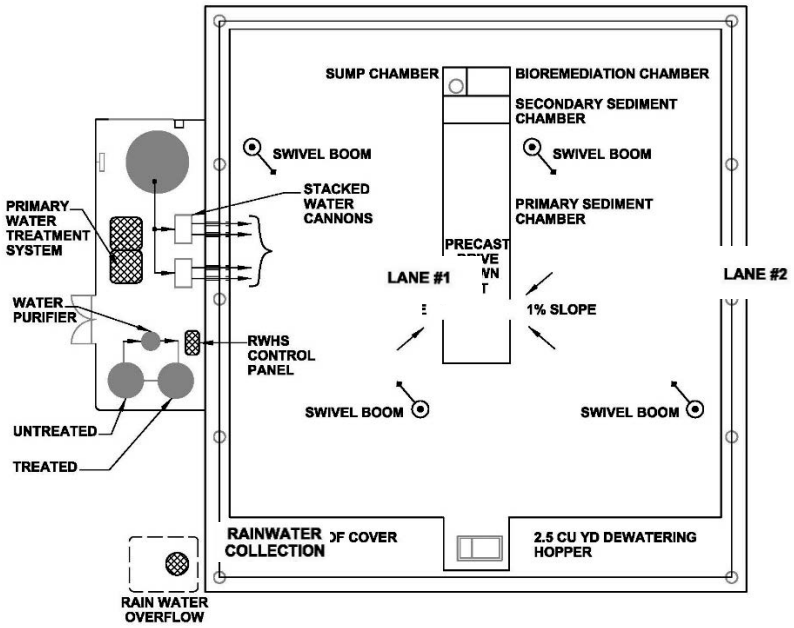
Figure 8-2 Single Lane, Heavy Solids Wash Rack



8-4.1.3.2 Dual Lane Design.

Versatile design, will handle most unit requirements. Up to 100 vehicles and/or items of equipment in less than 8 hours. With anticipated water use less than 1,000 gallons of fresh water to replace evaporation and carry-off.

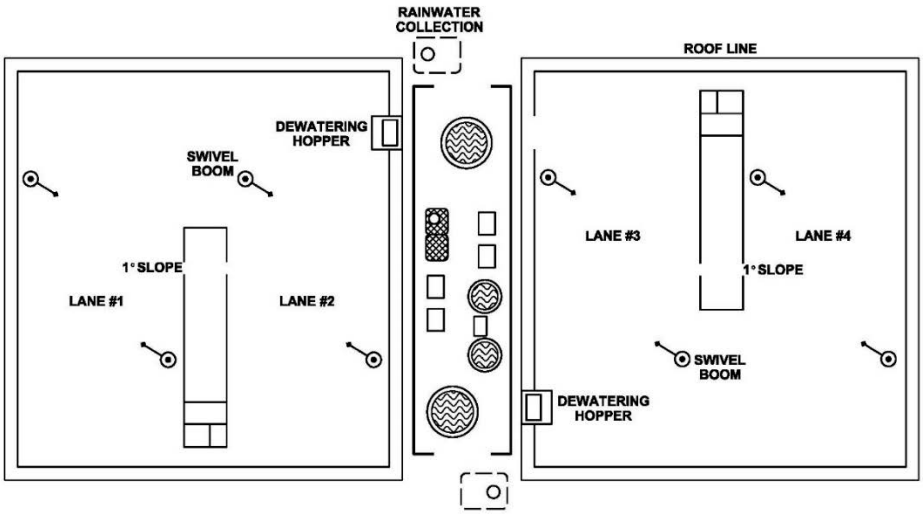
Figure 8-3 Dual Lane, Net Zero, Heavy Solids Wash Rack



8-4.1.3.3 Quad Lane Design.

Units requiring high volume thru-put. Up to 200 vehicles and/or items of equipment in less than 8 hours with anticipated water use less than 2,000 gallons of fresh water to replace evaporation and carry-off. In addition, this is the ideal design to use on the egress side of existing bird baths for heavy tracked vehicles to increase thru-put.

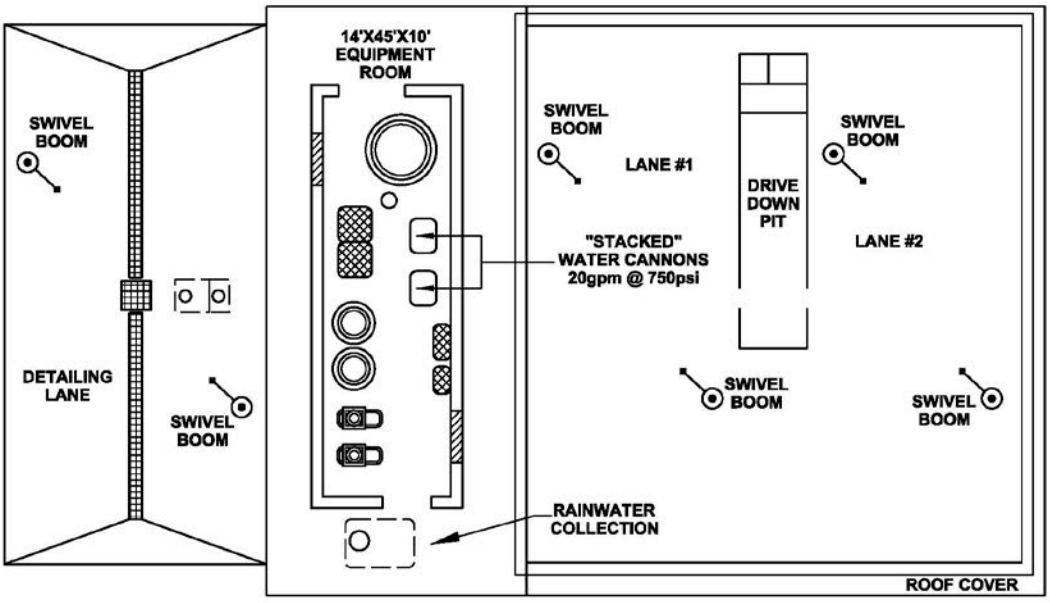
Figure 8-4 Quad Lane, Net Zero, Heavy Solids Wash Rack



8-4.1.3.4 Dual Lane-Combo Design.

Most versatile design, ideal for a variety of units. Handles the most diverse assortment of vehicles and equipment. Utilizes both hand held water cannons for heavy solids removal as well and hot water pressure washers for detail cleaning.

Figure 8-5 Dual Lane, Net Zero Wash Lane with Heavy Solids and Detailing Lanes



8-4.1.4 Design Options.

- Roof Cover (Required for Net Zero and “Closed Loop” Systems.
- Rain Water Harvesting Systems. (Requires Roof Cover)
- Enclosed Wash Facility
- Heated Pad (Snow Melt/Radiant Heat) for use in cold climates
- Lighting

8-4.2 Construction Details.

8-4.2.1 Site Preparation.

The wash facility should be positioned for easy access and to maximize drive thru traffic for increased thru-put. Existing soil conditions should be tested and confirmed. Removal of existing structures (if any), tear out and haul away requirements must be determined. Proximity to and rerouting of existing utilities must be considered during the siting phase.

8-4.2.2 Utilities.

- Electrical. See section 3-2.4.3 Electrical for requirements.
- Plumbing. A fresh water line (Minimum 1”, 60-80 psi) and a discharge line to sanitary (If applicable) may need to be piped underground to and from the wash facility. The internal plumbing to and from the equipment should be a minimum of Sch-80 PVC where the manufacturer does not have a generally accepted standard for the application.

- In regions where freezing conditions may occur, the water supply piping, valves and fittings at the wash stations must be “winterized” for protection from damage due to freezing.

8-4.2.3 Drive-Down Collection Pit (DDP).

For durability, water tightness and overall effectiveness, a multi-chambered, monolithically poured or pre-cast DDP is required. The DDP should be coated with a special epoxy coating to assure water tightness and prevent leaching of any kind. Tank design shall performed to ensure effective solids separation. Dwell time and flow rate will depend on the application and location of the wash facility.

8-4.2.4 Concrete Pad.

The concrete wash pad should be specified to meet the load requirements of the vehicles and items of equipment using the wash facility. A base should be designed and adjusted for existing soil conditions. The concrete pad should be a “sump” design; so that all wash water will drain into the collection pit. Footers should be included for the roof cover.

8-4.2.5 Equipment Room.

The equipment room will contain all of the equipment and should be sized appropriately (minimum 10’ ceiling height). Typically, the room is built using split-faced concrete block as metal buildings are not suitable for a wet environment. The room should have a gable roof, roll-up door and a man door. Lighting should be designed for adequate illumination of equipment for maintenance and repair. Interior and exterior electrical features should be in a NEMA 3R enclosure to prevent the ingress of water. Exterior lighting should be provided as required for washing and maintenance operations. Heating systems should be provided in climate zones where freezing is expected and ventilation fans should be provided to prevent overheating of the room. Where required by the building contents, exhaust fans should be provided to prevent the building up of chemical fumes. Wall hydrants and floor drains should be provided where required to service the equipment.

8-4.2.6 Roof Covers.

To achieve Net Zero status, a roof cover must be used to prevent rainwater from overfilling the system. Typical roof covers are fabricated of galvanized steel (in order to withstand the wet environment) in a clear span, gable design. A gutter system can be used to collect and harvest rainwater.

8-5 OPERATION AND MAINTENANCE.

The Closed Loop, Net Zero designed Wash Rack is designed as a system to ensure water conservation and water quality for washing vehicles and other equipment. The operation of the wash facility should be designed to facilitate ease of use and maintenance. Training on the features of the Closed Loop System is paramount for all operators and maintainers. Therefore, when in use, a trained operator must be present to ensure maximum efficiency during the course of operation.

8-5.1 Operation and Organization Maintenance Tasks.

Operator and Organization maintenance tasks will be taught by the system designer. Maintenance above Organizational level will be performed by appropriate military service personnel or by contractor logistics support as specified in the system design. Training will include proper operating and maintaining procedures and appropriate manuals (DVD) in order for units to train additional operators and maintainers.

8-5.2 Maintenance.

As with any equipment, regular maintenance is required to ensure proper working order. The responsibility for operating and maintaining this system will be determined at the time of contract award. Equipment operations, maintenance, and repair manuals will be specified and required to be provided by the contractor at completion of the construction contract.

If contractor logistics support is required for maintenance and for parts, appropriate manuals (DVD) will specify how to obtain the requisite support.

8-6 PERFORMANCE.

Performance standards should be established including parameters for past performance of equipment, water quality and thru-put efficiency.

8-6.1 Past Performance.

The equipment used in this design should have a proven, successful past performance under these specific guidelines and treating similar applications.

8-6.2 Water Quality.

When considering “Performance Standards”, particularly in a Closed-Loop, 100% recycle system, the quality of the recycled water is paramount. Parameters to be considered must include Biochemical Oxygen Demand (BOD), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and Hexane Extractable Material (HEM); Oil and Grease. Meeting these parameters makes the water suitable to be re-used for washing. There are two specific areas of consideration that a Decentralized; Closed-Loop system must focus on.

- The pre-treatment system (DDP) has the most significant impact on the quality of water that the “user” is constantly exposed to during the washing process. The multi-chambered design must be able to reduce BOD’s to <10 mg/L. TSS’s must be reduced to 120 – 400 mg/L and most importantly, HEM; Oil and Grease must be Non-Detect (ND). TDS is not addressed in this stage.
- The water treatment and purification systems must be able to treat the wash water to significantly tighter standards for this water to be used to replace carry-off and evaporation. BOD, TSS, and HEM must all be Non-Detect. TDS levels must be in the range of 500 – 800 mg/L.

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APPENDIX A REFERENCES

UNIFIED FACILITIES CRITERIA

http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 1-200-01, *General Building Requirements*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

UFC 3-101-01, *Architecture*

UFC 3-110-03, *Roofing*

UFC 3-201-01, *Civil Engineering*

UFC 3-401-01, *Mechanical Engineering*

UFC 3-501-01, *Electrical Engineering*

UFC 3-520-01, Interior *Electrical Systems*

UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*

UFC 3-550-01, *Exterior Electrical Power Distribution*

UFC 3-580-01, *Telecommunications Interior Infrastructure Planning and Design*

UFC 3-600-01, *Fire Protection*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*

UFC 4-020-02, *DoD Security Engineering Facilities Design Manual*, currently in Draft and unavailable

UFC 4-021-02NF, *Security Engineering Electronic Security Systems*

UFC 4-020-04A, *Electronic Security Systems: Security Engineering*

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APPENDIX B BEST PRACTICES

B-1 CASE STUDY: DECENTRALIZED VEHICLE WASH FACILITY.

B-1.1 Background.

The existing wash station consisted of a simple drain in a small concrete pad that led to a sand oil/water separator that discharged to sanitary sewer. A secondary, single wash lane was also located at the Maintenance Shop. It had a trench drain that also led to a sand oil/water separator that discharged to sanitary sewer. Portable pressure washers and garden hoses were used for the actual cleaning. Estimates placed water consumption in the hundreds of thousands of gallons annually. The largest single usage of water was coming from washing the vehicles and equipment returning from Monthly and/or Annual Training.

Figure B-1 Decentralized Dual Lane Wash Facility



Because of limited space at the facility and the number of vehicles to be washed, a decentralized, Net Zero dual lane wash facility was constructed.

B-1.2 Construction.

B-1.2.1 Site work.

The Wash facility was positioned on-site for one-way, drive thru traffic to maximize thru-put. Existing soil conditions and GEO testing were performed.

The small existing concrete wash lane was removed and the new wash facility was placed in the same location.

B-1.2.2 Utilities.

B-1.2.2.1 Electrical.

In the example project a 230v 3PH 200 AMP electrical service was run from a nearby utility pole to the main electrical panel of the equipment room. Although this does not meet the electrical criteria guidelines for size of service and having 3 phase power, it was better for the project. As part of determining the requirements, overall costs to the government does need to be considered. The decision to use the available power source was better for the project as a whole. The cost for a new medium voltage distribution would not save enough cost to the government in the efficiency difference between the single phase and 3 phase power to justify the first cost of the new service.

B-1.2.2.2 Plumbing.

A 1” fresh water line was tied into the existing fresh water line at the pre-existing wash pad. A backflow preventer was installed inline before entering the equipment room. The fresh water is used as “make-up” water only if the rainwater collection tank is empty.

All non-pressurized internal plumbing was installed using Sch. 80 PVC including the sump and drain line to the drive down collection pit.

1” Sch. 80 galvanized Steel pipe was installed from the equipment room to each of the four (4) swivel booms. The galvanized pipe was wrapped in a 4 mil polyethylene sleeve for additional protection against corrosion. The pipe was pressure tested at 750 PSI minimum.

B-1.2.2.3 Rainwater harvesting.

A minimum 1,000 gallon cistern was placed underground next to the equipment room. The gutter system from the roof canopy drains directly into the tank. Excess water drains through an overflow in the tank into a nearby drainage ditch. A sump pump was installed in the cistern to provide “make-up” water to the system “on-demand”.

B-1.2.3 Precast Drive Down Pit (DDP) Install.

A precast drive down collection pit measuring 36’L x 8’6”W x 4’T and weighing 44,000 lbs. was delivered onsite. A 70 ton crane was used to set the DDP in place. The DDP established all grades and slopes for the concrete pad and footers.

Sediment should be removed from the drive down collection pit on a regular basis; however, the exact frequency of cleanings will depend on variations of soiling, user requirements, and other considerations unique to the installation. The dewatering container should also be emptied on a regular basis.

B-1.2.4 Wash Pad.

A wash pad measuring 66’ x 72’ was poured around the drive down collection pit including a 3’ apron for roof structure columns and an 8’ apron for the dewatering container. The 4,000 PSI concrete was poured 12” thick with two (2) mats of #6 rebar, 12” OC. The finished grade of the concrete is a “sump design”, where all wash water on the pad drains back into the DDP. Footers for the roof cover were engineered with a 3’ x 3’ x 3’ minimum.

B-1.2.5 Roof Cover.

A clear span, gable roof was installed over both of the wash lanes. The roof structure is fabricated galvanized steel in order to withstand the wet environment. A gutter system was installed to direct rainwater into the underground holding tank.

B-1.2.6 Equipment Room.

An equipment room of 14’W x 36’L x 10’H (ceiling height) was built using split-faced cinder block. The color of the cinder block was chosen to match existing buildings. A roll-up door was installed to accommodate equipment installation (or future removal). An additional man door was installed. The roof is a gable truss design with an exterior metal roof and open ceiling interior.

B-1.2.7 Equipment.

B-1.2.7.1 Water Cannons and Swivel Booms.

Two “stacked” water cannons (a total of 4 water cannons) were installed in the equipment room. The four water cannons provide 20 GPM each at 750 PSI of recycled water to the swivel booms on the wash pad and are fed from a 1,800 gallon cone-bottom tank. The swivel booms are powder-coated steel mounted on concrete pedestals with a 6’ swivel boom arm allowing a 16’ minimum clearance underneath.

Attached to the end of the booms are 30’ of high pressure hose with a hand-held variable pressure trigger gun. The operation of the water cannons is controlled by a remote on/off switch.

B-1.2.7.2 Water Treatment Systems.

For the first stage of primary water treatment, an electro-coagulation (EC) system was installed. The system treats the wash water, removing heavy metals, suspended solids and emulsified oil & grease, and then sends the water to the purifier for final treatment. The system automatically controls all of the water flow throughout the wash facility including all pumps, floats and valves.

A microbiological water purifying system was installed to polish the water treated by the EC System. The water is purified, removing pathogens, particulates and turbidity and used to provide make-up water to the system for the loss of wash water through evaporation and carry-off.

B-1.2.7.3 Dewatering Container.

To treat the solids from the drive down pit, a 2.5 cu. Yd “self-dumping” dewatering hopper was set in place on the wash pad. After the pit is drained, the front loader can remove the solids from the DDP and dump them into the hopper. Using a specifically design filter, the solids stay in the hopper and the water drains back into the collection pit.

B-1.3 Performance.

B-1.3.1 Cleaning Process

An ARNG Unit completed a Training Exercise and on their return washed 98 Vehicles in 6 hours and used <1200 Gallons of water. Vehicles consisted of HEMTT's, Heavy Trucks, Humvee's and tracked vehicles. Solids load was Light to Moderate.

Average Wash Times per Lane:

1.	HEMTT’s	10-12 Minutes
2.	Heavy Trucks	5-7 Minutes
3.	Humvees	3-5 Minutes
4.	Tracked Vehicle	10-12 Minutes

B-1.3.2 Solids Separation

Immediately following the completion of washing the vehicles a mud settling test was performed on-site. After 30 minutes, most of the solids had settled out and after 24 hours, all solids had settled leaving a clear phase of water.

B-1.3.3 Water Quality

During the washing, water samples were collected at various locations and sent to an independent lab for testing. The test results are below.

1. In the primary chamber of the drive down collection pit (where the wash water drains directly from the vehicles).

a. BOD	4.73	mg/L	Untreated
b. TDS	2,225	mg/L	
c. TSS	1,220	mg/L	
d. HEM-Total	12	mg/L	
e. HEM-SGT	ND	mg/L	

f. HEM-Polar 12 mg/L

2. From nozzle of hand-held water cannon gun after pre-treatment by the drive down collection pit.

a. BOD 2.08 mg/L

b. TDS 2,055 mg/L

c. TSS 130 mg/L

d. HEM-Total ND mg/L

e. HEM-SGT ND mg/L

f. HEM-Polar ND mg/L

3. From “Clean” Tank after water treatment and purification

a. BOD ND mg/L

b. TDS 630 mg/L

c. TSS ND mg/L

d. HEM-Total ND mg/L

e. HEM-SGT ND mg/L

f. HEM-Polar ND mg/L

B-1.4 Conclusion.

This Net Zero Wash Facility is used daily to wash vehicles, tools & equipment and also used during monthly and annual training activities at the installation.

This wash facility design provides a capability that meets all DOD requirements for environmental compliance, sustainability and water conservation that allows for a more efficient, cost effective cleaning operation. Consequently, this results in a better use of the military’s land and drastically reduces water consumption while remaining environmentally compliant throughout the cleaning process.

B-2 DESIGN EXAMPLE

B-2.1 Introduction.

The following fictional case study example illustrates the planning and design procedures presented in this manual. This example involves Fort Swampy, a U.S. Army Forces Command (FORSCOM) installation which also trains National Guard units. The installation is located in a region with annual precipitation level of 63 inches (1.6

meters), and a 1-hr., 10-yr design storm of 2 inches (5.1 centimeters) intensity. The evaporation rate at the installation is 68 inches (1.7 meters) per year. The soil in the training areas contains some expansive, cohesive clays that will be a problem to remove from vehicles during the rainy periods throughout the year. Freezing temperatures are not expected at the installation. The prevailing winds are from the west-northwest.

B-2.2 Master Planning Considerations.

B-2.2.1 Training Schedule.

Two major training activities were scheduled at Fort Swampy last year, with the same number of major exercises expected to continue in the future. The installation requires vehicle washing all year. Table B-1 lists all of the troop units on-post by motor pool assignment. During a major exercise, the installation sends all working vehicles to the field. Range Control reports that it takes from 2 to 4 days to recall all of the vehicles from the field. Daily training activities consist of three or four company teams going to and returning from the field. Each company team consists of approximately 8 tracked vehicles and 30 wheeled vehicles. The National Guard units perform both monthly and annual training activities at the installation. The installation has provided the planner with a summary of the estimated number and types of N. 0. vehicles returning from the training field on a monthly basis. This information is listed in Table B-2 and graphically in Figure B-2 to show the distribution of vehicles used throughout the training year.

B-2.2.2 Number and Types of Vehicles.

B-2.2.2.1 Regular Army.

Table B-1 shows the vehicle types by motor pool. Several units are in each motor pool. A major training exercise assumes that every unit in every motor pool goes out to the field. Skirted vehicles, such as the M-l tank, are more difficult to clean since dirt can collect under the skirt. Fort Swampy currently has 85 M-l tanks, and more are expected to be acquired in the future. Seventy-nine percent of the vehicles are wheeled.

B-2.2.2.2 National Guard Units.

- The following vehicles will return after the monthly National Guard Training events:

31 light track	146 light wheel
26 heavy track (no M-ls)	58 heavy wheel
57 total tracked vehicles	204 total wheeled vehicles

- Seventy-eight percent of the total number of vehicles to be washed at the CVWF are wheeled.

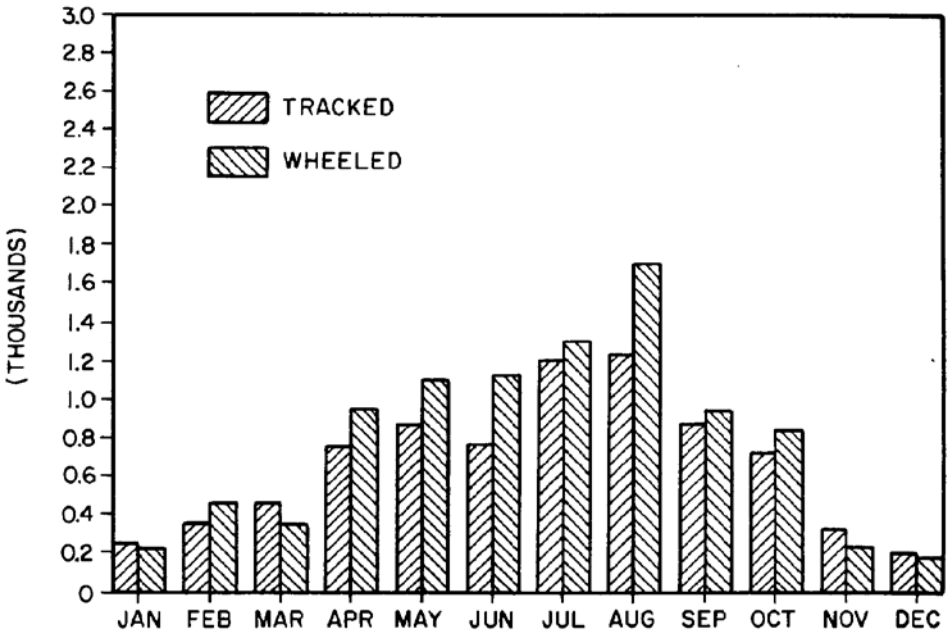
Table B-1 Number of Vehicle Types by Motor Pool Assignment

Unit Names by Motorpool	Heavy Track	Light Track	Heavy Wheel	Light Wheel	Nonstandard and Trailers
HNC Infantry	2	6	5	11	4
Infantry	85	11	49	18	2
Armor	74	7	53	12	7
HHB Divarty		1	11	17	
Field Artillery	14	26	41	27	2
Field Artillery, FC	16	19	57	31	2
Field Artillery	10	24	41	29	2
HHC Division Support Cmd		7	11	5	
Maintenance BN			118	50	9
Supply and Transport EN			101	25	17
NBC BN (Provisional)			27	39	1
Infantry	3	1	5	24	2
Medical BN			62	47	1
Engineer BN	6		39	36	5
Engineer BN	10		42	11	20
Maintenance Company	1		29	2	5
Maintenance Company	1		37	9	5
Ordnance Company			25	6	4
Supply & Support Co			25	7	6
Supply Company			21	6	6
HHD, TVans BN			1	6	3
Military Police EN			5	72	2
Air Defense Artillery	18	2	39	101	3
Cavalry	94	5	32	25	2
Engineer BK	82	5	53	64	9
Engineer BK			49	2	8
Signal BK			38	131	
MIEN	14	1	25	47	4
Air BK			42	28	
TOTAL					
Total Tracked	538				
Total Wheeled	1973				

Table B-2 Number of Vehicles Returning from the Field each Month

Month	Total Tracked	Total Wheeled
Jan	253	233
Feb	354	467
Mar	456	343
Apr	753	958
May	872	1089
Jun	768	1125
Jul	1198	1299
Aug	1227	1698
Sep	865	944
Oct	723	834
Nov	321	232
Dec	194	176
Avg per Month	665	783

Figure B-2 Vehicles Returning from the Training Areas each Month



B-2.2.3 Washing Requirements.

The Regular Army at Fort Swampy requires that all vehicles be washed as they return from field exercises. The installation requires that vehicles returning from major field exercises be washed within a period of 54 hours. Vehicles returning from routine, daily training activities must be washed within a period of 3 hours. The National Guard requires its vehicles to be washed within 8 hours of completing field exercises. Both the installation and the National Guard have indicated some flexibility with these washing times. Night time washing operations must be provided to meet the installation's requirements; therefore, lighting will be provided in the preparation, bath, wash station, and vehicle assembly areas. Vehicle interior washing capabilities are also required by the installation. Since the vehicles are returned to the motor pools for maintenance inspections, they must receive a detailed washing.

B-2.2.4 Vehicle Soiling.

Soil samples taken from the training areas, as well as off dirty vehicles, have been tested in a soils laboratory. A grain size analysis (dispersed) was made as described in Chapter 3. Results indicated a composition of 14 percent sand, 54 percent silt, and 32 percent clay. From the soil classification diagram (Figure 3-3), the soil is a silty clay with a soil type number (Si) of 4. Based on the amount of rain received annually at the installation and the fact that the rainy season is also a training season, the climatic factor was chosen as 2.0. From equation 3-1, the soiling index (Si) is calculated to be 8, which indicates heavy soiling conditions and thus potentially longer washing times using standard means. A nondispersed particle size analysis was also made by the laboratory which indicated that 50 percent of the particles were larger than 0.05 mm, 80 percent of the particles were larger than 0.02 mm, 90 percent of the particles were larger than 0.01 mm, and 97 percent of the particles were larger than 0.005mm.

B-2.2.5 Installation Requirements.

B-2.2.5.1 Prewash.

A bath prewash is indicated at Fort Swampy because cohesive soil found in the training areas, combined with the limited washing period, require the type of prewashing best served by a bath facility. To achieve the desired soaking action on the skirted M-1 tanks for gross soil removal, the depth of water in the bath should be adjustable up to 3.5 feet (1.1 meters).

B-2.2.5.2 Wash Stations.

The wash stations will be the standard design described in Chapter 4. Interior wash equipment will be included. Since tracked vehicles will also be using the wash stations, each island must be protected by concrete barriers and all pavement in the CVWF must be constructed of concrete.

B-2.2.5.3 Preparation Area.

Since the CVWF will have a bath, two preparation areas are required. The first area will be located before the bath to allow troops to prepare the vehicles for washing and to queue-up behind the bath lane. The second preparation area will be between the bath exit and the entrance to the wash stations, this is a queuing area for vehicles that have left the bath or have bypassed the bath.

B-2.2.5.4 Waste Washwater Treatment.

Fort Swampy purchases potable water from a local water district at a current price of $1 per 1000 gallons (3785 liters). The existing wastewater treatment system at the installation does not have the capacity to treat the large hydraulic and solids loadings expected from the CVWF. In addition, the State will not allow discharge to the environment. Therefore, a total recycle system is required. Due to the high clay content of soils in the training area, laboratory settling tests have indicated extremely long detention times should be required for a lagoon treatment, therefore a sand filter system was chosen as the form of secondary treatment.

B-2.2.5.5 Makeup Water.

Sources have been investigated and the only reliable, environmentally acceptable source of makeup water is the potable water system. The potable water supply is limited to 3 million gallons (11.36 million liters) per day. Daily water usage at the installation is 2 million gallons (7.57 million liters) per day, with 1 million gallons (3.79 million liters) reserved for firefighting. No water is available for expansion facilities. However, it is estimated that the motor pools now use 0.13 to 0.20 million gallons (0.49 to 0.76 million liters) of water per day to wash vehicles. Part of this volume of conserved water can be used as makeup water for the new CVWF.

B-2.2.6 Sizing.

B-2.2.6.1 Bathprewash.

The designer estimates that the processing rate through the bath will be 6 vehicles per hour per tracked vehicle lane and 11 vehicles per hour per dual-purpose lane. This decision was based on the soiling index computed for the site and the processing rates given in Chapter 3 and illustrated on Figure 3-4.

- Regular Army. The designer uses equations 3-2 and 3-3 from Chapter 3 to determine how many tracked and dual-purpose lanes are needed for prewashing Regular Army vehicles. The tracked lanes will be used for most of the large tactical vehicles; therefore, dual-purpose lanes are estimated without including the tracked vehicles, as discussed in Chapter 3. The installation has estimated that 80 percent of the tracked vehicles and 65 percent of the wheeled vehicles returning from the field will require immediate washing in the bath with the rest bypassing to the wash stations. It has been assumed that trailers and nonstandard vehicles, such as bulldozers and goers, will proceed directly to the wash stations.

Other vehicles, such as ambulances and support vehicles, may not require immediate washing and will use the facility at a later time. Malfunctioning vehicles may be returned to the motor pool directly or may be left in the field until all other vehicles return. The designer has also considered vehicles in-tow such as tanks and trailers. Using the vehicle counts from table B-2, the number of tracked and dual-purpose lanes required for washing after a major training exercise are computed:

$$\text{Number of tracked lanes: } \frac{0.80\times(538\text{ veh})}{6\text{ veh/hr/lane}\times(54\text{ hr})} = 1.33\text{ lanes} \qquad \text{eq. B-1}$$

$$\text{Number of dual} - \text{purpose lanes: } \frac{0.65\times(1973\text{ veh})}{11\text{ veh/hr/lane}\times(54\text{ hr})} = 2.16\text{ lanes} \qquad \text{eq. B-2}$$

Since the installation is flexible with respect to washing times, the designer rounds the number of lanes as described in Chapter 3. One tracked lane and two dual-purpose lanes were recommended to accommodate the Regular Army's needs. Using the above information, the numbers of tracked and dual-purpose lanes required for washing after routine daily training exercises are computed:

$$\text{Number of tracked lanes: } \frac{0.80\times 8\text{ veh/team}\times 4\text{ teams}}{6\text{ veh/hr/lane}\times 3\text{ hr}} = 1.42\text{ lanes} \qquad \text{eq. B-3}$$

$$\text{Number of dual} - \text{purpose lanes: } \frac{0.65\times 30\text{ veh/team}\times 4\text{ teams}}{11\text{ veh/hr/lane}\times 3\text{ hr}} = 2.36\text{ lanes} \qquad \text{eq. B-4}$$

It is apparent that the one tracked vehicle lane and the two dual purpose lanes estimated above will meet the requirements for both major training exercises and routine daily training activities.

- National Guard. The same computation is used to compare the bath requirements for the National Guard units except that a high percentage of vehicles will use the bath because there are few support vehicles and all units are to be returned to the motor pool extremely clean. It is estimated that 90 percent of tracked vehicles and 75 percent of wheeled vehicles will use the bath prewash. Using information from above, the number of bath lanes required is computed:

$$\text{Number of tracked lanes: } \frac{0.90\times 57\text{ veh}}{6\text{ veh/hr/lane}\times 83\text{ hr}} = 1.07\text{ lanes} \qquad \text{eq. B-5}$$

$$\text{Number of dual} - \text{purpose lanes: } \frac{0.75\times 204\text{ veh}}{11\text{ veh/hr/lane}\times 8\text{ hr}} = 1.74\text{ lanes} \qquad \text{eq. B-6}$$

A comparison of the results shows that the one tracked lane and two dual-purpose lanes will satisfy both Regular Army and National Guard needs at the prewash facility. Designer realizes that light-tracked vehicles may be washed in the dual-purpose lanes.

B-2.2.6.2 Wash Stations.

The clay content in the soils at the installation and the requirement that vehicles return to the motor pools well cleaned for inspection and maintenance after washing suggest that the processing time required for troops to do a detailed washing at the wash stations will be at the high end of the range. From the processing rates given in Chapter 3 (Figure 3-4) and the soiling index (Si) previously computed, the designer has determined that 3.75 vehicles can be processed per hour in each wash station following the prewash. For the tracked vehicles not using the prewash, a processing rate of 1.75 vehicles per hour is selected; and for wheeled vehicles not using the prewash, a processing rate of 5 vehicles per hour is selected. Compute the number of wash lanes required after a major training exercise:

$$\text{Tracks from bath:} \quad \frac{0.80 \times 538 \text{ veh}}{3.75 \text{ veh/hr/lane} \times 54 \text{ hr}} = 2.12 \qquad \text{eq. B-7}$$

$$\text{Tracks bypassing bath:} \quad \frac{0.20 \times 538 \text{ veh}}{1.75 \text{ veh/hr/lane} \times 54 \text{ hr}} = 1.14$$

$$\text{Wheeled from bath:} \quad \frac{0.65 \times 1973 \text{ veh}}{3.75 \text{ veh/hr/lane} \times 54 \text{ hr}} = 6.33$$

$$\text{Wheeled bypassing bath:} \quad \frac{0.35 \times 1973 \text{ veh}}{5 \text{ veh/hr/lane} \times 54 \text{ hr}} = 2.56$$

$$\text{Total Wash Lanes} = 12.15 \text{ lanes}$$

The number of lanes required to meet the daily training exercise is computed:

$$\text{Tracks from bath:} \quad \frac{0.80 \times 32 \text{ veh}}{3.75 \text{ veh/hr/lane} \times 3 \text{ hr}} = 2.28 \qquad \text{eq. B-8}$$

$$\text{Tracks bypassing bath:} \quad \frac{0.20 \times 32 \text{ veh}}{1.75 \text{ veh/hr/lane} \times 3 \text{ hr}} = 1.22$$

$$\text{Wheeled from bath:} \quad \frac{0.65 \times 120 \text{ veh}}{3.75 \text{ veh/hr/lane} \times 3 \text{ hr}} = 6.93$$

$$\text{Wheeled bypassing bath:} \quad \frac{0.35 \times 120 \text{ veh}}{5 \text{ veh/hr/lane} \times 3 \text{ hr}} = 2.80$$

$$\text{Total Wash Lanes} = 13.23 \text{ lanes}$$

Requirements for the Regular Army exceed those for the National Guard and because the installation is flexible in regard to wash times, the designer selects 12 wash stations.

B-2.2.7 Site Selection.

B-2.2.7.1 Geography.

The site selected over several possibilities is adjacent to the only main route, Range Road that the vehicles will travel as they return to the cantonment area from the training fields.

B-2.2.7.2 Geology.

The site has 45 feet (13.7 meters) of relief over a 25-acre (0.10-square kilometer) area. The site is on the top of a ridge that is approximately 200 feet (61 .0 meters) wide and 700 feet (213.4 meters) long. Site borings have shown that the water table will not interfere with construction or operation of the CVWF. The site has never been used for any purpose. Engineers have determined that if work to lengthen or widen the ridge is to be done at the site, it will raise construction costs considerably due to the location of the bedrock. Figure B-3 shows a topographic map of the site.

B-2.2.7.3 Utilities.

All required utilities are within a reasonable distance to the proposed site. A 10 inch (25.4-centimeter) potable water line runs parallel to Range Road. Electrical and telephone lines also run parallel to this road. The latrines can be tied into the sanitary sewer lines which are within 0.75 miles (1.2 kilometers) of the site. As long as wastewater from the facility is recycled, the added load from the CVWF is not expected to burden any of the existing sewer lines.

B-2.3 Engineering and Design.

B-2.3.1 Bath Design.

Figure B-4 shows the bath arrangement for the new Fort Swampy CVWF consisting of one tracked lane and two dual purpose lanes. Dimensions are taken from the definitive drawings and entrance and exit slopes are selected as shown. Overall length is computed using these slopes.

B-2.3.1.1 Water Cannons.

The flow rate from the water cannons in all lanes is selected as 80 gallons per minute (gpm) (303 liters per minute). The delivered pressure selected is 100 pounds per square inch (psi) (6.8 atmospheres). These are the maximum flow rate and pressure values recommended and are chosen because the soil consists of clays which are not easily removed.

B-2.3.1.2 Flexors.

Flexors in the dual-purpose lane should be exposed 4 inches (10.1 centimeters) with a center-to-center spacing of 17 inches (43.2 centimeters), since about the same number of light- and heavy-wheeled vehicles are expected to use the bath. The tracked lane

should have flexors exposed 10 inches (25.4 centimeters) and spaced 5.5 feet (1.7 meters) o.c. because the primary user will be heavy tracked vehicles.

Figure B-3 Site Map with a Proposed Layout – Fort Swampy

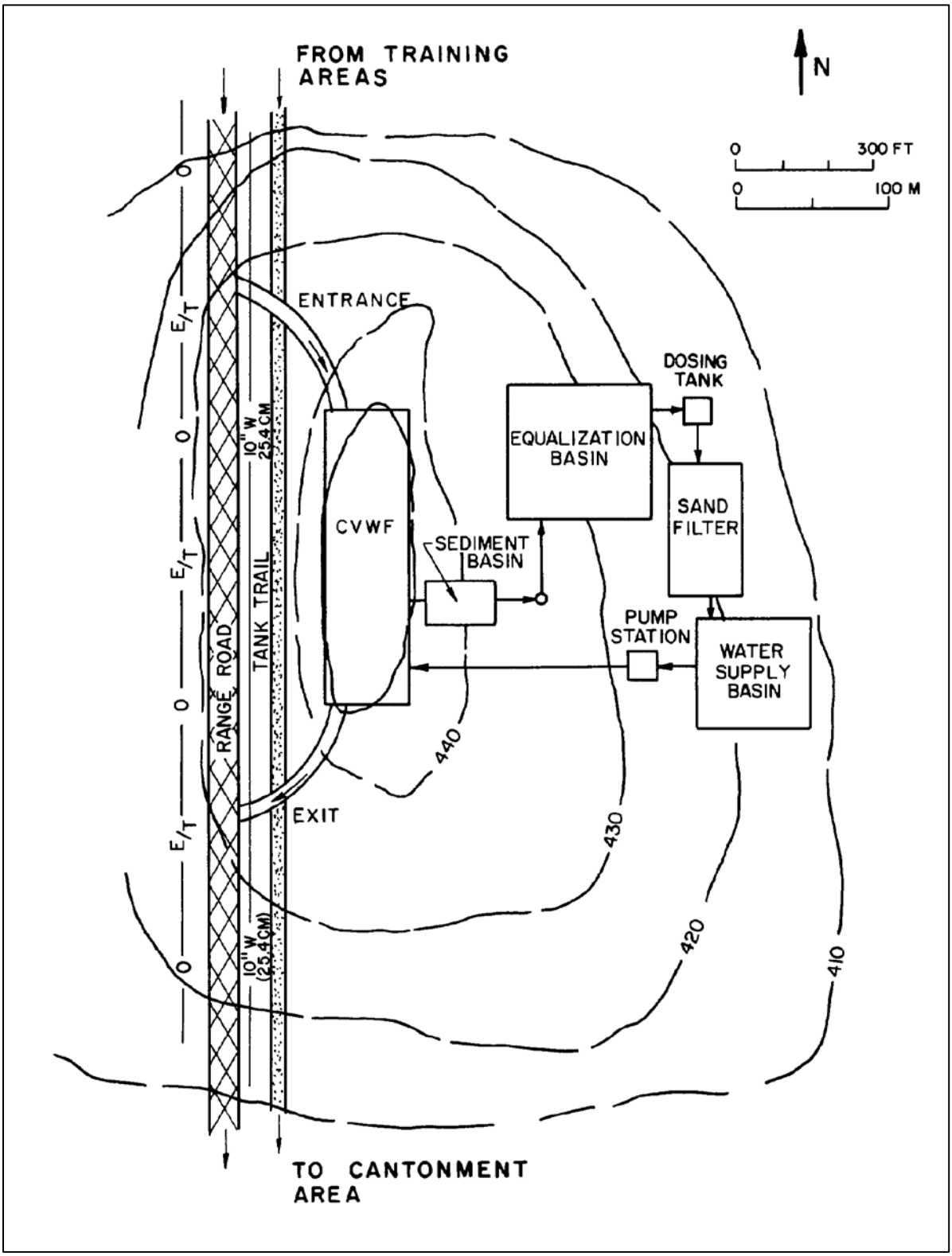
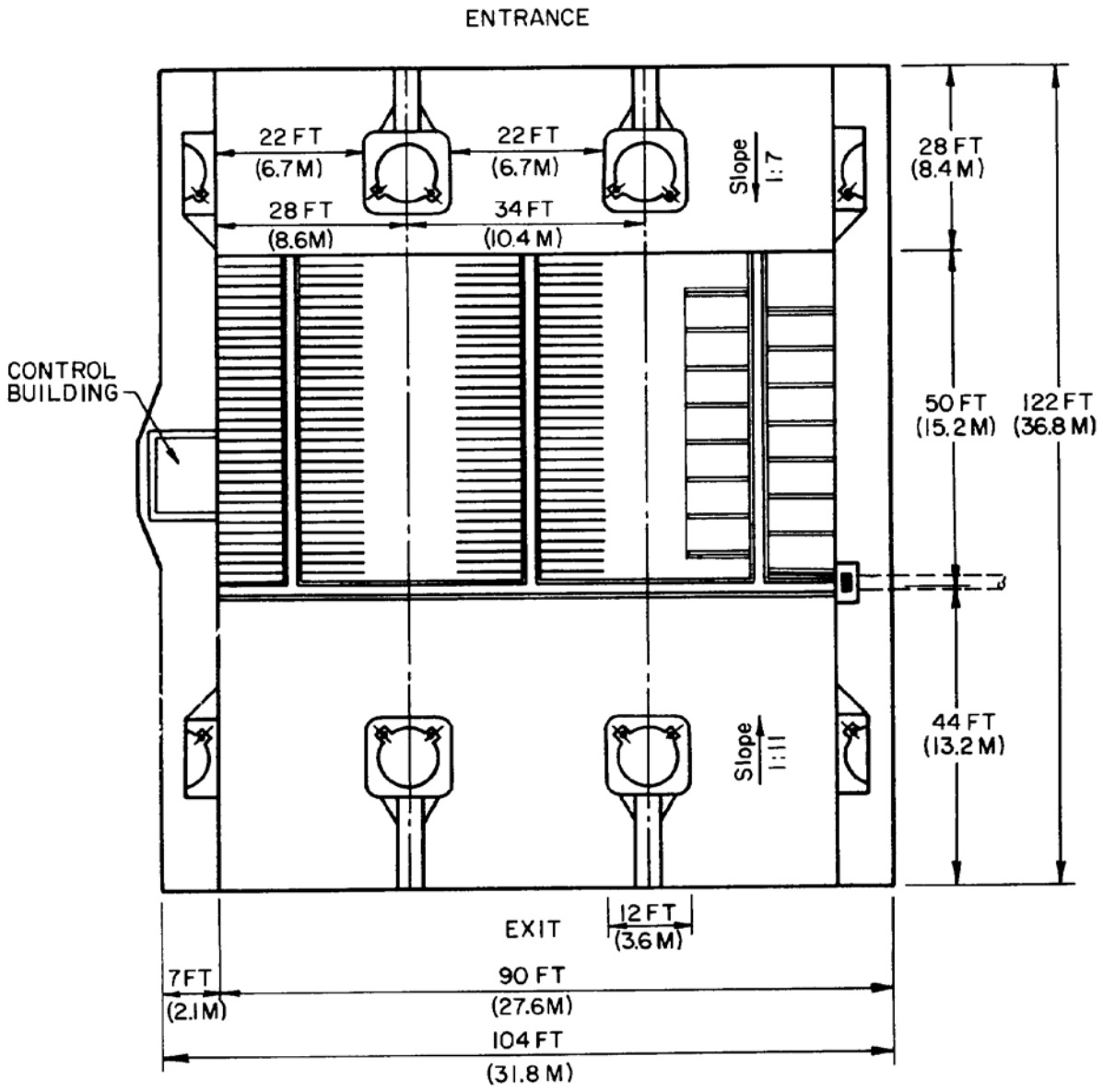


Figure B-4 Bath Design



B-2.3.1.3 Entrance Ramp.

Because Fort Swampy does not have freezing weather, the maximum slope on the entrance ramp, 1 in 7, can be used. This design will give a projected ramp length of 24.5 feet (7.5 meters).

B-2.3.1.4 Exit Ramp.

The maximum slope of 1 in 11 can be used for the exit ramp. With this slope, the projected ramp length is 38.5 feet (11.7 meters).

B-2.3.2 Wash Station Design.

The flow rate selected per hose is 30 gpm (114 liters per minute) at 90 psi (6.1 atmospheres) pressure. These are the maximum flow rate and pressure values recommended and were chosen because the soil consists of clays which are not easily removed. Interior washing points, which are low-pressure, low-flow outlets consisting of yard hydrant and utility hose will be placed at each island. The limited area for construction on the natural ridge will dictate the configuration of the wash station area. Two configurations, A and B, are evaluated.

B-2.3.2.1 Configuration A.

With the 12 stations placed in a linear fashion perpendicular to traffic flow and a standard center-to-center spacing of 25 feet (7.6 meters), the total width of the wash station would be 300 feet (91.2 meters) (Figure B-5). Adding the width of the bypass lane, 22 feet (6.7 meters), yields a facility width of 322 feet (97.9 meters), which is too wide to be constructed on this narrow ridge.

B-2.3.2.2 Configuration B.

This configuration would place the islands in two parallel rows, with a queuing area down the center of the rows and two bypass lanes on the outside of the stations (Figure B-6). Half islands are placed at the ends of each row. The islands would be placed at a 60 degree skew to the normal flow of traffic. This layout would require more area to be cleared and paved, but the facility width would be no more than 180 feet (54.9 meters), which is less than the constraint imposed by the ridge. The designer chooses configuration B as the best alternative after performing a cost comparison.

B-2.3.3 Vehicle Preparation Areas.

The installation has stated that three vehicles queuing to enter each bath lane should be sufficient. Other vehicles waiting to use the facility can queu-up along Range Road adjacent to the wash facility. If traffic problems occur, Range Control will coordinate the number of vehicles leaving the training areas with the wash facility activities.

B-2.3.3.1 Entrance Vehicle Preparation Area.

The entrance vehicle preparation area should provide enough room for three vehicles per lane to wait to be washed in the bath. The longest tracked vehicle to use the facility is the M-l tank, which is some 32 feet (9.8 meters) long. The longest wheeled vehicle is the M- 978 Tanker Truck at 33 feet (10 meters). At least 52 feet (12.8 meters) per vehicle should be allowed (10 feet (3.lm) clear on each end). Therefore, the preparation area should be at least 156 feet (47.5 meters) long. An additional 20 percent or 30 feet (9.0 meters) of entrance staging is added yielding a total length of 165 feet (50.3 meters).

B-2.3.3.2 Preparation Area between the Bath and Wash Stations.

The preparation area between the bath and the wash stations should be at least two vehicle lengths, rounded to 60 feet (18.2 meters) with all other factors considered. The assembly area after the wash stations should also allow for two vehicles, again rounded to 60 feet (18.2 meters).

B-2.3.3.3 Aisle Space between Wash Station Islands

The aisle space between the two rows of islands should be at least 75 feet (22.9 meters) wide to allow the vehicles to maneuver and queue and the Exit lanes should be a minimum of 22 feet (6.7 meters) wide. The exit vehicle assembly area will be the full width of the facility, 159 feet (48.5 meters). Figure B-6 shows these dimensions.

B-2.3.4 Sizing the Treatment System.

B-2.3.4.1 Water Usage Factor.

A bath system is to be installed. The soils on the vehicles will be partially cohesive, and not easily removed; therefore, a reasonable steady rate of vehicles is expected through the bath and the wash stations. The designer selects the following estimates for the various water usage factors, based on experience: $U_1 = 1.0$; $U_2 = 0.90$ (bath full); $U_3 = 0.80$; $U_4 = 0.20$; $U_5 = 0.20$; $U_6 = 0.20$; $U_7 = 0.80$; $U_8 = 0.20$.

B-2.3.4.2 Cleanup Time.

The cleanup time (K) is estimated to be 1 hour based on the 30 minutes it will take the operator to drain the bath (T_D) and an additional 30 minutes for troops to hose down the bath and staging areas. It is assumed that bath flushing and area clean-up will occur once per wash period.

B-2.3.4.3 Flow Rate.

Using the parameters defined in Chapter 6, the designer computes various flow conditions.

Figure B-5 Configuration A

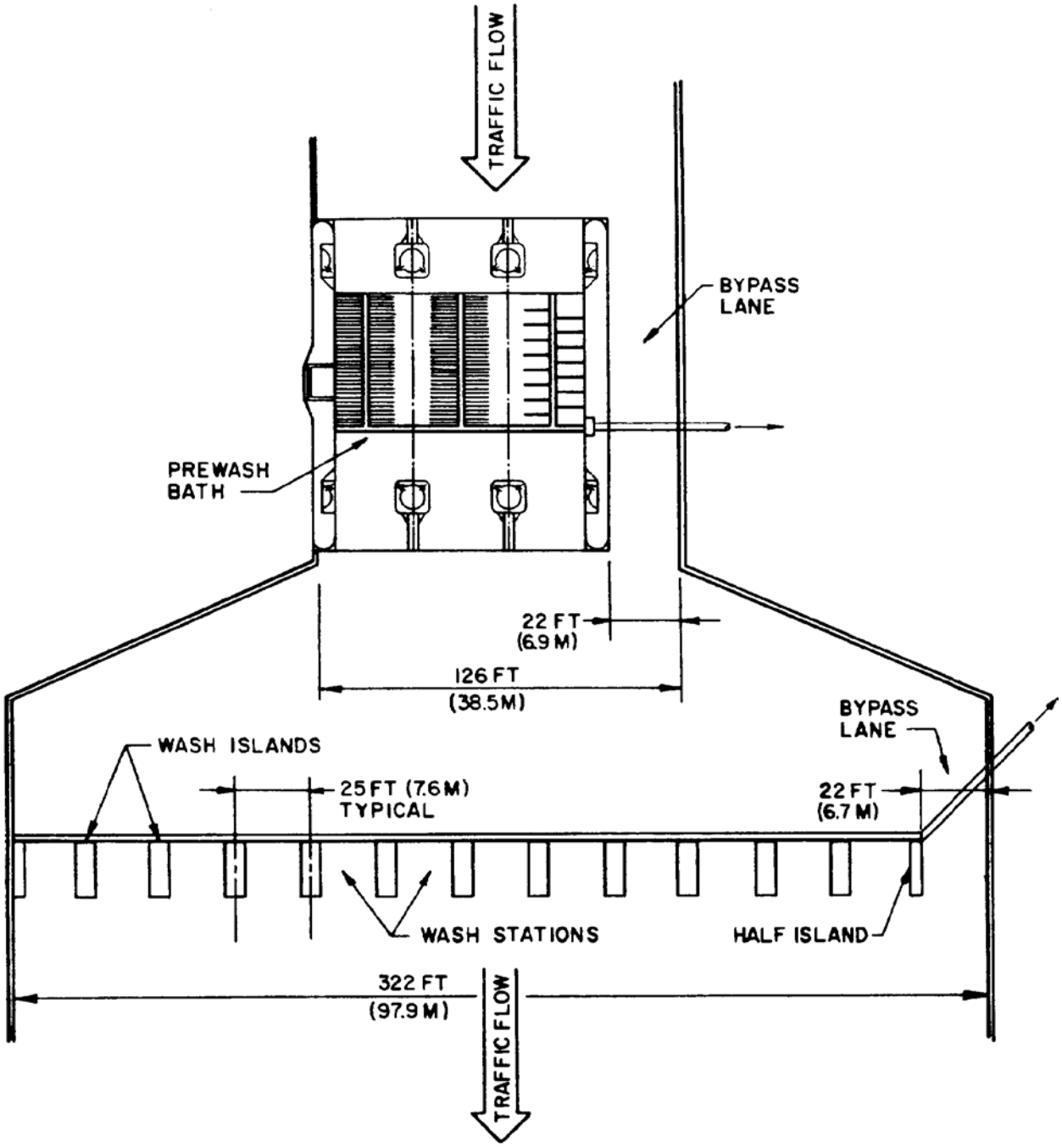
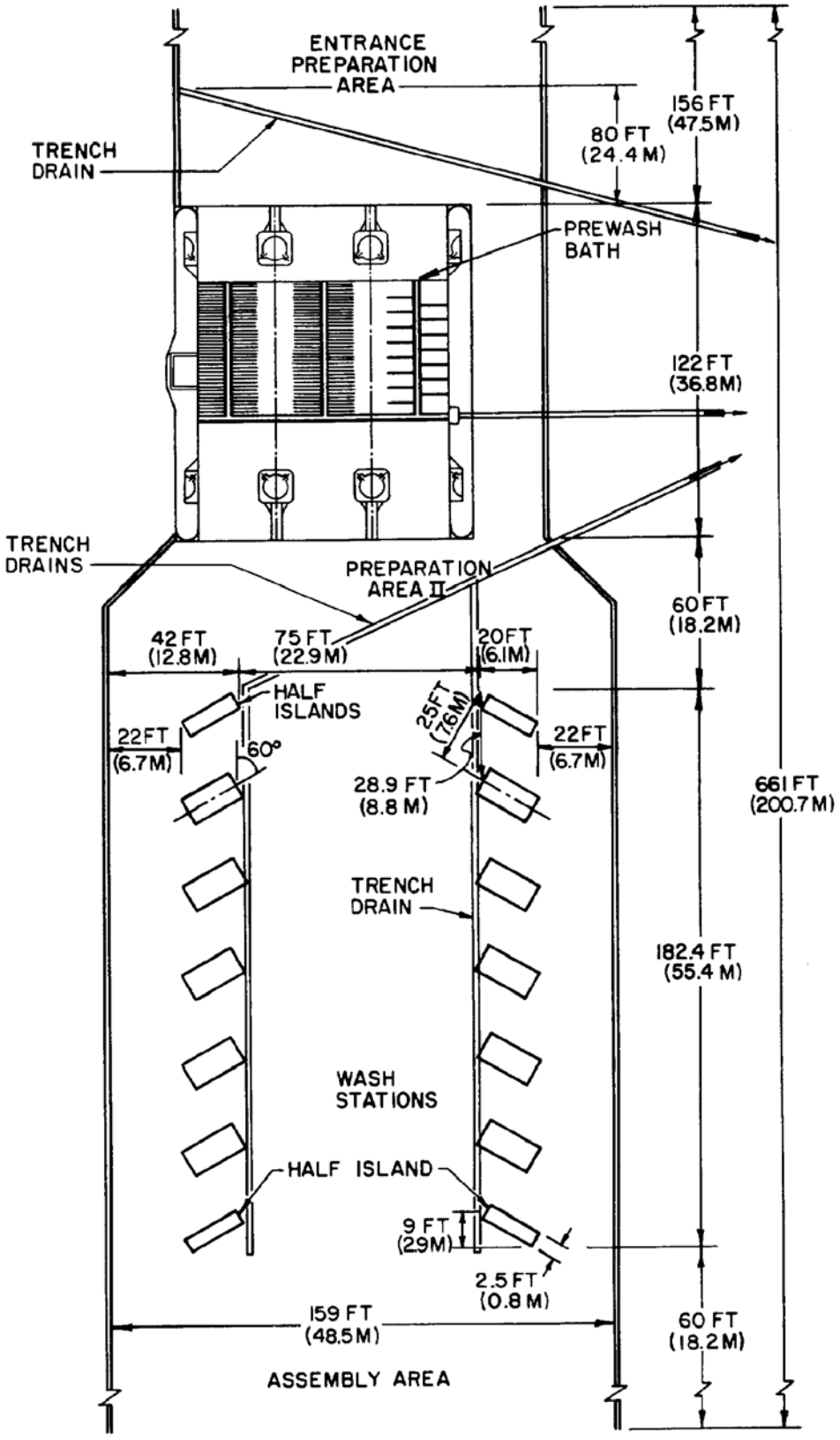


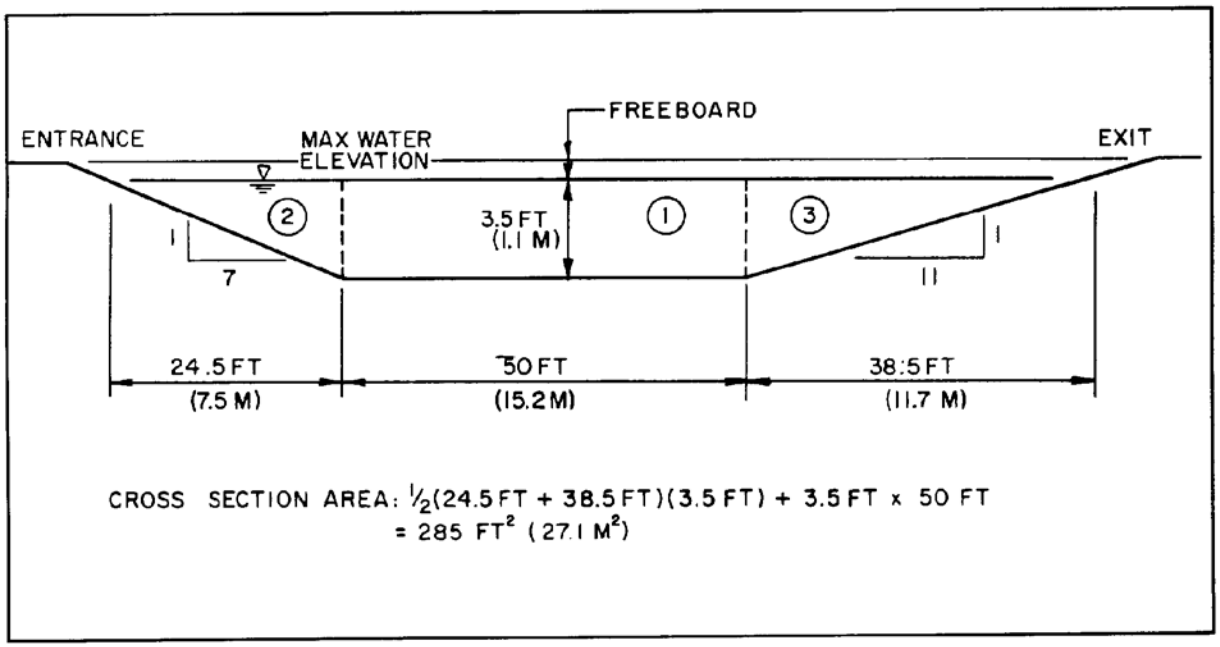
Figure B-6 Configuration B



a. Bath Drain Flow Rate, Q_1.

Refer to Figure B-7.

Figure B-7 Cross Section of the Bath



Q_1 = (width x cross section) x 7.48 gpcf/drain time

Q_1 = (90 ft x 285 sf) x 7.48/30 min

Q_1 = 6,395 gpm (24,207 Lpm)

b. Bath Overflow, Q_2.

Q_2 = Number of cannons x cannon discharge

Q_2 = N_{wc} x F_{wc}

Q_2 = 12 x 80 gpm

Q_2 = 960 gpm (3,634 Lpm)

c. Wash Station Flow, Q_3.

Q_3 = Number of wash station hoses x hose discharge

Q_3 = N_{st} x F_{st}

Q_3 = 24 x 30 gpm

Q_3 = 720 gpm (2,725 Lpm)

d. Entrance Area Trench Flush Flow, Q_4.

Q_4 = Number of flusher points x flusher discharge

$Q_4 = N_{fl} \times F_{fl}$

Q_4 = 1 x 75 gpm

Q_4 = 75 gpm (284 Lpm)

e. Bath Flush Flow, Q_5.

Q_5 = Number of flush points x flusher discharge

$Q_5 = N_{ud} \times F_{ud}$

Q_5 = 4 x 750 gpm

Q_5 = 3000 gpm (11,355 Lpm)

f. Wash Station Trench Flushes Flow, Q_6.

Q_6 = Number of flush points x flusher discharge

$Q_6 = N_{tz} \times F_{tz}$

Q_6 = 3 x 75 gpm

Q_6 = 225 gpm (852 Lpm)

g. Interior Hydrant Flow at Wash Stations, Q_7. A total of six duplex hose bibs are placed on alternating full islands to serve the 12 wash stations.

Q_7 = Number of interior washpoints x hose discharge

$Q_7 = N_{int} \times F_{int}$

Q_7 = 12 x 10 gpm

Q_7 = 120 gpm (454 Lpm)

h. Clean-up Yard Hydrant Flow, Q_8. A total of six hydrants, strategically placed, are required to hose down the paved areas.

Q_8 = Number of hydrant hose connections x hydrant discharge

$Q_8 = N_y \times F_y$

Q_8 = 6 x 30 gpm

Q_8 = 180 gpm (681 Lpm)

i. Storm Runoff from Paved Wash Facility, Q_9. Use Rational Formula with runoff coefficient, C, of 0.95 and a rainfall intensity for a 1-hr., 1-yr storm of 2.0 inches. Then,

Q_9 = C x I x length x width/43,560 gfpa

Q_9 = 0.95 x 2.0 x 580 ft. x 160 ft./43,560 gfpa

Q_9 = 4.05 cfs 0r 1818 gpm (6881 Lpm)

j. Rainfall Falling on Open Basins, Q_{10}. Estimate surface area of dual-cell sediment basin:

L x W x 2 = 150 ft x 50 ft x 2 = 15,000 sf

Estimate surface area of equalization basin:

L x W = 300 ft x 300 ft = 90,000 sf

Estimate surface area of sand filters:

L x W =3 00 ft x 150 ft = 45,000 sf

Estimate surface area of washwater supply basin:

L x W = 300 ft x 300 ft = 90,000 sf

Then: $Q_{10} = C \times I \times A_B/143{,}560$ sfpA

Q_{10} = 1.0 x 2.0 x 240,000 sf/43,560 sfpA

Q_{10} = 11 cfs or 4,937 gpm (18,686 Lpm)

k. Summary of CVWF Flow Rates. A summary of computed flows is presented in Table B-3.

l. Overflow Rate, Q_{over}. Using equation 6-5, calculate the sediment basin overflow rate during the washing period. The designer assumes that the entrance preparation area trench flusher, represented by Q_4, and the bath flushers, represented by Q_5, are not in operation after the bath is filled and, therefore these values are not used in the calculation. Apply the appropriate usage factor at each flow source. Then,

$Q_{over} = U_2Q_2 + U_3Q_3 + U_6Q_6 + U_7Q_7$

Q_{over} = 0.90 (960 gpm) + 0.80 (720 gpm) + 0.20 (225 gpm) +

0.30)(120 gpm)

Q_{over} = 1,581 gpm (5,984 Lpm)

B-2.3.4.4 Volumes.

Using equations defined in Chapter 6, the designer computes the various component volumes for the following selected average daily conditions:

Clean-up period, K, = 60 min

Daily wash period, T_w, = 180 min

Total Wash and clean-up, T_2, = 240 min

Storm Duration, T_s, = 60 min

a. Earth Volume Drained, V_1. Assume only one bath fill/flush per wash period. Then,

V_1 = Bath volume x Number of fills

V_1 = 90 ft x 285 sf x 7.48 gpcf x 1 fill

V_1 = 191,862 gal (726,198 L)

b. Bath Overflow Volume, V_2.

V_2 = Bath weir overflow rate x (wash period + clean up)

$V_2 = Q_2 \times T_2$ = 960 gpm x 240 min

V_2 = 230,400 gal (872,064 L)

c. Wash Station Volume, V_3.

V_3 = Wash station flow rate x wash period

$V_3 = Q_3 \times T_w$ = 720 gpm x 180 min

V_3 = 129,600 gal (490,536 L)

d. Entrance Trench Flusher Volume, V_4.

V_4 = Trench flush flow rate x cleanup period

$V_4 = Q_4 \times K$ = 75 gpm x 60 min

V_4 = 4500 gal (17,032 L)

Table B-3 Summary of CVWF Flow Rates

Parameter		Discharge Points		Unit Flow Rate		Total Flow (Q)	
				gpm	Lpm	gpm	Lpm
Q_1	Bath		Outflow	6,395	24,207	6,395	24,207
Q_2	Water Cannons	12	Cannons	80	303	960	3,634
Q_3	Wash Stations	24	Hoses	30	114	720	2,725
Q_4	Prep Flushers	1	Flusher	75	284	75	284
Q_5	Bath Flushers	4	Flushers	75	2,040	3,000	11,355
Q_6	Trench Flushers	3	Flushers	75	284	225	852
Q_7	Interior Wash	12	Hoses	10	38	120	454
Q_8	Yard Hydrants	6	Nozzles	30	114	180	681
Q_9	Rainfall Pavement	2.13	Acres	1,818	6,881	1,818	6,881
Q_{10}	Rainfall Basins	5.51	Acres	4,937	18,686	4,937	18,686

e. Bath Flusher Volume, V_5.

V_5 = Bath flusher flow rate x cleanup period

$V_5 = Q_5 \times K = 3{,}000$ gpm x 60 min

$V_5 = 180{,}000$ gal (681,300 L)

f. Wash Station Trench Flusher Volume, V_6.

V_6 = Trench flusher flow rate x (wash period + clean-up)

$V_6 = Q_6 \times T_2 = 225$ gpm x 240 min

$V_6 = 54{,}000$ gal (204,390 L)

g. Interior Wash Water Volume, V_7.

V_7 = Interior wash flow rate x wash period

$V_7 = Q_7 \times T_w = 12$ gpm x 180 min

$V_7 = 21{,}600$ gal (81,756 L)

h. Clean-up Yard Hydrant Volume, V_8.

V_8 = Yard hydrant flow rate x cleanup period

$V_8 = Q_8 \times K = 180$ gpm x 60 min

$V_8 = 10{,}800$ gal (40,878 L)

i. Pavement Runoff Volume, V_9.

V_9 = Pavement runoff rate x storm duration

$V_9 = Q_9 \times T_s = 1{,}818$ gpm x 60 min

$V_9 = 109{,}080$ gal (412,868 L)

j. Rainfall Volume Added to Basins, V_{10}.

V_{10}= Rainfall rate x storm duration

$V_{10} = Q_{10} \times T_S = 4{,}937$ gpm x 60 min

$V_{10} = 296{,}220$ gal (1,121,193 L)

k. Summary of Average Daily Volume. Table B-4 summarizes the computed average daily volumes for the stated design conditions at Fort Swampy.

l. Total Average Daily Volume for Facility, V_{avg}. The designer uses equation 6-2, however, designer chooses not to include pavement runoff volume, V_9 or rainfall volume on basins, V_{10}. Designer also assumes that flush water will be withdrawn from the washwater supply basin and therefore, V_1, V_5, and V_6 are included in the computation. Then,

$$V_{avg} = U_1V_1 + U_2V_2 + U_3V_3 + U_4V_4 + U_5V_5 + U_6V_6 + U_7V_7 + U_8V_8$$

$$V_{avg} = 1.0\ (191{,}862) + 0.9\ (230{,}400) + 0.8\ (129{,}600) + 0.2\ (4{,}500) +$$
$$0.2\ (180{,}000) + 0.2\ (54{,}000) + 0.8\ (21{,}600) + 0.2\ (10{,}800)$$

$V_{avg} = 570{,}042$ gal (2,157,609 L)

B-2.3.4.5 Calculate Maximum Volume for the Peak Use Period, V_{max}.

The designer computes the various component maximum volumes for the following selected peak use conditions:

Clean-up period, K, = 60 min (1 hr)

Peak use period, T_w, = 3240 min (55 hr)

Total wash and clean-up, T_t, = 3300 min (56 hr)

Storm duration, T_s, = 60 min (1 hr)

The designer assumes that one bath fill, B, will be withdrawn from the equalization basin.

Table B-4 Summary of Average Daily Volume

Parameter		Discharge Points		Total Flow Rate		Operating Time	Volume (V)	
				gpm	Lpm	min	gal	L
V_1	Bath		Outflow	6,395	24,207	30	191,862	726,198
V_2	Water Cannons	12	Cannons	960	3,634	240	230,400	872,064
V_3	Wash Stations	24	Hoses	30	2,725	180	129,600	490,536
V_4	Prep Flushers	1	Flusher	75	284	60	4,500	17,032
V_5	Bath Flushers	4	Flushers	3,000	11,355	60	180,000	681,300
V_6	Trench Flushers	3	Flushers	225	852	240	54,000	204,390
V_7	Interior Wash	12	Hoses	120	454	180	21,600	81,756
V_8	Yard Hydrants	6	Nozzles	180	681	60	10,800	40,878
V_9	Rainfall Pavement	2.13	Acres	1,818	6,881	60	109,080	412,868
V_{10}	Rainfall Basins	5.51	Acres	4,937	18,686	60	296,220	1,121,193

a. Maximum Bath Volume Drained, V_1.

$V_1 = V_B$ x Number of fills

V_1 = 191,862 gal x 1

V_1 = 191,862 gal (726,198 L)

b. Maximum Bath Overflow Volume, V_2.

V_2 = Bath overflow rate x (total wash period + clean-up)

$V_2 = Q_2 \times T_2$ = 960 gpm x 3,300 min

V_2 = 3,168,000 gal (11,990,880 L)

c. Maximum Volume from Wash Stations, V_3.

V_3 = Wash station flow rate x peak wash period

$V_3 = Q_3 \times T_w$ = 720 gpm x 3,240 min

V_3 = 2,332,800 gal (8,829,648 L)

d. Maximum Volume from Entrance Trench Flusher, V_4.

V_4 = Entrance trench flusher flow rate x clean-up period

$V_4 = Q_4 \times K$ = 75 gpm x 60 min x 3 cleanups

V_4 = 13,500 gal (51,098 L)

e. Maximum Volume from Bath Flushing, V_5.

V_5 = Bath flusher flow rate x cleanup period

$V_5 = Q_5 \times K$ = 3,000 gpm x 60 min

V_5 = 180,000 gal (681,300 L)

f. Maximum Volume from Wash Station Flushing, V_6.

V_6 = Flusher flow rate x (wash + cleanup + two additional cleanup periods)

$V_6 = Q_6 \times (T_1 + 2K)$

V_6 = 225 gpm (3,300 min + 2 x 60 min)

V_6 = 769,500 gal (2,912,558 L)

g. Maximum Interior Wash Water Volume, V_7.

V_7 = Interior wash flow rate x wash period

$V_7 = Q_7 \times T_w$ = 120 gpm x 3,240 min

V_7 = 388,880 gal (1,471,608 L)

h. Maximum Volume from Yard Hydrants, V_8.

V_8 = Yard hydrant flow rate x clean-up period x number clean-ups

$V_8 = Q_6 \times K \times 3$=10,800 gal x 60 min x 3

V_8 = 32,400 gal (122,634 L)

i. Maximum Pavement Runoff Volume, V_9.

V_9 = Pavement runoff rate x storm duration

$V_9 = Q_9 \times T_S$ = 1,818 gpm x 60 min

V_9 = 109,080 gal (412,868 L)

j. Maximum Rainfall Volume on Basins, V_{10}.

V_{10} = Rainfall rate x storm duration

$V_{10} = Q_{10} \times T_S$ = 4,937 gpm x 60 min

V_{10} = 296,220 gal (1,121,193 L)

k. Summary of Maximum Volumes. Table B-5 summarizes the computed maximum volumes for the stated conditions at Fort Swampy.

Table B-5 Summary of Maximum Volumes

Parameter		Discharge Points		Total Flow Rate		Operating Time	Volume (V)	
				gpm	Lpm	min	gal	L
V_1	Bath		Outflow	6,395	24,207	30	191,862	726,198
V_2	Water Cannons	12	Cannons	80	3034	3,300	3,168,000	11,990,880
V_3	Wash Stations	24	Hoses	30	114	3,240	2,332,800	8,829,648
V_4	Prep Flushers	1	Flusher	75	284	180	13,500	51,098
V_5	Bath Flushers	4	Flushers	750	2840	60	180,000	681,300
V_6	Trench Flushers	3	Flushers	75	284	3,420	769,500	2,912,558
V_7	Interior Wash	12	Hoses	10	38	3,240	388,000	1,471,608
V_8	Yard Hydrants	6	Nozzles	30	114	180	32,400	122,634
V_9	Rainfall Pavement	2.13	Acres	1,818	6,881	60	109,080	412,868
V_{10}	Rainfall Basins	5.51	Acres	4,937	18,686	60	296,220	1,121,193

l. Calculate Maximum Wash Volume for Facility, V_{max}.

$V_{max} = U_1V_1 + U_2V_2 + U_3V_3 + U_4V_4 + U_5V_5 + U_6V_6 + U_7V_7 + U_8V_8$

V_{max} = 1.0 (191,862 gal) + 0.9 (3,168,000gal) + 0.8 (2,332,800 gal)

+ 0.2 (13,500 gal) + 0.2 (180,000 gal) +0.2 (769,500 gal) +

0.8 (388,800 gal) + 0.2 (32,400 gal)

V_{max} = 54,319,422 gal (20,512,512L) or

V_{max} = 724,522 cf (20,287 CM)

B-2.3.4.6 Sediment Basin Design.

The effective water depth of the basin will be 8 feet (2.4 meters) and free board is 2 feet (0.6 meters). The sediment depth will be determined by calculations. Settling tests performed on soils found in the training areas showed that 82 percent of the suspended solids will settle in less than 2 hours (120 minutes). This can be checked theoretically by using Stokes Law and the nondispersed soil particle gradation test results, after the basin size has been determined.

a. Operation. A dual-celled sediment basin is required. One cell will be used to settle solids during continuous washing and the adjacent basin will detain the surge volume created when the bath is flushed. A dual-cell arrangement will also allow one cell to be closed for cleaning while the other is treating wastewater; the wastewater will not have the designed detention time, but the wash facility will be operable. The installation has indicated that the basins will be cleaned every 6 months and it will take approximately 5 days to drain and clean each cell.

b. Water Volume. In addition to a sediment volume, each cell in the basin must be able to hold the greater of the overflow and bath volume or the stormwater volume; therefore, the bath and the overflow volumes are compared with the stormwater volume to determine which value will control the basin site. The total volume of water required in each cell is computed:

V_w = Bath overflow volume + bath volume

= Q_{over} detention time + V_B

V_w = 1,581 gpmx 120 min + 202,633 gal

V_w = 392,353 gallons (1,485,056 L)

V_w = 52,453 cf (1,469 CM)

Calculate storm water volume:

V_{st} = paved area storm runoff

V_{st} = V_o/7.48 gpcf

V_{st} = 109,080/7.48 = 14,582 cf (408 CM)

Since the overflow plus the bath volume is larger than the stormwater runoff volume, the overflow plus bath volume is the controlling factor and each cell is sized to detain at least 52,453 cf (1504 CM) of water. The designer chooses an effective water depth of 8 ft. (2.4 M), an access ramp slope of 1 on 6, a ramp width of 18 ft. and a basin length-to-width ratio of 3 to 1. Figure B-8 shows the general geometry of each cell. The dimensions of the basin are then calculated using the information given and noting that the volume occupied by the ramp must be considered:

V_{sw}= L_S x W_S x D_W - 1/2 x L_r x D_w x W_r = 52,453

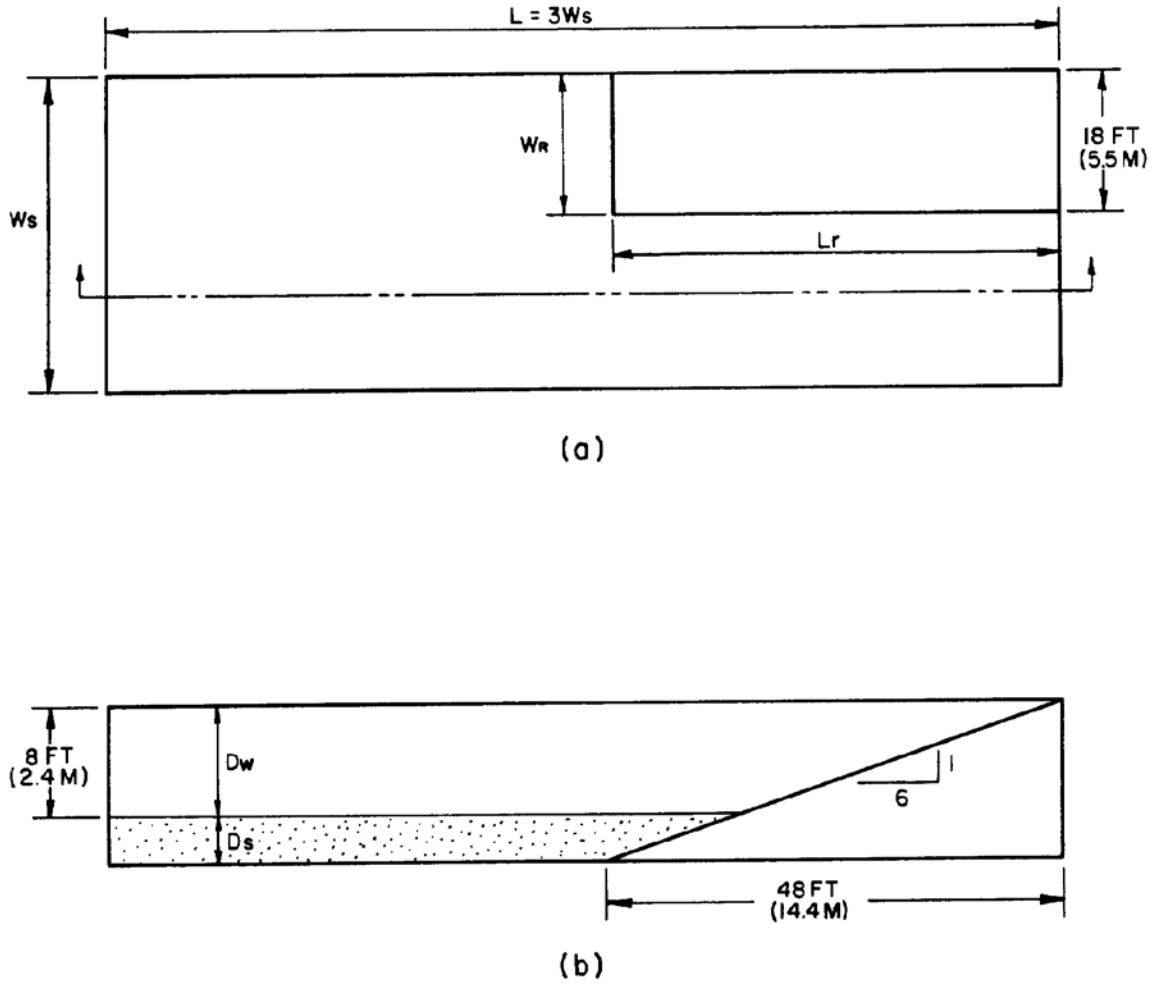
V_{sw} = 3W_s x W_s x 8 – 1/2 x 48 x 8 x 18 = 52,453

W_s = 2,042

W_s = 45 ft. (13.7 M) and

L_s = 135 ft. (41.2M)

Figure B-8 Water Volume Configuration: (a) Plan View and (b) Cross Section



c. Sediment Volume. The designer estimates that the installation has average-to-heavy soiling conditions. By applying Stokes Law, using Q_{over} with the basin size previously calculated, and checking the soil particle size

information, removal of 82 percent of the soil, as determined by settling tests, is verified. Using equations 6-3 and 6-4 with data from Table B-2: Sediment Volume = (Tracked vol. + Wheeled vol.) x duration of wash season x sediment basin trap efficiency.

$$\text{Sediment Volume} = \left(\frac{2.0 \text{ cu ft}}{\text{wash}} \times \frac{665 \text{ washes}}{\text{month}} + \frac{0.6 \text{ cu ft}}{\text{wash}} \times \frac{783 \text{ washes}}{\text{month}}\right) \times 6 \text{ months} \times 0.82 \text{ percent cleaning}$$

= 8,855 cf (248 CM)

The same equations that were used to size the cell based on water volume are used to size the cell for the sediment volume, except that the volume of the ramp is assumed negligible. The width and length of the cell are known, and the depth is calculated. Thus –

$(L_s - L_r) \times W_x \times D_s$ = Sediment volume

(145 ft - 48 ft) x 48 ft x D_s = 8,855 cf

D_s= 1.9 ft. (0.58M)

say D_s = 2.0 ft. (0. 61M)

d. Total Cell Size. The calculated sediment basin dimensions are summarized in Figure B-9.

B-2.3.4.7 Equalization Basin.

The volume of water in the equalization basins is based on the greater of V_{avg} for any assumed 5 day wash period or V_{max}.

V_{EB} = 5 x V_{avg} = 5 x 570,042 gal = 2,850,210 gal (10,788,045 L)

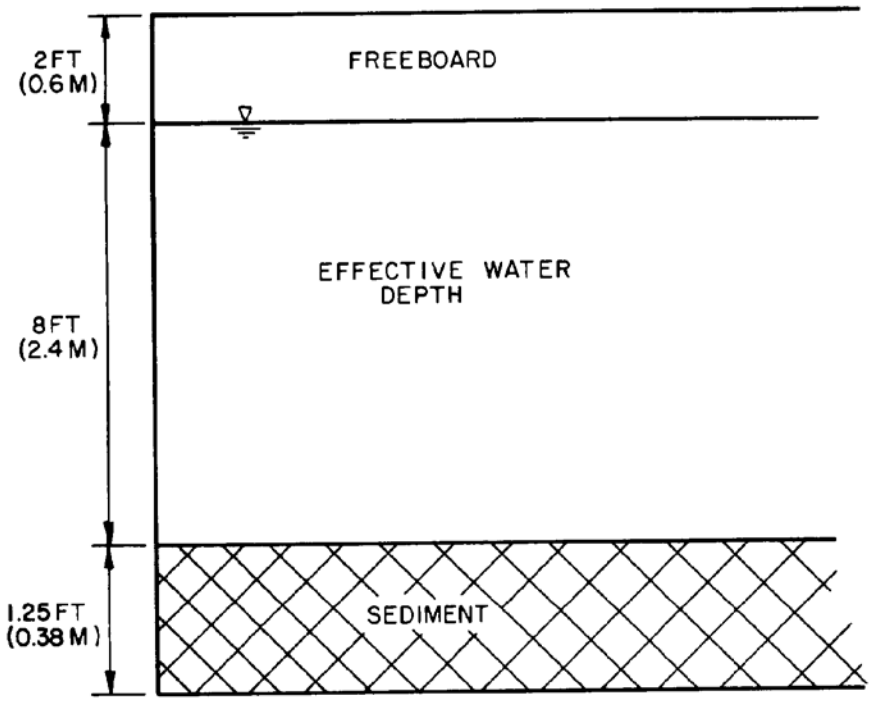
V_{EB} = 381,044 cf (10,699 CM) or;

V_{EB} = V_{max} = 724,522 cf (20,287 CM)

The designer uses a safety factor of 1.25 times the value of V_{max} or 905,653 cf (25,358 CM to size the basin. The designer selects an effective water depth of 8 ft. (2.4 M), 2.0 ft. (0.6 M) of sediment storage, 2.0 ft. (0.6 M) of dead storage or a total depth of 15 ft. (3.7 M). The average area at the midpoint of the equalization basin water zone is:

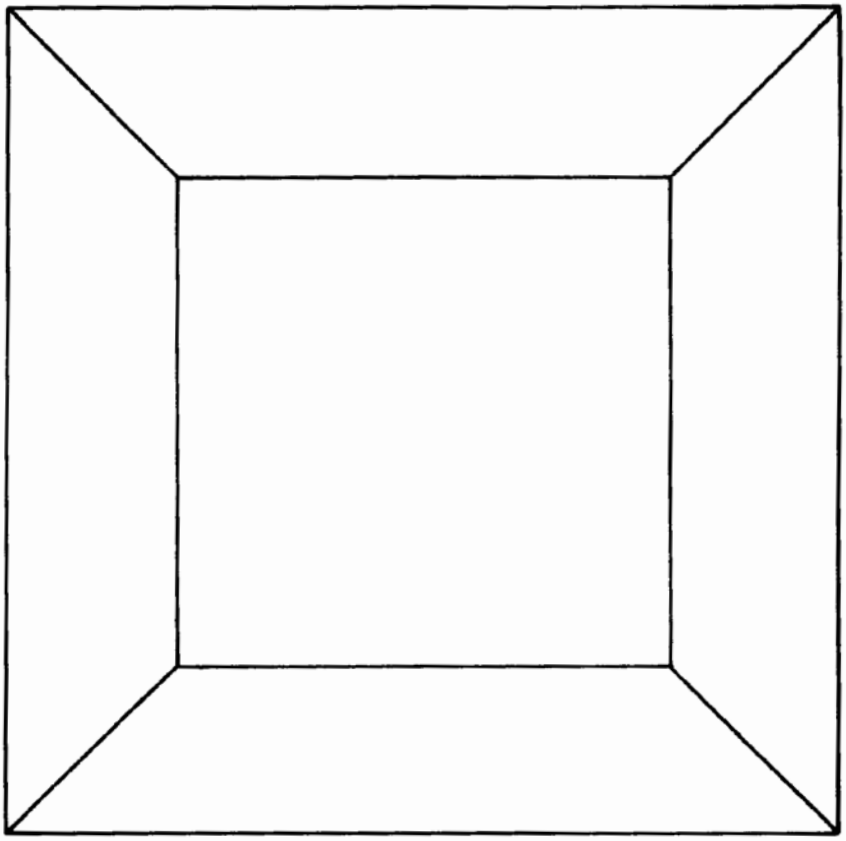
905,653 cf/8 ft = 113,207 sf (10,528 SM)

Figure B-9 Overall Cell Configuration

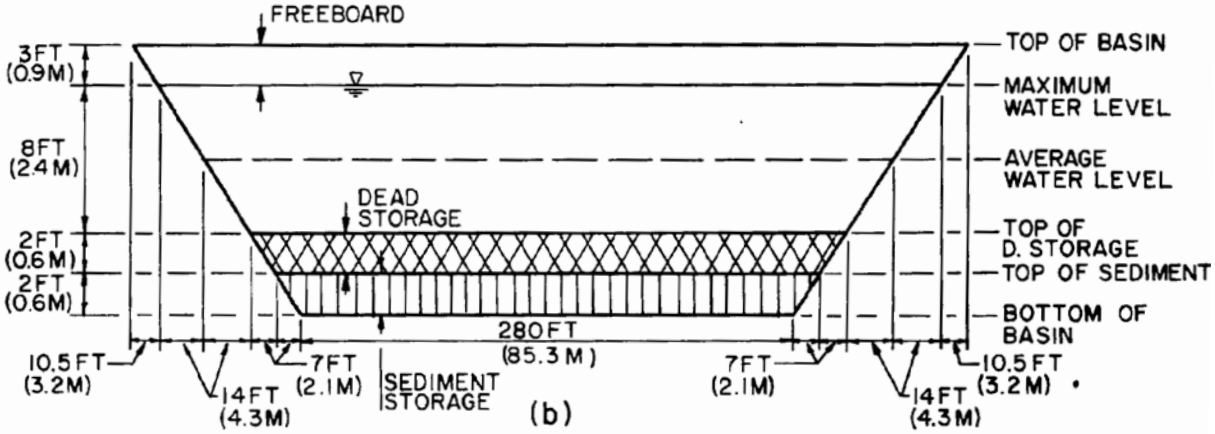


The designer selects to use a square basin (Figure B-10) with side slopes of 1 to 3.5. The basin is sized by taking the square root of the average area required to determine the average length and width of the basin. This method gives the average basin size – 336 feet by 336 feet (102 meters by 102 meters). With the slope of the walls at 1 to 3.5, 7.0 ft (2.2 M) are added to the average side for each foot (meter) of depth above or subtracted below the average depth. The length of the basin at the water surface would be 364 feet by 364 feet (110 meters by 110 meters). With 3 feet (0.9 meters) of freeboard added, the overall top dimension of the basin will be 385 feet by 385 feet (117 meters by 117 meters). Subtracting 3.5 feet (1.1 meters) off of each side for each foot (meter) below the average depth, the dimensions of the bottom of the basin, with 2 feet (0.6 meters) allowed for sediment storage and 2 feet (0.6 meters) allowed for dead storage, would be 280 feet by 280 feet (86 meters by 86 meters).

Figure B-10 Equalization Basin: (a) Plan View and (b) Cross Section



(a)



(b)

B-2.3.4.8 Intermittent Sand Filters.

The installation has indicated that the facility need not be fully operational for 7 days after a major washing operation that takes about 2 days (54 hours). The designer chooses two filters, which will allow one filter to operate while the other one is allowed to rest. A loading rate of 8 inches (20.3 centimeters) per filter dose will be used. The filter dose frequency is every 8 hours. The designer calculates the area required for the sand filters:

Filter Area = A_F = V_{max} / Dosing Rage

$$A_F = \frac{724{,}522 \text{ cf}}{(2 \text{ days} + 7 \text{ days})} \times \frac{\text{acre/day}}{650{,}000 \text{ gal}} \times \frac{7.48 \text{ gpcf}}{\text{cu ft}}$$

$$A_F = 0.93 \text{ acres or } 19{,}040 \text{ sf } (1{,}770 \text{ SM})$$

Thus, each filter should be 0.47 acres or 20,473 sf (1,904 SM).

B-2.3.4.9 Dosing Base.

The designer has performed an economic study which showed that a dosing basin would be cost-effective when compared with installing larger pumps. Water can flow by gravity to the sand filter. Small pumps can take water from the equalization basin to the dosing basin. With a dosing basin, the designer is able to use smaller pumps for charging the dosing basin over a long period of time. The basin is sized to hold the volume of water to charge one filter. The volume is calculated as follows:

$$\text{Volume} = 20{,}473 \text{ sf} \times \frac{8 \text{ inches}}{\text{charge}} \times \frac{\text{foot}}{\text{inches}} \times \frac{7.48 \text{ gal gpcf}}{\text{cu ft}}$$

$$\text{Volume} = 102{,}093 \text{ gal } (386{,}422 \text{ L})$$

B-2.3.4.10 Water Supply Basin.

Design criteria call for the size of the water supply basin to be the larger of V_{max} (724,522 cf or 20,287 CM); or V_{ave} for an S day wash period.

V_{ave} = 5 x Vave = 5 x 570,042 gal

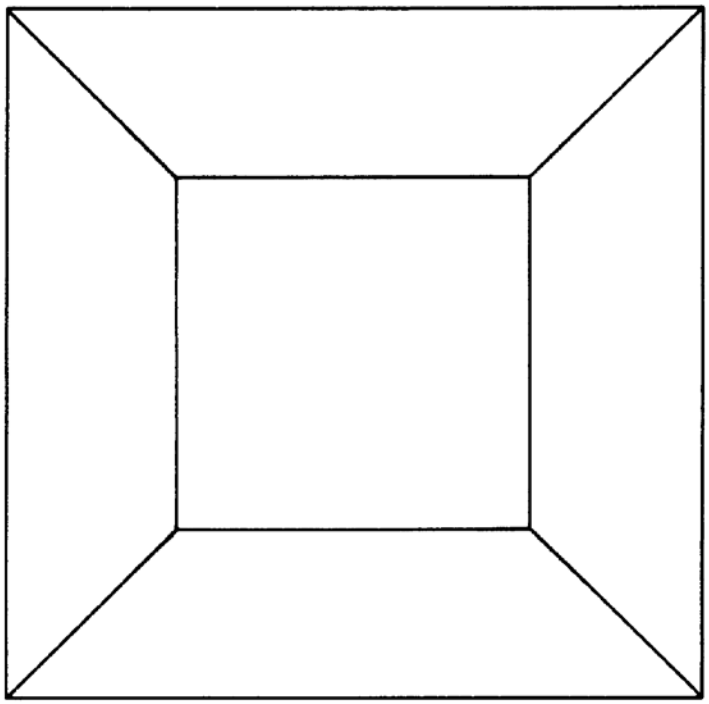
V_{ave} = 2,850,210 gal (10,788,045 L) or 381,044 cf (10,669 M)

Since V_{max} is larger than five times V_{ave}, the designer uses a safety factor of 1.25 times V_{max} to size the water supply basin or 905,653 cf (25,358 CM). Because of the large water volume required, the designer chooses an effective depth of 10 feet (3.0 meters) with 2.0 feet (0.6 meters) of dead storage for a total depth of 12 feet (3.7 meters). The water surface area can then be calculated as follows:

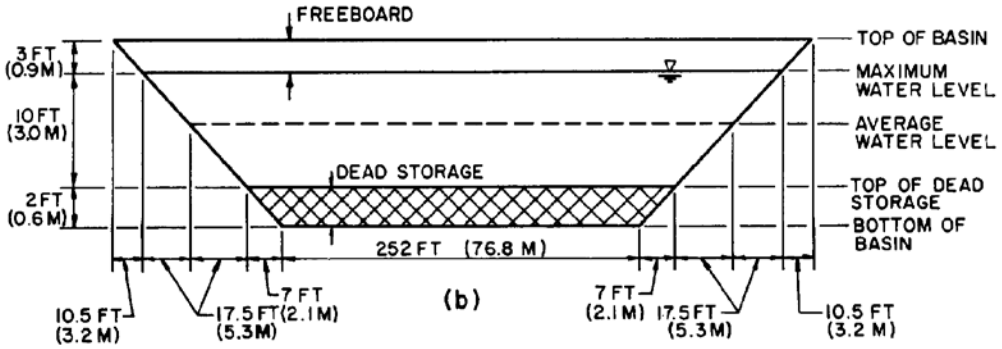
A_{ws} = 905,653 cf / 10 ft. = 90,565 sf

Using the method described for sizing the equalization basin and assuming a square basin gives the average basin size at the midpoint of water depth is 301 feet by 301 feet (92 meters by 92 meters). With the side slopes of 1 to 3.5, the dimensions of the basin at the top of the water level would be 336 feet by 336 feet (102.4 meters by 102.4 meters). With the 3 feet (0.9 meters) of freeboard added, the overall top dimension of the basin will be 357 feet by 357 feet (109 meters by 109 meters). The bottom of the basin would be 252 feet by 252 feet (77 meters by 77 meters) (Figure B-11).

Figure B-11 Water Supply Basin: (a) Plan View and (b) Cross Section



(a)



(b)

B-2.3.4.11 Makeup Water.

An economic analysis has revealed that, if wells are drilled as the primary source of makeup water for the CVWF, the return on investment will be 37 years. Since the design life of the facility is only 20 to 2 years; the installation chooses to use the existing potable water supply as a source of makeup water since the supply is dependable. The existing 10-in. (25.4-cm) water line running adjacent to Range Road can be tapped. Makeup water will be added to the water supply basin at night when demand on the potable water supply is lowest.

B-2.3.4.12 Emergency Discharge.

The closest sanitary sewer connection is approximately 0.75 mi. (1.2 km). The designer decides to provide a sewer from the water supply basin to the existing sanitary sewer line to handle emergency overflows. This will prevent overflows from otherwise being discharged to the environment.

B-2.3.4.13 Check Calculations.

Figure B-12 shows the expected water volume in the equalization basin at any given time during the washing activities. This graph confirms that at no time during a major wash will the equalization basin volume of 5.5 mg be exceeded during the peak water usage period. The projected volume for the water supply basin is also plotted (Figure B-13). This graph show that 5.5 Mg is sufficient to ensure that an adequate supply of wash water is available at all times.

Figure B-12 Equalization Basin Water Balance – Water Volume versus Time

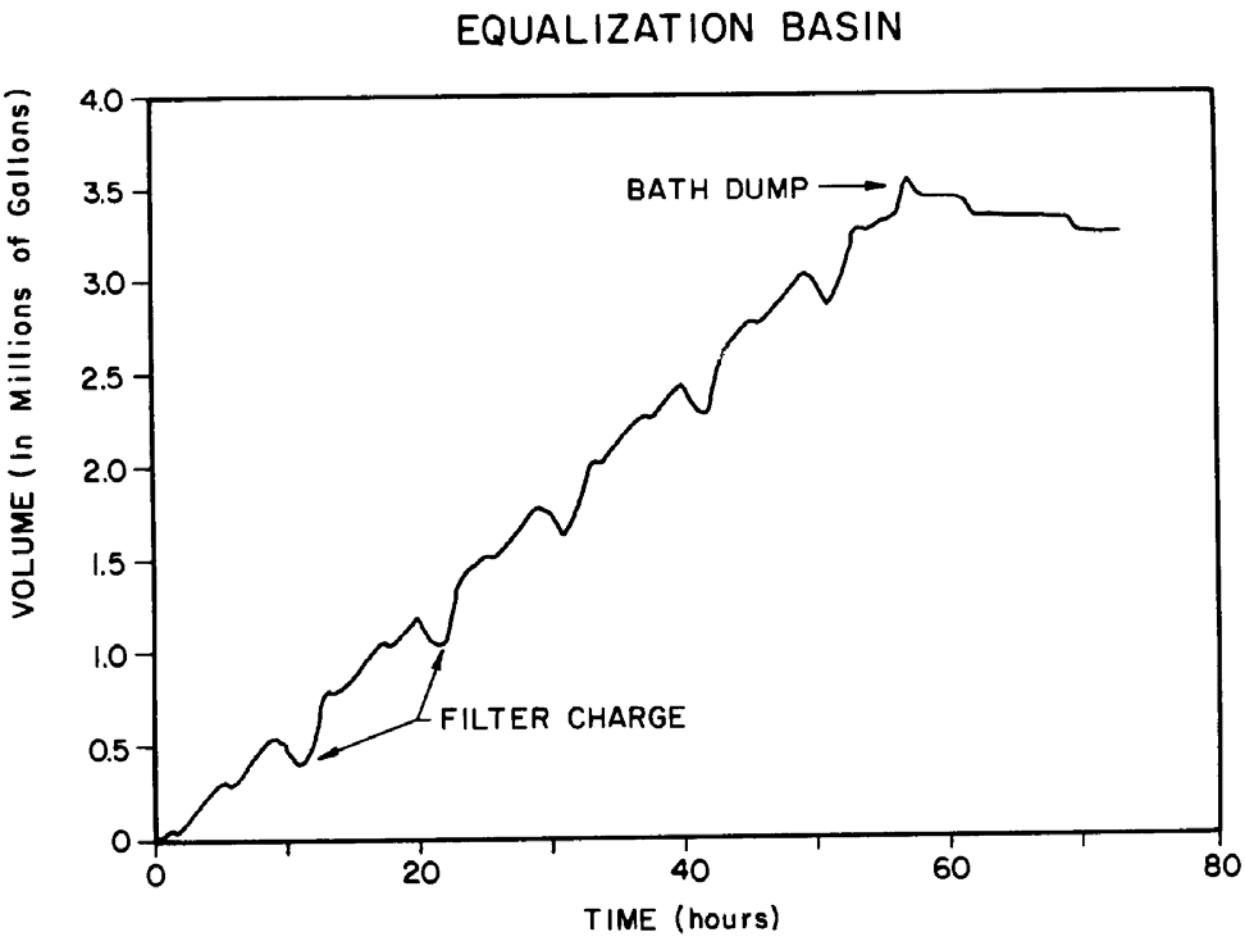
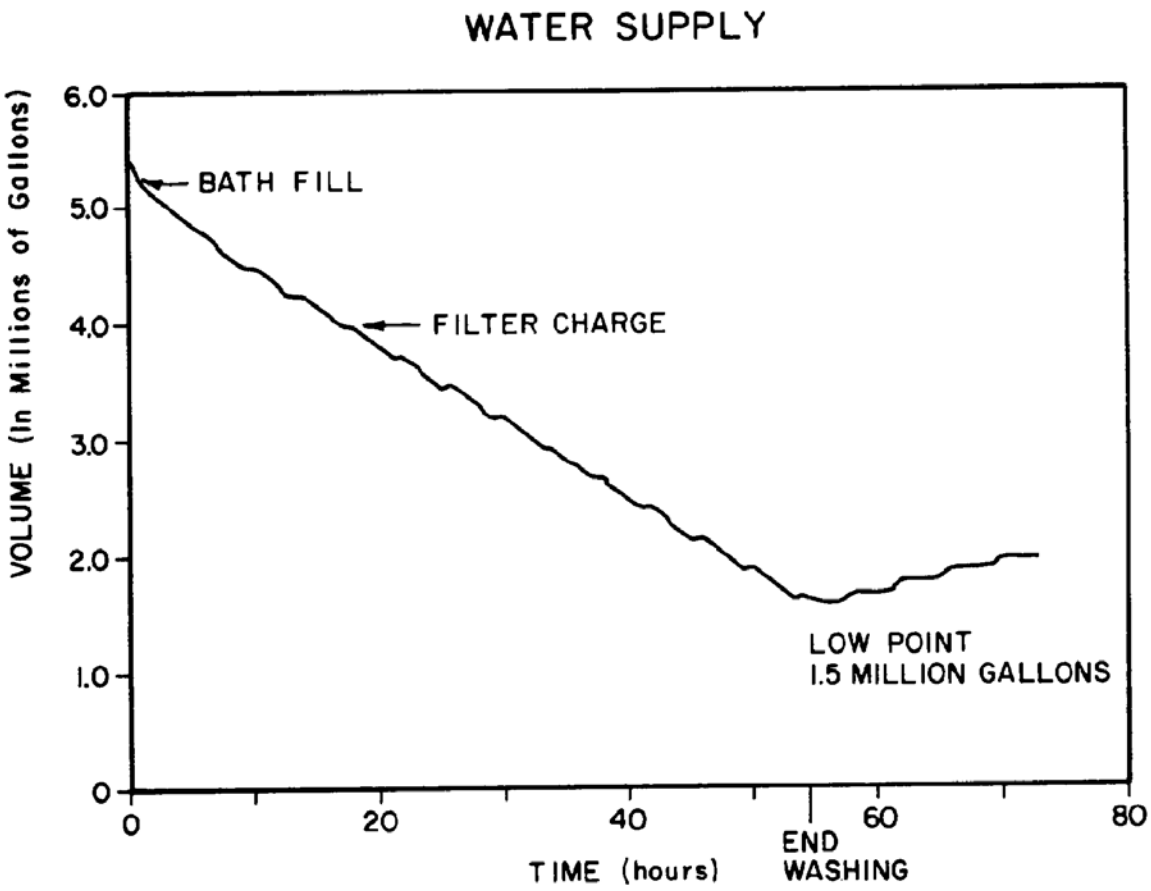


Figure B-13 Water Supply Basin Capacity



APPENDIX C GLOSSARY

C-1 ACRONYMS

AFCEC	Air Force Civil Engineer Center
BIA	Bilateral Infrastructure Agreement
BOD	biochemical oxygen demand
CONUS	continental United States
CVWF	central vehicle wash facility
DDP	drive down collection pit
DoD	Department of Defense
gpm	gallons per minute
HDPE	high density polyethylene
HEM	hexane extractable material
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
IBC	International Building Code
NAVFAC	Naval Facilities Engineering Command
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
OCE	Office of the Chief of Engineers
pH	hydrogen-ion concentration
SOFA	Status of Forces Agreements
SS	suspended solids
TDS	total dissolved solids
TM	Technical Manual
TMP	transportation motor pool

TSS total suspended solids

UFC Unified Facilities Criteria

U.S. United States

WBDG Whole Building Design Guide

WTS water treatment system

C-2 DEFINITION OF TERMS

Assembly Area: Paved space located after the wash stations to allow replacement of interior items, drying, assembly of vehicles into units, and final inspection prior to exiting the CVWF.

Bentonite: Clay with a high content of the mineral montmorillonite group. Characterized by high adsorption and very high volume changes with wetting and drying.

Biological Treatment: Process in which bacteria and other microorganisms use waste constituents as a food source; results in the breakdown of complex organic materials into simple, more stable sub-stances.

Bypass Lane: Driving lane reserved for vehicles in the CVWF to go past the prewash basin and/or the wash stations to expedite forward movement.

Cantonment: Developed portion (city-like area) of a permanent military installation.

Central Vehicle Wash Facility: Structure designed specifically to clean large numbers of tactical or transportation motor pool vehicles.

Chemical Oxygen Demand: Standard laboratory procedure for measuring the oxygen required for oxidation of carbonaceous (organic) material in wastewater.

Cleanup Time: Period required to clean a CVWF, including drainage and cleaning of the prewash bath.

Cohesive Soil: Fine-grained soil that sticks together, such as a clay or silt.

Collection System: Network of underground conduits and appurtenances that receives and conveys wastewater.

Colloids: Microscopic suspended particles that do not settle in a standing liquid and can be removed only by coagulation or biological action.

Control Building: Structure at a CVWF that provides the operator a central location to observe the washing operations and regulate pumps, valves, and other equipment.

Detention Time: Theoretical period that it takes a particle of matter to flow through a tank or basin.

Dissolved Solid: Solid material remaining in a wastewater after filtering; deter- mined by specific tests.

Dosing Tank: Receptacle that automatically and hydraulically empties itself each time it is filled to capacity.

Drainage Area: Rainfall catchment area common to a single runoff point.

Drainage Structure: Construction used to collect and/or divert surface waters to a collection system; includes inlets, trench drains, catch basins, and manholes.

Dual-Purpose Lab: Area of a prewash facility that serves both wheeled and tracked vehicles.

Effective Depth: Usable depth of sediment basin and/or lagoon for treatment or settling purposes, after deducting the depth reserved for storage of solids and freeboard allowance.

Effluent: Liquid flowing out of a reservoir, basin, tank, or other container.

Energy Dissipater: Structure used to dampen erosion potential of a flowing body of water by reducing its forward velocity.

Equalization Basin: Receptacle used to dampen variations in the flow of water.

Evaporation Rate: Rate at which water becomes a vapor and is lost from a body of water.

Filter Charge: Total volume of water necessary to flood the surface of a filter to a specific depth.

Filter Medium: Granular material (sand and/or gravel) in a filter through which water passes.

Filtration: Unit operation in which solid or colloidal material is separated from a liquid by movement through a granular or porous material such as sand.

Flexor: Device installed in the bottom of a water bath at a prewash facility for causing the wheels or tracks of a vehicle to move up and down (flex) to assist in removing dirt from the vehicle.

Flushers: Devices such as water sprays that increase water flow and velocity to prevent solids deposition or to remove deposited solids in a pipe, channel, or other conduit.

Freeboard: Distance in elevation from the maximum water surface of a tank or basin to the top of its walls or overflow.

Grade: Inclination or slope of a surface in terms of a ratio or percentage of vertical rise to horizontal distance.

Grease: General term used to describe the lubricants applied to tactical and TMP vehicles.

Hardstand: Impervious surface, either bituminous or concrete, used as a pavement for pedestrian and/or vehicular traffic.

Hydraulic Loading: Volume of a liquid per unit time applied to a given system or treatment process

Hydrogen Ion Concentration (pH): Measure of the number of hydrogen ions in a solution indicting acidity/alkalinity.

Impervious: Term used to describe the condition in which water or some other fluid cannot easily pass through a material such as soil.

Inflow: Water or wastewater entering a basin, pond, channel, or other storage or collection facility.

Influent: Liquid flowing into a container, basin, or tank.

Interior Wash: Low-pressure, low-flow volume of water used to clean the interior of tactical vehicles, such as truck beds and cab areas.

Intermittent Sand Filter: Filter system with a granular medium (sand and/or gravel) which is flooded at given time intervals with a water or wastewater for treatment.

Lagoon: Pond-like body of water used to treat industrial, commercial, and sanitary wastewaters.

Loading: Rate at which a filter charge is applied to a filter.

Makeup Water: Water added to a system or process to compensate for the amount of water lost due to leakage, percolation, evaporation, release, overflows, usage, or similar action.

Manhole: Structure, usually located at the junction of two or more underground pipes, which allows access to pipes for inspection and maintenance.

Oil Skimmer: Device used for removing oil and grease from a water surface.

Percolation: Downward movement of a liquid through a soil.

Permeability: Term describing the ability of water to move through a soil when the soil is saturated.

Pond: Engineered impoundment containing raw or partially treated wastewater in which aerobic and/or anaerobic stabilization occurs (also see lagoon).

Porosity: Ratio, usually expressed as a percentage, or the volume of voids in a given soil mass to the total volume of the soil mass.

Potable Water: Water supply that is safe for human consumption.

Preparation Area: Paved area for troops to remove trash from vehicle interiors, plug drain holes, open bilge pump discharge lines, and other tasks prior to the prewash or wash facilities.

Primary Treatment: The first phase in treating wastewater in which all debris and settleable solids, along with floating materials (e.g., oil and grease) are removed.

Roller Compacted Concrete: A stiff concrete, low in water content which is placed with a paver-compactor and then rolled.

Sanitary Plant: Wastewater treatment plant designed to process a municipal waste (sanitary, commercial, or industrial).

Secondary Treatment: Second phase in wastewater treatment in which the major portion of the suspended solids and a portion of dissolved solids are removed by physical and/or biological means.

Sediment Basin: Receptacle immediately downstream of the wash stations and prewash, if provided, designed to settle and contain solids from a CVWFs wastewater.

Settling Test: A way to determine the rate at which a particular material settles from a quiescent water.

Staff Gauge: Device for measuring water depth in a basin, pond, or lagoon.

Stop: Device used to limit the movement of a piece of equipment.

Surface Water: Water found on the surface of the ground due to rainfall or snow melt; includes incidental water (e.g., that dripping from vehicles).

Suspended Solids: Weight unit of measurement of the non-settling particles or solids in a dispersed state in the wastewater.

Total Dissolved Solids: Weight unit of measurement indicating the sum of all dissolved solids (volatile and nonvolatile) in a water or wastewater.

Transportation Motor Pool: Facility that provides and maintains commercial vehicles for daily use at an installation (cars, buses, trucks, etc.).

Turbidity: Measure of water clarity.

Usage Factor: Estimated percentage of time that the maximum water usage condition will exist at a CVWF.

Valve Box: A pre-manufactured structure made of concrete, steel, plastic, or fiberglass, which is placed around an underground valve.

Wash Period: Time during which vehicles are washing at a CVWF.

Wash Station: Area of a CVWF where high-pressure, high-flow volumes of water are supplied to hoses for cleaning vehicles.

Wastewater Treatment Plant: Facility designed to process sanitary, commercial, and/or industrial wastewater.

Water Cannon: Device used to direct a large volume of water, at high pressure, toward an object.

Water Supply Basin: Receptacle at a CVWF that holds treated water for reuse at prewash and wash stations.

Weir: Usually a flat piece of metal with a characteristic shape (rectangular, V-notched, etc.) which is inserted into flowing Water for determining the flow rate.

APPENDIX D "DECENTRALIZED HEAVY SOLIDS WASH RACK SITE SURVEY

"DECENTRALIZED" - HEAVY SOLIDS WASH RACK
SITE SURVEY

PROJECT INFORMATION: Page 1 of 5

DATE: _____

PROJECT LOCATION: _____

_____

_____

SHIP TO ADDRESS: _____

_____

_____

BILL TO ADDRESS: _____

_____

_____

CONTRACT OFFICER: _____

PHONE: _____

CELL: _____

EMAIL: _____

PRIMARY CONTACT: _____

PHONE: _____

CELL: _____

EMAIL: _____

SECONDARY CONTACT: _____

PHONE: _____

CELL: _____

EMAIL: _____

"DECENTRALIZED" - HEAVY SOLIDS WASH RACK
SITE SURVEY

SITE INFORMATION:

EXISTING SURFACE:

Sand / Soil: YES ☐ NO ☐

Concrete: YES ☐ NO ☐

Thickness: _____

Pavement: YES ☐ NO ☐

Thickness: _____

Gravel: YES ☐ NO ☐

TEAR OUT -DUMP On Site: YES ☐ NO ☐

WHERE: _____

DIST. From WASH RACK: _____

AREA PLAT: YES ☐ NO ☐

REQUIRED THIS PROJECT: YES ☐ NO ☐

CURRENT SOIL/GEO: YES ☐ NO ☐

REQUIRED THIS PROJECT: YES ☐ NO ☐

EXISTING POWER: _____

DIST. From WASH RACK: _____

PROJECTED POWER REQUIREMENT: 208-230 VOLT, 3 PHASE, 200-400 AMPS

(MINIMUM Requirement - Based on Project Design)

HEAVY-UP REQUIRED: YES ☐ NO ☐

BY OWNER: YES ☐ NO ☐

BY PRIME CONTRACTOR: YES ☐ NO ☐

EXISTING WATER: YES ☐ NO ☐

DIST. From WASH RACK: _____

PROJECTED WATER REQUIREMENT: *MINIMUM: 1" Inside Diameter Pipe - 80 PSI*

SANITARY DISCHARGE: YES ☐ NO ☐

DIST. From WASH RACK: _____

PICTURES ATTACHED: YES ☐ NO ☐

"DECENTRALIZED" - HEAVY SOLIDS WASH RACK
SITE SURVEY

UNIT INFORMATION:

UNIT DISCRIPTION: _____

VEHICLE INVENTORY:

HEAVY TRACK:	
LIGHT TRACK:	
HEAVY WHEEL:	
LIGHT WHEEL:	
TRAILERS:	
MAINTENANCE:	
CONSTRUCTION:	
TOTAL VEHICLES:	

AVERAGE WASH CYCLES: **PER MONTH**

"DECENTRALIZED" - HEAVY SOLIDS WASH RACK
SITE SURVEY

"NET ZERO" DESIGN CRITERIA:

100% CLOSED LOOP SYSTEM

RECYCLES 100% OF ALL WASH WATER

FLEXIBILITY IN DESIGN OPTIONS - *(MINIMAL FOOTPRINT)*

STANDARDIZED:

- DESIGN
- CONSTRUCTION
- OPERATION AND MAINTENANCE
- SUSTAINABILITY

NO SANITARY DISCHARGE MONITORING OR TESTING REQUIRED

MUST MEET EXECUTIVE ORDERS 13423 & 13514

"NET ZERO" FACILITY DESIGN OPTIONS: ***(SEE ATTACHED DRAWINGS)***

"NET ZERO" - SINGLE LANE: ☐

"NET ZERO" - DUAL LANE: ☐

"NET ZERO" - DUAL LANE - COMBO: ☐

"NET ZERO" - QUAD LANE: ☐

"NET ZERO" PAD DESIGN OPTIONS:

ROOF COVER: YES ☐ NO ☐

RAINWATER HARVEST SYSTEM: YES ☐ NO ☐
(MUST HAVE ROOF COVER)

SNOW-MELT SYSTEM: YES ☐ NO ☐
(HEATED PAD)

OTHER: YES ☐ NO ☐

"DECENTRALIZED" - HEAVY SOLIDS WASH RACK
SITE SURVEY

NOTES / QUESTIONS

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UFC 4-215-01
1 December 2014

UNIFIED FACILITIES CRITERIA (UFC)

ARMORIES AND ARMS ROOMS



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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by \1\ ... /1/)

Change No.	Date	Location

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The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Subject: UFC 4-215-01, *Armories and Arms Rooms*

Cancels: This is a new Tri-Service document. This is to be used in conjunction with other Tri-Service UFC documents in the development of Armories and Arms Rooms. A listing of documents is in Appendix A - References

Description: The UFC 4-215-01, *Armories and Arms Rooms*, represents another step in the effort to bring uniformity to the planning, design and construction of military facilities. The document requires the use of the latest building codes including the International Building Code.

New military requirements were incorporated and improved references to other documents have been identified for energy conservation, sustainable development, and antiterrorism standards.

This is the first Tri-Service criteria document to be published for this building type.

Reason for Creating this Document: The existing guidance was inadequate for the following reasons:

- The Services are currently using their own individual criteria documents, ex. AF Guides, NAVFAC Instructions, Army Technical Instructions, and Marines P-numbered management manuals. This document promotes criteria uniformity, and reduces current reliance upon individual Service specific documents.

- The existing Service-specific guidance did not properly reference and identify recently updated and published Tri- Service documents.

Impact: The following direct benefits will result with the new UFC 4-215-01, *Armories and Arms Rooms.*

- Creation of a single source for common DoD Armory criteria and an accurate reference to individual Service-specific documents.

- Eliminates misinterpretation and ambiguities that could lead to design and construction conflicts.

- Facilitates updates and revisions and promotes agreement and uniformity of design and construction between the Services.

Unification Issues:

Section 2-8.1: Air Force's approval authority for installation of emergency power systems at Armories is the Air Force Civil Engineer Center (AFCEC), as opposed to the other Services which allow the Installation Commander as the approval authority.

Section 3-4.3.2: Army does not require provision for card readers with key pads at equipment cage (platoon, company) doors and office doors.

Section 3-4.6.1: The Army does not require lockers to be provided for showering or changing clothes. This is due to the Army typically constructing only "Arms Rooms" within other facilities; thus, the existence of an "Arms Room" would not require showers and associated lockers for showering and changing.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This UFC provides requirements for a unified approach to the planning, programming, and design of DoD Armories and Arms Rooms. These facilities store only very limited amounts of small arms ammunition; thus, this document does not cover facilities utilized for storing ammunition or explosives. For facilities storing ammunition or explosives that fall under DoD 6055.09-M, *DOD Ammunition and Explosive Safety Standards*, refer to requirements in UFC 4-420-01, *Ammunition and Explosives Storage Magazines*.

1-2 APPLICABILITY.

This UFC applies to all military service elements and contractors involved in the planning, design, and construction of DoD armories and arms rooms worldwide. The information in this UFC applies to the design of all construction projects, to include new construction, additions, alterations, and renovation projects in the continental United States (CONUS) and outside the continental United States (OCONUS).

1-3 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *General Building Requirements*. UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-4 REFERENCES.

Appendix A contains a list of references used in this document. The publication date of the code or standard is not included in this document. In general, the latest available issuance of the reference is used.

1-5 GLOSSARY.

Appendix C contains acronyms, abbreviations, and terms.

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CHAPTER 2 PLANNING CRITERIA

2-1 PHYSICAL SECURITY.

Physical security is that part of security concerned with physical measures designed to safeguard personnel; to prevent unauthorized access to equipment, installations, material, and documents; and to safeguard them against espionage, sabotage, damage, and theft.

The applicable DoD and Service-specific physical security documents for Armories and Arms Rooms are as follows:

- DoD Military Handbook 1013/1A, Section 2
- DoDM 5100.76, *Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives*, for pre-design considerations.
- Navy: OPNAVINST 5530.13C, *Physical Security Instruction for Conventional Arms, Ammunitions, and Explosives*
- Marine Corps: MCO 5530.14A, *Marine Corps Physical Security Program Manual*
- Army: Army Regulation (AR) 190-11, *Physical Security for Arms, Ammunition, and Explosives*
- Air Force: Air Force Instruction (AFI) 31-101, *Integrated Defense* (FOUO).

Include representatives from the intended facility users, as well as the designated military installation intelligence officers, operational officers, security and law enforcement officials, and engineering and planning personnel in the planning and design process.

2-1.1 Threat Assessment.

Generally, arms storage structures are designed according to the physical security regulations and instructions listed above. Local threat considerations need to be taken into consideration and the "design basis threat" can be established using UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*.

2-2 SCOPE OF FACILITY.

Comply with DoDM 5100.76. Armory facility functional design is driven by inventory control, storage, equipment repair and maintenance, delivery, management methodologies, and any additional functions accommodated in the specific facility. These functions and how they drive the design of the facility are described in greater detail herein. Arms, ammunition and explosives (AA&E) storage is driven by Security Risk Categories (SRC) per DoDM 5100.76. For Army Arms Rooms representative risk categories are established per AR 190-11.

2-2.1 Armories and Arms Rooms.

"Armory" is a facility, usually free-standing, containing one or more separate weapon storage and distribution spaces. See Appendix B, Drawing B-1, for the layout of a typical Armory. An "Arms room" is a single room built inside, or adjacent to, another building for the purpose of storing and distributing weapons. See Appendix B, Drawing B-3, for the layout of a typical Arms Room.

2-2.1.1 Armory.

Navy and Marine Corps armories are categorized in UFC 2-000-05N, *Facility Planning Criteria for Navy/Marine Corps Shore Installations*, Category Code 143 45. An armory for Fleet Marine Force air and ground units provides temperature and humidity controlled, and secure space for storing and maintaining weapons assigned to personnel. In planning for a Marine Corps armory, the method is to build the space requirements by weapon and ammunition count. To calculate space requirements, the space allocation for a Navy and Marine Corps armory can be determined by using the UFC 2-000-05N, *Facility Planning Criteria for Navy/Marine Corps Shore Installations* space planning tool on the NAVFAC portal. Adjustments can be made for units that do not conform to infantry battalion model, such as squadron or logistics battalion. Navy and Marine Corps Armories store limited amounts of safety and security ammunition and may also be authorized for storing ammunition with those personal weapons that have been authorized for storage by the Commanding Officer in a container in the facility.

The Army also has large free-standing weapons storage facilities in specialized circumstances (identification of which is FOUO); however, the Army more typically stores weapons in an Arms Room within another facility.

The weapons/equipment within the armory is typically stored within cabinets, wall lockers, gun racks, shelving, boxes/crates, or wall boards. In most cases, this method of storage allows some stacking of the weapons/equipment which can reduce floor space requirements. See Appendix B, Drawing B-1, for the typical layout of an Armory.

2-2.1.1.2 Portable Armory.

An armory constructed and designed to be relocatable. They are a custom fabrication built in accordance with Naval Surface Warfare Specification 3046-93.2. Relocatable Armories are not permanent Armory solutions. Portable armories must also comply with DoDM 5100.76 and the Service-specific requirements within AR 190-11 and OPNAVINST 5530.13C.

2-2.1.2 Arms Rooms.

Army arms rooms are constructed according to the requirements of Army Regulation (AR) 190-11; these are facilities, similar in function to the weapons storage spaces of armories, with very limited maintenance and repair facilities. Standard Army practice is to have an arms room built inside or adjacent to each line company headquarters building. Arms rooms are also located inside military police buildings, special operations centers, reserve training facilities, and other installations. If required, add space for a small amount of ammunition storage. See Appendix B, Drawing B-3, for the layout of a typical Arms Room.

Air Force arms rooms are governed by Air Force Instruction (AFI) 31-101, ETL 11-18, *Small Arms Range Design and Construction*, and AFMAN 32-1084, *Facility Requirements*. Air Force weapons repair and maintenance facilities are normally located in a Combat Arms Facility.

Navy and Marine Corps arms rooms must comply with OPNAVINST 5530.13C.

2-2.1.3 Modular Arms Room.

Governed by Federal Specification (Fed. Spec.) AA-V-2737, *Modular Vault Systems*. Modular arms rooms' construction is placed inside a building during new construction, is inserted inside an existing building, or is an addition to an existing structure. It may be a free-standing arms room, constructed of precast concrete or steel plate. The physical security requirements for a modular arms room are the same as for a standard arms room or armory building. These are not to be confused with portable armories.

2-3 ARMORY PLANNING DETERMINATIONS.

Planning the size and layout of armory facilities depends upon the following determinations.

2-3.1. Inventory and Number of Personnel to be Serviced.

The facility inventory, number of workers, and number of personnel to be serviced drives the overall area of the facility. Use individual service space planning criteria and user input to determine specific needs. This area will be provided by the DoD Form 1391 for the project.

2-3.2. Weapons Distribution Protocols.

The weapons distribution protocol affects the layout of the facility. In most armories the weapons are distributed through Issue Ports. The design of the Issue Ports is a determinant of the types of weapons that can be issued. Issue Port size is regulated by Physical Security requirements. See Issue Port details in Appendix B.

Larger weapons and accessories may require special distribution procedures that mandate that weapons and accessories be distributed through the facility doorways. The protocol for these issues will be established by the facility user.

For Arms Rooms, weapons issue is through the Class 5 Armory Door or day gate. The day gate can be configured with an issue window or as a Dutch door to facilitate issuance and return of weapons and equipment.

2-3.3. Weapons Storage.

Determine weapons storage requirements during initial project planning. High-density storage systems may be necessary to accommodate the quantity and variation of the weapons and supporting equipment requiring storage. The configuration and mobility of selected storage systems may impact the funding source required to obtain the system, either as facility construction costs or installed equipment costs (FF&E), and must be programmed accordingly in the project funding documentation (DD 1391, etc.) by the facility planner. Configuration of storage systems will also impact decisions regarding structural systems, fire protection requirements, security systems and lighting.

2-3.4. Weapons Cleaning Stations.

The type, number, and arrangement of weapons cleaning station worktables and accessories are an integral part of the building functional planning. The cleaning process will take place in a covered area, typically located outside but adjoining the facility in temperate climates and incorporated into the facility in harsh climates. Outside covered areas will be scheduled at one-half square footage. Supplemental heating may be necessary for outside cleaning areas.

Interior weapons cleaning rooms are located outside the secure perimeter of the armory.

The size of the weapons cleaning area is based on the number of personnel using the space, and the amount of time allowed for cleaning. For Air Force facilities, AFMAN 32-1084 requires 15 SF per each person cleaning weapons concurrently.

2-3.4.1 Location.

The location of the weapons cleaning areas will be reflected in the space planning allowances shown in the project funding documentation (DD 1391, etc.), either as an exterior covered space square footage requirement or as additional interior square footage in the facility.

2-3.4.2 Interior Location.

For interior locations, the type, number, and arrangement of weapons cleaning and repair worktables and accessories will be designed as an integral part of the building interior.

2-4 STAFFING AND OFFICE MANAGEMENT.

Determine staffing requirements for armories to size the administrative areas, staff lockers, and toilets, in accordance with the individual service's space criteria. Staffing for arms rooms would be located in an adjacent office with visual control of the room entrance.

2-5 OTHER FACILITY FUNCTIONS.

For the armory to accommodate one or more of the following additional functions, specialized areas will be required. These spaces should be outside of the secure perimeter of the armory.

- Personnel training functions - classrooms.
- Non-Standard weapons inventory, servicing, and/or fabrication functions – machine shops, wood shop, indoor firing range.
- Small arms shop (Category Code 215 10) contained in a Navy or Marine Corps Armory or for a small arms shop in support of multiple facilities.

2-6 SPACE ASSESSMENT.

See the Functional Data Sheets in Chapter 4 for additional information on the space types and their relationships to each other.

2-6.1 Other Functions.

If the program calls for it, add a gunsmith shop for weapon construction and maintenance. Air Force weapons repair and maintenance are normally provided in a Combat Arms Facility. Add other functions defined by the program.

2-6.2 Break Area.

Armory areas as required for, recycling bins space, and coffee machine, microwave oven and refrigerator.

2-6.3 Loading Considerations.

If a loading dock is necessary to accommodate material transfer in and out of the facility, coordinate it with storage requirements.

2-6.4 Support Areas.

Accommodate staff needs such as offices and administrative tasks, toilets, lockers, showers, and janitor closets. The areas are determined by the staffing requirements. These spaces can be located outside of the secure perimeter of the armory.

2-6.4.1 Building Services Areas.

These spaces accommodate building services such as mechanical, electrical, and communications. Provide separate Mechanical and Electrical Equipment rooms, sized according to the size of the facility, with direct access to the exterior only. The Mechanical and Electrical rooms are not required to be within the secure perimeter. Provide lockable doors for the Mechanical and Electrical rooms. Interior access is prohibited.

- Where requested by user, provide toilet facilities accessed from the exterior of the building as part of the building program, in addition to interior toilets.
- Trash & Garbage Removal and Recycling. Garbage storage, removal and recycling systems will be determined prior to design, based on installation requirements.
- Segregated areas for special wastes.
- Other Facility Functions. These spaces will be determined by the specific facility requirements and the individual service's space planning criteria.

2-7 BUILDING SITE PLANNING.

The armory functions are important to the mission for any installation. Consider the following factors in the site selection and planning.

2-7.1 Location.

The following must be addressed when locating a facility:

- In locating the facility, the first consideration is physical security. Provide a clear, unobstructed view of the fence openings and entry path from the facility entrance.
- Site selection must take into account the requirement that an armed response force must be able to respond on-site to the armory location within 15 minutes of an alarm or report of intrusion, in accordance with DoDM 5100.76.
- For Armories, another important siting consideration is locating it in close proximity to the operational hub of the regiment, battalion, or company, when possible.

2-7.2 Parking.

Provide adequate parking as close to the facility as possible within antiterrorism (AT) requirements. Parking must be located outside of clear zone.

2-7.3 Fencing.

DoDM 5100.76 does not require fencing for armories. Provide security fencing around the perimeter of the entire building site when dictated by the installation/base commander. When fencing is required, per DoDM 5100.76, establish clear zones that extend a minimum of 12 feet (3.66 m) on the outside and 30 feet (9.14 m) on the inside of fence (or to the maximum extent within available land space if minimum requirements cannot be met). For more stringent clear zone requirements for Marine Corps facilities, refer to MCO 5530.14A.

2-8 BUILDING SUPPORT SYSTEMS.

2-8.1 Emergency Power.

Coordinate with Installation Commanding Officer to determine if emergency power is required to support the critical mission and identify the requirements, including load to be served and time duration, in the project funding documents. Emergency power may be required to provide air-conditioning/humidity control in weapons storage areas, and other systems to support the mission. **Service Exception:** For **Air Force**, the Air Force Civil Engineering Center (AFCEC) is the approval authority for installation of emergency power systems.

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CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL.

3-2 PHYSICAL SECURITY.

See Chapter 2 paragraph “Physical Security” and “Armories and Arms Rooms” for additional design requirements.

3-3 SITE WORK.

3-4 ARCHITECTURE AND INTERIOR DESIGN.

3-5 ELECTRICAL DESIGN.

In addition to the criteria established in UFC 1-200-01 and the references therein, comply with the following armory-specific requirements:

3-5.1 Telecommunications Systems.

Refer to specific requirements for spaces in Chapter 4, Room Data Sheets. In arms rooms, consider providing phone to allow communication with security forces.

3-5.2 Power.

Provide ceiling-mounted power cord reels at each worktable in weapons maintenance areas. Floor mounted flush receptacles and conduit stub-ups are not permitted.

3-5.3 Lighting.

Provide lamp breakage protection (wire guards) for lighting fixtures in rooms as required in spaces in Chapter 4, Room Data Sheets. Provide site security lighting in accordance with the requirements of UFC 3-530-01. Provide security lighting for all arms storage areas and facilities. The lighting must be sufficient to allow guards or individuals responsible for maintaining surveillance to see illegal acts such as forced entry or the unauthorized removal of arms. Provide a minimum of 0.2 foot-candles (2 lux) illumination measured on the horizontal plane at ground level, sufficient to allow detection of unauthorized activity. Locate exterior light switches so they are only accessible to authorized personnel.

3-5.4 Emergency Power.

When identified in the project funding documents, provide emergency power generator to support mission requirements. Army Regulation AR190-11 requires a minimum 4 hour power source (battery) to operate security features.

3-5.5 Electronic Security Systems (ESS).

Coordinate ESS requirements for the facility with the Service-specific documents identified in Chapter 2 paragraph titled “Physical Security”. Design the ESS in accordance with UFC 4-021-02, *Electronic Security Systems*.

3-5.5.1 Intrusion Detection System (IDS)

Provide an IDS including the following, unless there is a documented exception.

- Point sensors on doors and other “accessible openings” exceeding 96 square inches (619 square centimeters)

- Interior volumetric sensors, including coverage of all shelving and gun racks. When required by user, provide individual IDS sensing for each weapons storage area. Ensure IDS components are not rendered useless by blocked line of sight.

- A duress alarm (panic button) at each issue port (for Navy and Marine facilities)

- Line supervision on transmission lines. If line supervision is unavailable, two independent means of alarm signal transmission is required.

- Reporting to a central monitoring station where alarms will sound and from which a response force can be dispatched. An alarm bell located only at the protected location is not acceptable.

3-5.5.2 Access Control Systems

Provide card reader with keypads at entry to building. Provide key pad, with card reader when required, at the entrance of each interior weapons storage area. Card readers must be approved for use by service's security authorities.

3-5.5.3 Closed Circuit Television (CCTV)

Provide CCTV system when required.

3-6 HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) DESIGN.

In addition to UFC 1-200-01, *General Building Requirements,* and the stated and cross referenced requirements for HVAC Systems, comply with the following:

3-6.1 Maximum Ductwork Size.

Where possible, limit maximum ductwork size penetrating the perimeter of the secure area (roof or walls) to less than the dimensions for a "man-passable opening" as defined in MIL HDBK 1013/1A. Where the "man-passable opening" dimensions must be exceeded, provide hardening at the opening in accordance with MIL HDBK 1013/1A.

3-6.2 Controls.

Specify direct digital control (DDC) system per UFGS 23 09 23.13 20, *BACnet Direct Digital Control Systems for HVAC*, or UFGS 23 09 23, *Lonworks Direct Digital Control for HVAC and Other Building Control Systems*. Coordinate DDC specification to ensure proper interface to existing or planned base-wide DDC/EMCS system.

Refer to Room Data Sheets in Chapter 4 for spaces which require humidity control.

3-6.3 Ventilation.

Ventilation systems for the Weapons Repair and Maintenance Workshops and any interior weapons cleaning areas must comply with UFC 3-410-04, *Industrial Ventilation.*

3-7 PLUMBING DESIGN.

In addition to UFC 1-200-01, *General Building Requirements,* and cross referenced requirements therein, comply with the following in the design of the plumbing system for this facility type:

- Provide hose bibbs at exterior weapons cleaning areas. In lieu of hose bibbs, provide freeze proof hydrants where the climate demands.

- Locate air compressor(s) and air dryer(s) in the Mechanical Room when feasible. If outdoors, provide outdoor rated compressed air system, mounted on a slab, for the covered weapons cleaning area and the indoor weapons repair and

maintenance workshops. Provide compressed air outlets at the worktables. Equip interior compressed air outlets with ceiling hung hose reels.

3-8 FIRE PROTECTION.

Refer to UFC 1-200-01, *General Building Requirements,* and comply with stated and cross referenced requirements for Fire Protection Systems, with the following additions or exceptions for this facility type:

3-8.1 Fire Suppression Systems.

For armories 5,000 square feet (464.5 sq. m.) or greater, provide automatic sprinkler protection throughout the facility and for the outdoor weapons cleaning areas when attached to the building.

3-8.2 Fire Alarm Systems.

Provide a Fire Alarm System for armories of 5,000 square feet (464.5 sq. m.) or greater. Fire alarm systems are not required for portable armories.

3-8.3 Installations with a Single Armory

For Installations that have only one armory, and that armory houses the Installation's Security Forces weapons and ammunition, mitigation of risks associated with loss of security forces weapons and ammunition due to fire shall be provided by one of the methods below.

- Provide automatic sprinkler protection throughout the building, regardless of size.
- The installation Security Officer must maintain a written contingency plan in the event the armory and contents are destroyed due to fire. This written plan must be approved by the installation Commanding Officer.

3-8.4 Mass Notification Systems.

When required for an inhabited building, provide mass notification system in accordance with UFC 4-021-01, *Design and O&M: Mass Notification Systems*.

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CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-1 INTRODUCTION.

This chapter identifies the specific design requirements for each functional area as outlined in the space program. Tables 4-1 through 4-12 provide this data in a standard Functional Data Sheet format.

Armory planning determinations, along with other basic building design and operation determinations, establish the size, layout, and design of the facility functional spaces. The various components below may apply to an armory or an arms room project.

The interior construction specialties, equipment and furnishings criteria provided in these tables are broken down as follows:

- Casework/Built-in Equipment. This includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, and window treatments.
- Furnishings, Fixtures, and Equipment (FF&E). This includes contractor-furnished, contractor-installed loose items such as desks, tables, chairs, bookshelves, and televisions (if mounted, TV mount would be built-in).
- User-provided FF&E. This includes all government-furnished, government-installed items, which are typically limited to office equipment such as computers, printers, copiers, and projectors (if mounted, projector mount would be built-in).

4-2 ISSUE PORTS.

Provide issue ports for Navy and Marine Corps armories. The issue port accommodates distribution of weapons to authorized personnel. For the Navy and Marines, OPNAVINST 5530.13C and MCO 5530.14A require openings “not to exceed 190 in-sq when open; and when not in use will be secured with material comparable to that forming the adjacent walls.” (NOTE: DoDM 5100.76 requires IDS point sensors on any “accessible openings,” which is defined as 96 sq in (0.06 square meters)). Provide at least one issue port at each caged or separate unit arms room.

See Appendix B – Drawings for Issue Port drawings.

TABLE 4-1 ENTRY CANOPY

Description/Usage	Provide a canopy or enclosure at the main entrance to the facility for personnel who must wait at the facility entrance. It may be a column supported canopy. Determine the size by the number of personnel to be served, arrival and departure considerations, and the procedure followed.
Ceiling Ht.	11’ – 4” (3.45 m) min (new construction)
Finishes	Floor: Sealed Concrete Base: N/A Walls: N/A Ceiling: Painted or prefinished
Plumbing	None
HVAC	None
Fire Protection	None
Power	None
Lighting	Provide per Chapter 3
Communication	None
Acoustics	None
Casework/Built-in Equipment	None
Furnishings Fixtures & Equip. (FF&E)	None
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-2 VESTIBULE

Description/Usage	A vestibule is appropriate to prevent major heat loss and gain, and to screen and protect visitors prior to entry into the facility proper.
Ceiling Ht.	11’ – 4” (3.45 m) min (new construction)
Doors	Use hollow metal doors with half glass for the outside door(s). If the inside of the vestibule is on the secure perimeter, the inside door must be GSA-approved Class 5 Armory Door. At the inside of the armory door, provide a day gate for added security.
Finishes	Floor: Sealed Concrete; consider recessed entry mat. Base: Resilient Walls: Epoxy on CMU or concrete. Provide wall guard protection at locations subject to cart traffic. Ceiling: Painted exposed structure
Plumbing	None
HVAC	Provide per Chapter 3
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3. Provide lamp protection.
Communication	Provide per Chapter 3
Acoustics	None
Casework/Built-in Equipment	None
Furnishings Fixtures & Equip. (FF&E)	None
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-3 CORRIDOR

Description/Usage	Circulation. The semi-public areas of the facility allow for circulation to other functions.
Ceiling Ht.	11’ – 4” (3.45 m) min (new construction)
Finishes	Floor: Sealed Concrete Base: Resilient Walls: Epoxy on CMU or concrete/expanded metal. Provide wall guard protection at locations subject to cart traffic. Ceiling: Painted exposed structure
Plumbing	None
HVAC	Provide per Chapter 3
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3. Provide lamp protection.
Communication	Provide per Chapter 3
Acoustics	None
Casework/Built-in Equipment	Tackboards
Furnishings Fixtures & Equip. (FF&E)	None
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-4 DUTY OFFICE

Description/Usage	Administrative office
Ceiling Ht.	8’ – 0” (2.44 m) min
Finishes	Floor: Resilient tile Base: Resilient Walls: Painted walls. Ceiling: Acoustical panel
Plumbing	None
HVAC	Provide per Chapter 3
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3
Communication	Provide per Chapter 3
Acoustics	Provide per Chapter 3
Casework/Built-in Equipment	None
Furnishings Fixtures & Equip. (FF&E)	Office furniture
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-5 MECHANICAL ROOM

Description/Usage	Mechanical equipment housed here. Access only from the exterior of the building.
Ceiling Ht.	11’ – 4” (3.45 m) min. (new construction)
Finishes	Floor: Sealed Concrete Base: Resilient Walls: Painted CMU or concrete Ceiling: Painted exposed structure
Plumbing	Provide per Chapter 3
HVAC	Provide per Chapter 3
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3
Communication	Provide per Chapter 3
Acoustics	None
Casework/Built-in Equipment	None
Furnishings Fixtures & Equip. (FF&E)	None
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-6 STAFF TOILETS/SHOWERS

Description/Usage	Male and female toilets and shower facilities.
Ceiling Ht.	8’ – 0” (2.44 m) min
Finishes	Floor: Porcelain tile Base: Porcelain or Ceramic tile Walls: Ceramic tile wainscot 48” high except, full height ceramic tile or solid surface material in showers. Painted walls. Ceiling: Moisture resistant acoustical panel ceiling or mold-resistant gypsum board.
Plumbing	Lavatories, urinals, water closets, showers
HVAC	Provide per Chapter 3
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3
Communication	Provide per Chapter 3
Acoustics	No special requirements
Casework/Built-in Equipment	Vanity cabinets for lavatories. Toilet partitions and accessories. Provide solid surfacing material at countertops. Lockers and benches if required
Furnishings Fixtures & Equip. (FF&E)	
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-6A EXTERIOR TOILETS

Description/Usage	Optional male and female toilet facilities, accessed from the exterior of the building. Primarily required for Armories in remote locations.
Ceiling Ht.	8’ – 0” (2.44 m) min
Finishes	Floor: Sealed Concrete Base: None Walls: Painted walls. Ceiling: Moisture resistant acoustical panel ceiling or mold-resistant gypsum board.
Plumbing	Lavatories, urinals, water closets
HVAC	Provide per Chapter 3
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3
Communication	Provide per Chapter 3
Acoustics	No special requirements
Casework/Built-in Equipment	Toilet accessories.
Furnishings Fixtures & Equip. (FF&E)	None
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-7 ELECTRICAL CLOSET

Description/Usage	Electrical panels and other equipment. Access only from the exterior of the building.
Ceiling Ht.	11’ – 4” (3.45 m) min (new construction)
Finishes	Floor: Sealed Concrete Base: Resilient Walls: Painted CMU or concrete Ceiling: Painted exposed structure
Plumbing	None
HVAC	Provide per Chapter 3
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3
Communication	Provide per Chapter 3
Acoustics	None
Casework/Built-in Equipment	None
Furnishings Fixtures & Equip. (FF&E)	None
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-8 COMMUNICATIONS ROOM

Description/Usage	Communications equipment housed here.
Ceiling Ht.	11’ – 4” (3.45 m) min. (new construction)
Finishes	Floor: Sealed Concrete Base: Resilient Walls: Painted. Provide ¾-inch (19 mm) plywood attached to wall for attachment of IT and telephone equipment. Ceiling: Painted exposed structure
Plumbing	None
HVAC	Provide per Chapter 3
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3
Communication	Provide per Chapter 3
Acoustics	None
Casework/Built-in Equipment	Communications racks
Furnishings Fixtures & Equip. (FF&E)	None
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-9 JANITORS CLOSET

Description/Usage	Cleaning supplies and equipment storage.
Ceiling Ht.	8’ – 0” (2.44 m) min
Finishes	Floor: Sealed Concrete Base: Resilient Walls: Painted Ceiling: Painted GWB ceiling.
Plumbing	Floor mop sink
HVAC	Provide per Chapter 3
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3
Communication	None
Acoustics	None
Casework/Built-in Equipment	Storage shelving for cleaning supplies and equipment; mop rack.
Furnishings Fixtures & Equip. (FF&E)	None
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-10 COVERED WEAPONS CLEANING AREA

Description/Usage	Exterior column supported canopy with concrete slab. Determine the size by the number of personnel to be served, arrival and departure considerations, and the procedure followed. Provide space for weapons cleaning tables, cleaning equipment, and clearing of weapons.
Ceiling Ht.	11’ – 4” (3.45 m) min (new construction)
Finishes	Floor: Concrete Base: N/A Walls: N/A Ceiling: Painted ceiling.
Plumbing	Hose bibbs. Use freeze proof hydrants in lieu of hose bibbs where climate demands. Provide compressed air system with compressed air outlets at worktables (50 psi and 15 scfm, verify these requirements during design).Provide emergency eyewash station.
HVAC	Provide radiant heating. Coordinate the type of heating allowed with fire protection requirements where solvent vats are provided.
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3. Provide lighting at 30 footcandles (300 lux) ambient and 50 footcandles (500 lux) at task with vacancy sensor (manual on, vacancy off). Provide lamp protection (wire guards).
Communication	None
Acoustics	None
Casework/Built-in Equipment	Weapons cleaning tables
Furnishings Fixtures & Equip. (FF&E)	Weapons cleaning equipment, weapons clearing barrels, hazardous material storage for oily rags. Trash containers.
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-10A INTERIOR WEAPONS CLEANING AREA

Description/Usage	Interior building space for weapons cleaning. Required for areas with harsh climates. Determine the size by the number of personnel to be served, arrival and departure considerations, and the procedure followed. Provide space for weapons cleaning tables, cleaning equipment, and clearing of weapons.
Ceiling Ht.	11' – 4" (3.45 m) min (new construction)
Finishes	Floor: Sealed Concrete Base: N/A Walls: Epoxy Paint Ceiling: Painted exposed structure.
Plumbing	Compressed air system with ceiling hung hose reels at worktables (50 psi and 15 scfm, however, verify requirements during design). Deep sinks. Emergency eyewash station.
HVAC	Provide per Chapter 3. Coordinate the type of heating allowed with fire protection requirements where solvent vats are provided. Provide special ventilation in accordance with Chapter 3, HVAC Design, to control solvent vapors.
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3
Lighting	Provide per Chapter 3. Provide lighting at 30 footcandles (300 lux) ambient and 50 footcandles (500 lux) at task with vacancy sensor (manual on, vacancy off). Provide lamp protection (wire guards).
Communication	None
Acoustics	None
Casework/Built-in Equipment	Weapons cleaning tables
Furnishings Fixtures & Equip. (FF&E)	Weapons cleaning equipment, weapons clearing barrels, hazardous material storage for oily rags.
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-11 WEAPONS REPAIR AND MAINTENANCE WORKSHOPS

Description/Usage	Weapons repair and regular maintenance. The square footage of repair and maintenance workspace areas will be determined by the program. In some armories this space may have secondary functions as a training space.
Ceiling Ht.	11' – 4" (3.45 m) min (new construction)
Finishes	Floor: Sealed Concrete Base: Resilient Walls: Epoxy on CMU or concrete. Ceiling: Painted exposed structure
Plumbing	Compressed air system with ceiling hung hose reels (50 psi and 15 scfm, however, verify requirements during design). Hand sink and emergency eyewash.
HVAC	Provide humidity control to limit the relative humidity to no greater than 40% at 80 degrees Fahrenheit (26.7 degrees Celsius). Design to 68 deg F (20.0 deg C) dry bulb and 40% RH for indoor design heating conditions, and 75 deg F (23.9 deg C) dry bulb and 40% RH for indoor design cooling conditions. Provide special ventilation in accordance with Chapter 3, HVAC Design, to control solvent vapors.
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3. Provide power reels.
Lighting	Provide per Chapter 3. Provide lamp protection. Provide lighting at 30 footcandles (300 lux) ambient and 50 footcandles (500 lux) at task
Communication	Provide per Chapter 3. Provide duress alarm at each issue port.
Acoustics	None
Casework/Built-in Equipment	None
Furnishings Fixtures & Equip. (FF&E)	Weapons maintenance workbenches, tables, stools, hand tools, power tools and parts cabinets
User-Provided Equip. (GF&GI)	Tools and Parts
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

TABLE 4-12 WEAPONS STORAGE AREA

Description/Usage	The weapons and equipment within the armory are typically stored within cabinets, gun racks, shelving, boxes/crates, or wall boards. In most cases, this method of storage allows some stacking of the weapons/equipment which can reduce floor space requirements. Provide storage space for gun cases, ammunition cases, etc. The areas are determined by analysis of the need, the number of personnel to be served, and the defined delivery cycles. An armory will have multiple cages, each for a company-sized unit (approximately 105 personnel), with weapons racks, locking cage door with a key / pushbutton lock. Provide a minimum of one issue port for each caged area or separate arms room. Provide space for weapon cleaning. Allow space for a small workbench with power if required by User. Provide workbench if requested.
Ceiling Ht.	11’ – 4” (3.45 m) clear to underside of concrete (new construction)
Finishes	Floor: Sealed Concrete Base: Resilient Walls: Epoxy on CMU or concrete. Ceiling: Painted exposed structure.
Plumbing	None
HVAC	Provide humidity control to limit the relative humidity to no greater than 40% at 80 degrees Fahrenheit (26.7 degrees Celsius). If personnel will be working in these areas, design to 68 deg F (20.0 deg Celsius) dry bulb and 40% RH for indoor design heating conditions, and 75 deg F (23.9 deg Celsius) dry bulb and 40% RH for indoor design cooling conditions.
Fire Protection	Provide per Chapter 3
Power	Provide per Chapter 3. Provide power for workbench(es) if required by User.
Lighting	Provide per Chapter 3. Provide lamp protection (wire guards).
Communication	Provide per Chapter 3. Provide duress alarm at each issue port for Navy and Marine facilities. Locate motion detector on corridor cage wall.
Acoustics	No special requirements
Casework/Built-in Equipment	Equipment cages of woven wire mesh partitions, shelving, and wallboards. If storage requirements warrant high-density or wall-mounted storage shelving/racks/boards, these items must be coordinated and included in construction. Consider structural loads, IDS sensors and fire protection systems during design of high-density storage. Storage shelving/racks may require attachment to floor or structure.

TABLE 4-12 WEAPONS STORAGE AREA

Furnishings Fixtures & Equip. (FF&E)	Free-standing weapons racks and cabinets. Workbenches, if requested.
User-Provided Equip. (GF&GI)	None
For use during project execution by the appropriate Service agency	
Occupancy	
Min. net ft^2(m^2)	

APPENDIX A REFERENCES

DEPARTMENT OF DEFENSE

http://www.dtic.mil/whs/directives/corres/pub1.html

DoD 6055.09-M, *DOD Ammunition and Explosive Safety Standards*

DoDM 5100.76, *Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives*

MIL-HDBK-1013/1A, *Military Handbook Design Guidelines For Physical Security of Facilities*, http://www.wbdg.org/ccb/NAVFAC/DMMHNAV/1013_1a.pdf

U.S. Government Specification (Naval Surface Warfare Center) 3046-93.2, *Purchase Spec Portable Vault*

DEPARTMENT OF THE AIR FORCE

http://www.wbdg.org/ccb/browse_org.php?o=33

AFI 31-101, *Integrated Defense (FOUO)*

AFI 32-1024, *Standard Facility Requirements*

AFMAN 32-1084, *Facility Requirements*

ETL 11-18, *Small Arms Range Design and Construction*

DEPARTMENT OF THE ARMY

http://armypubs.army.mil/

AR 190-11, *Physical Security of Arms, Ammunition, and Explosives*

DEPARTMENT OF THE NAVY

http://doni.daps.dla.mil/allinstructions.aspx

OPNAVINST 5530.13C, *Physical Security Instruction for Conventional Arms, Ammunition, and Explosives*

HEADQUARTERS, MARINE CORPS

MCO 5530.14A, *Marine Corps Physical Security Program Manual*
http://www.marines.mil/Portals/59/Publications/MCO%205530_14A.pdf

FEDERAL SPECIFICATIONS

http://www.navfac.navy.mil/navfac_worldwide/specialty_centers/exwc/products_and_services/capital_improvements/dod_lock/Documents/FedSpecs.html

Federal Specification (Fed Spec.) AA-D-600D, *Door, Vault, Security*

Fed Spec. AA-V-2737, *Modular Vault Systems*

Fed Spec FF-L-2937, *Combination Lock, Mechanical*

MILITARY SPECIFICATIONS

http://www.navfac.navy.mil/navfac_worldwide/specialty_centers/exwc/products_and_services/capital_improvements/dod_lock/Documents/MilitarySpecifications.html

Military Specification MIL-P-43607J, *Padlock, Key Operated, High Security, Shrouded Shackle*

Military Specification MIL-H-29181C, *Hasp, High Security, Shrouded, for High and Medium Security Padlock*

UNIFIED FACILITIES CRITERIA

http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 1-200-01, *General Building Requirements*

UFC 2-000-05N (P-80), *Facility Planning Criteria for Navy/Marine Corps Shore Installations*

UFC 1-202-01, *Host Nation Facilities in Support of Military Operations*.

UFC 3-120-01, *Design: Sign Standards*

UFC 3-201-02, *Landscape Architecture*

UFC 3-410-04, *Industrial Ventilation*

UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls*

UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*

UFC 4-021-01, *Design and O&M: Mass Notification Systems*

UFC 4-021-02, *Electronic Security Systems*

UFC 4-022-03, *Security Fences and Gates*

UFC 4-420-01, *Ammunition and Explosive Storage Magazines*

UNIFIED FACILITIES GUIDE SPECIFICATIONS

http://www.wbdg.org/ccb/browse_cat.php?c=3

UFGS 23 09 23.13 20, *BACnet Direct Digital Control Systems for HVAC*

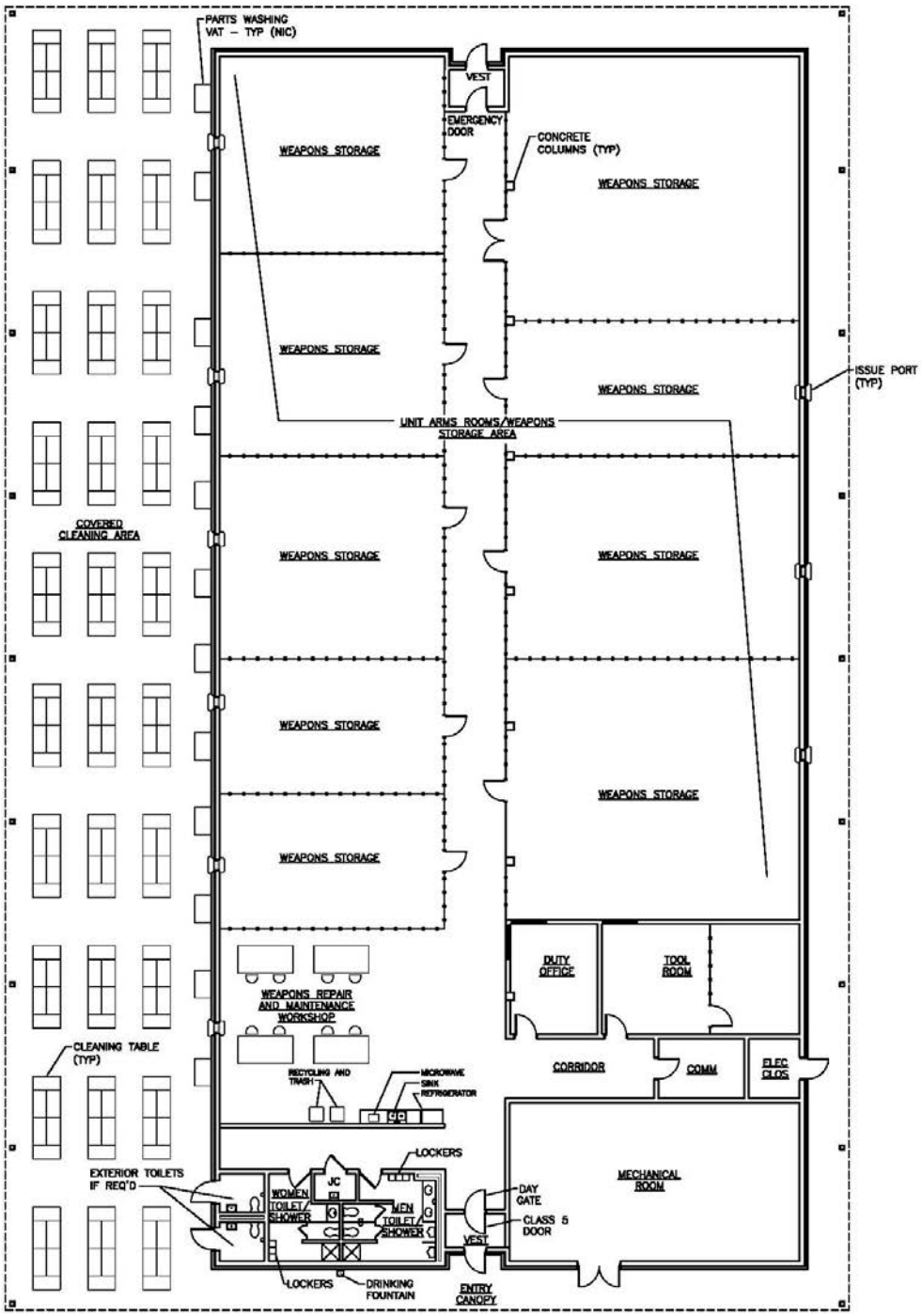
UFGS 23 09 23, *Lonworks Direct Digital Control for HVAC and Other Building Control Systems*

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APPENDIX B DRAWINGS

B-1 A PROTOTYPE ARMORY.

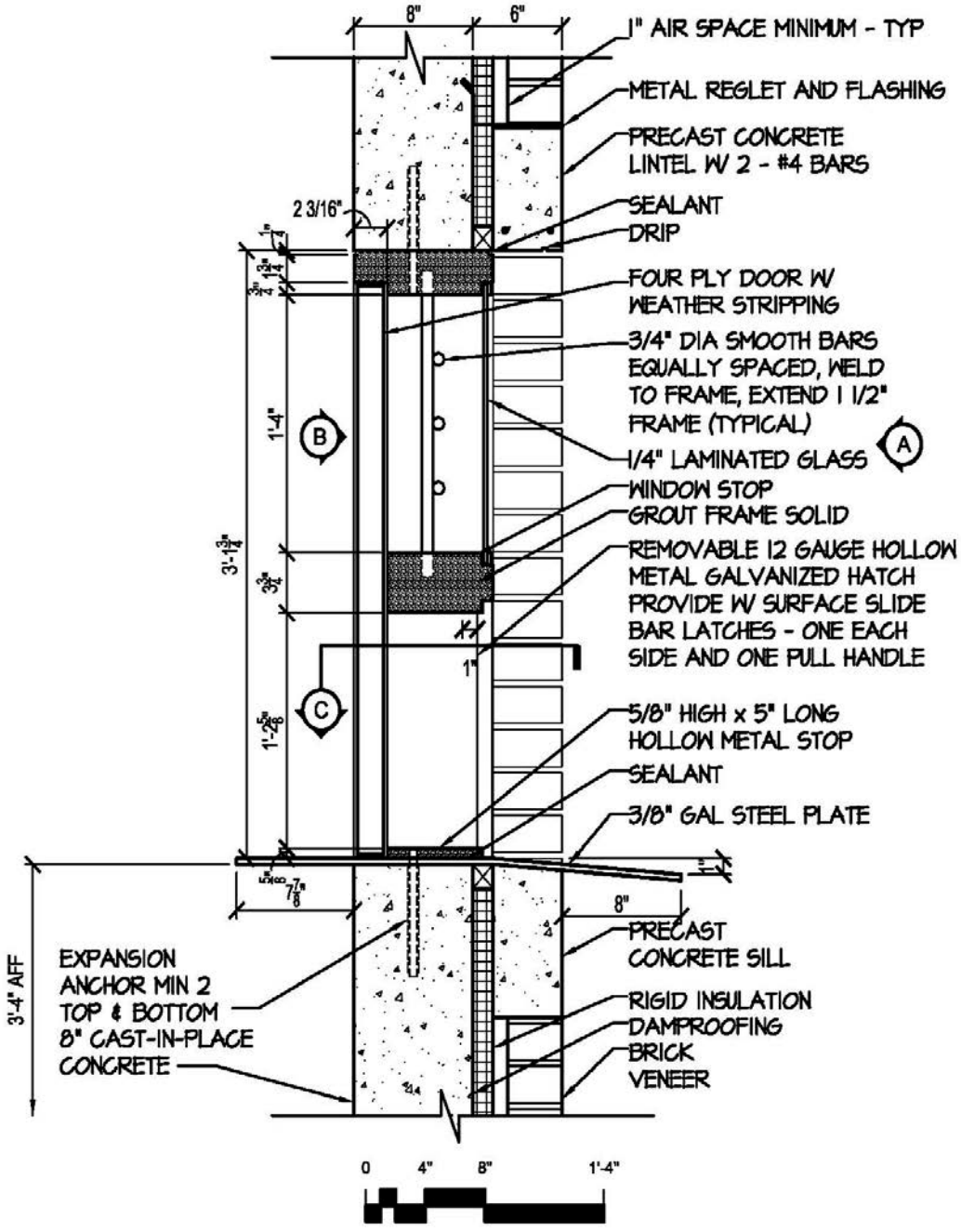
The plan below is a prototype armory plan.



B-2 ISSUE PORT.

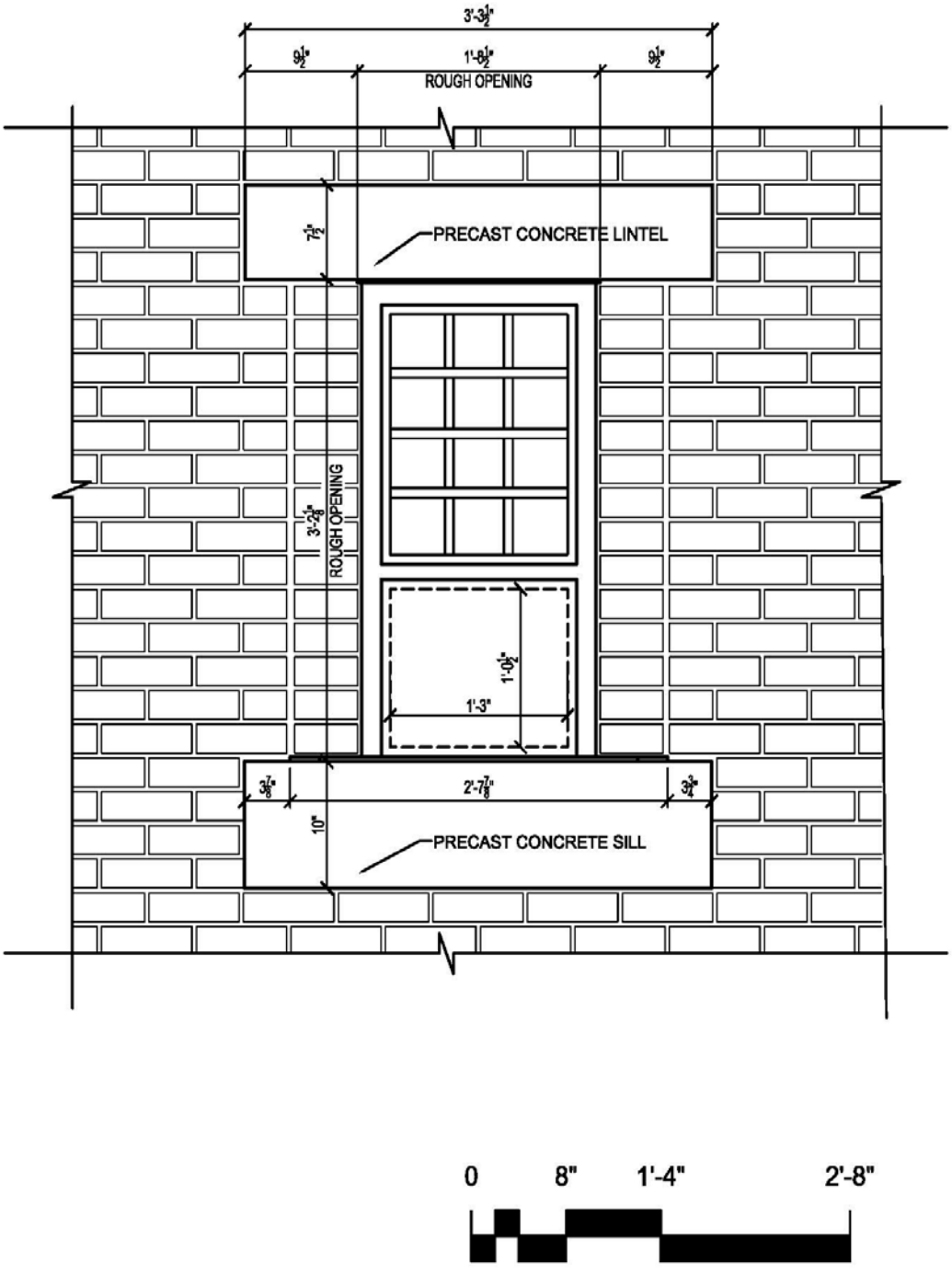
The drawings below are a preferred design for an issue port. All steel materials for the issue port must be hot-dip galvanized.

Wall Section at Issue Port

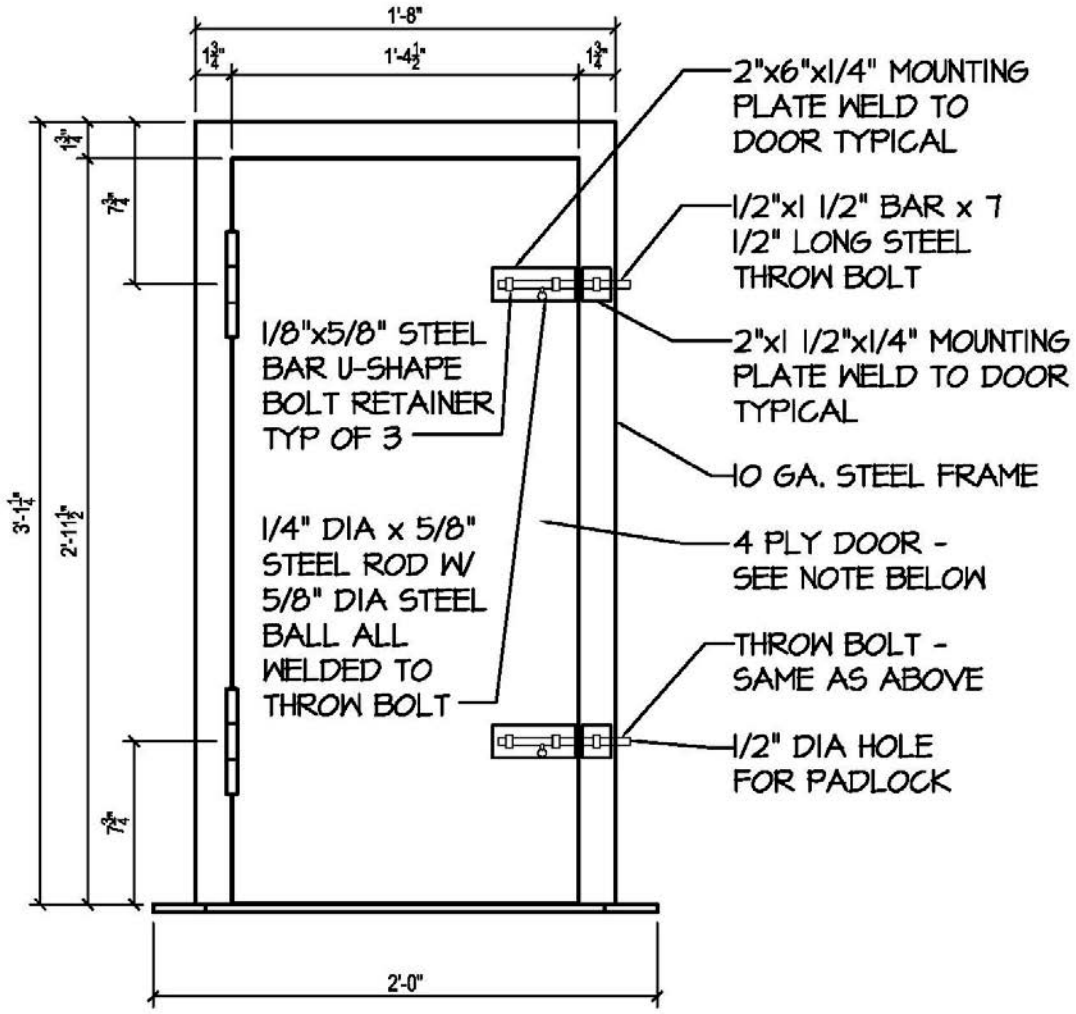


A. Exterior Wall Elevation of Issue Port

The issue port maximum opening is 190 square inches (15” x 12.5” = 187.5 sq in).



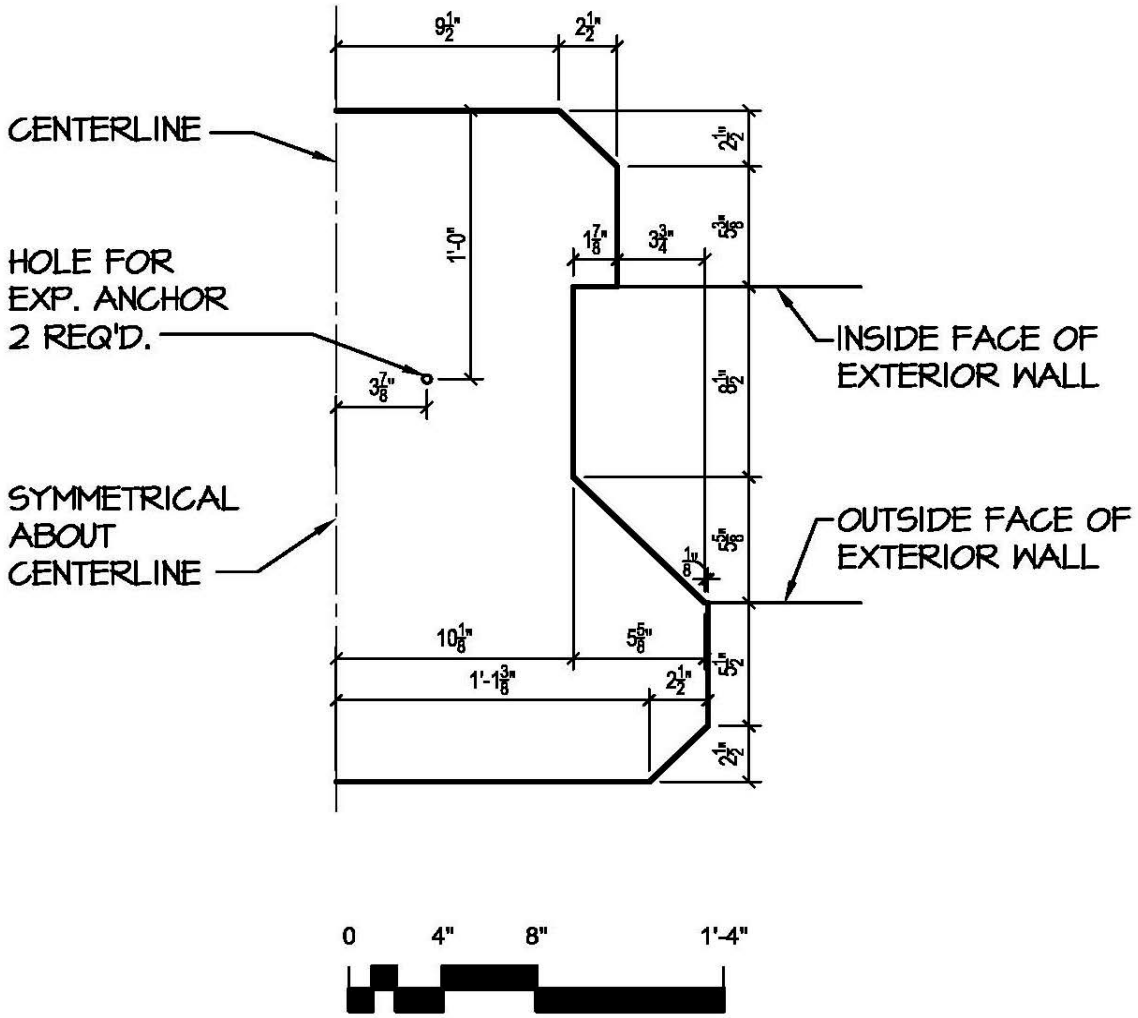
B. Inside Issue Port Door Elevation



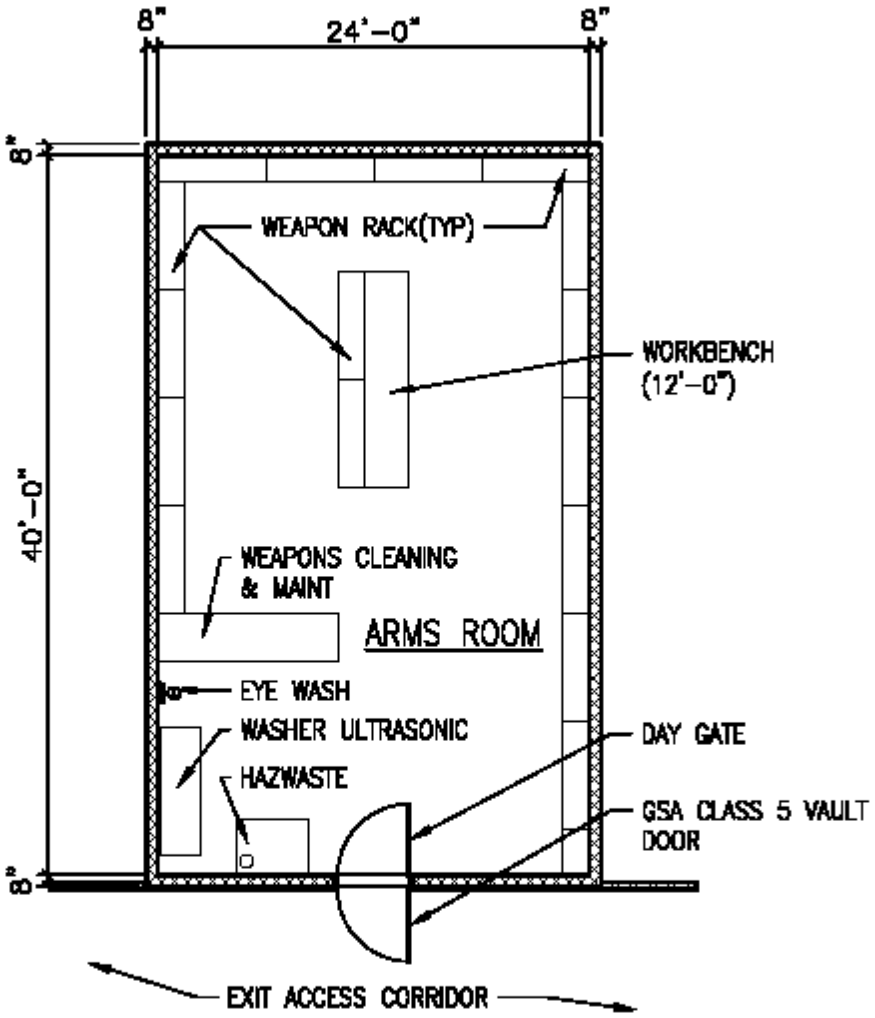
NOTE: 4-PLY DOOR CONSISTS OF 3/16" STEEL PLATE ON THE INSIDE OVER 1/4" POLYCARBONATE SHEET OVER 1 3/4" SOLID CORE WOOD WITH 10 GA. STEEL SHEET FACE PLATE AND EDGES



C. Issue port Half Plate Plan



B-3 TYPICAL ARMS ROOM.



TYP. ARMS ROOM LAYOUT
SCALE: 1/8" = 1'-0"

APPENDIX C GLOSSARY

ACRONYMS

AA&E	Arms, Ammunition and Explosives
AFCEC	Air Force Civil Engineer Center
AFI	Air Force Instruction
AFMAN	Air Force Manual
AR	Army Regulation
AT	Antiterrorism
BIA	Bilateral Infrastructure Agreement
C	Celsius
CCTV	Closed Circuit Television
cm	Centimeter
CMU	Concrete Masonry Unit
CONUS	Continental United States
DDC	Direct Digital Controls
deg	Degrees
DoD	Department of Defense
EMCS	Energy Management Control System
ESS	Electronic Security Systems
ETL	Engineering Technical Letter

F	Fahrenheit
Fed Spec	Federal Specification
FF&E	Furniture, Fixtures and Equipment
FOUO	For Official Use Only
GF	Government Furnished
GI	Government Installed
GSA	General Services Administration
GSF	Gross Square Feet
GWB	Gypsum Wallboard
H&S	Headquarters & Support
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
Ht	Height
HVAC	Heating, Ventilation and Air Conditioning
IAP	Installation Appearance Plan
IDG	Installation Design Guide
IDS	Intrusion Detection System
in	inch(es)
IT	Information Technology
LEED	Leadership in Energy and Environmental Design

m	Meter
MCO	Marine Corps Order
min	Minimum
mm	Millimeter(s)
NAVFAC	Naval Facilities Engineering Command
O&M	Operation and Maintenance
OCONUS	Outside Continental United States
psi	Pounds per square inch
RH	Relative Humidity
SF	Square Feet
SOFA	Status of Forces Agreements
sm	Square Meter
sq m	Square Meter
Sq ft	Square Foot (Feet)
sq	Square
SRC	Security Risk Categories
STC	Sound Transmission Coefficient
TV	Television

UFC	Unified Facilities Criteria
UFGS	Unified Facility Guide Specification
U.S.	United States

FC 4-218-01F
28 OCTOBER 2015
Change 2, 24 March 2025

FACILITIES CRITERIA (FC)

AIR FORCE CRITERIA FOR PRECISION MEASUREMENT EQUIPMENT LABORATORY DESIGN AND CONSTRUCTION

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FACILITIES CRITERIA (FC)

AIR FORCE CRITERIA FOR PRECISION MEASUREMENT EQUIPMENT LABORATORY DESIGN AND CONSTRUCTION

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AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by **\1** ... **/1/**) and **\2** … **/2/** .

Change No.	Date	Location
1	1 August 2020	Table 1-1b. Variance is defined in integer values of degrees C rather than in degrees F.
2	24 March 2025	Paragraphs 1-3 and 3-7.10.2; Table 4-8

This FC supersedes FC 4-218-01F, *Air Force Criteria for Precision Measurement Equipment Laboratory Design and Construction*, dated 28 October 2015.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://www.wbdg.org/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

AUTHORIZED BY:



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Director
Air Force Civil Engineer Center

FACILITIES CRITERIA (FC) CHANGE SUMMARY SHEET

Document: FC 4-218-01F, *Air Force Criteria for Precision Measurement Equipment Laboratory Design and Construction.*

Superseding: Facilities Criteria (FC) 4-218-01F, *Air Force Criteria for Precision Measurement Equipment Laboratory Design and Construction*.

Description: This FC prescribes Air Force criteria for design and construction of new Precision Measurement Equipment Laboratories (PMELs) and updates to existing facilities on Air Force installations. It incorporates the provisions of Unified Facilities Criteria (UFC) 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*, and UFC 3-401-01, *Mechanical Engineering.*

Reasons for Document:

- Supersedes FC 4-218-01F, incorporating Criteria Change Request (CCR) 7691.
- Provides a design guide for Architect and Engineering firms, design agencies, planners, and Air Force organizations for the design of PMEL facilities.
- Updates existing criteria to reflect new and revised industry standards.

Impact:

- Improves energy efficiency.
- Ensures that PMEL environmental systems provide temperature and humidity conditions that will enable performance of traceable measurements for Test, Measurement, and Diagnostic Equipment (TMDE).

Unification Issues:

- Design criteria for Air Force PMEL facilities are specific to accommodate Air Force-unique organizational and operational considerations.

Disclaimer:

- Use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This FC provides guidelines for evaluating, planning, programming, and designing PMEL Facilities. Alteration and renovation projects should update existing facilities to meet the guidance and criteria within budgetary constraints. This FC is not intended as a substitution for thorough review by individual Program Managers and Operations Staff in the appropriate agency. This FC is a guide for site selection and design of a new metrology laboratory or for modification of an existing facility. This FC outlines standards for design and construction of Type II and Type III PMELs.

1-2 REQUIREMENTS.

Requirements which directly affect the accuracy and integrity of the measurements made and are unique to a calibration laboratory are addressed. Criteria in this FC must not be used as sole justification for a new facility or to improve an existing facility if the facility's condition does not adversely affect the environmental requirements enabling performance of traceable measurements.

1-3 APPLICABILITY.

\2 This UFC follows the same applicability as UFC 1-200-01, paragraph 1-3, with no exceptions. **/2/**

1-4 USERS OF THIS DOCUMENT.

This FC is intended to be a source of basic architectural and engineering information for all individuals involved in the planning, design, and evaluation of PMEL facilities.

1-4.1 Architects and Engineers.

Architects and engineers (A/Es) who provide design services for PMEL facility construction or renovation will be under the direction of the AFCEC Facility Engineering Directorate.

1-4.2 Planning Personnel.

Planning personnel will use this FC along with other documents for programming new or replacement facilities, pre-design planning, or assessing the extent of improvements required in an existing or new PMEL in order to achieve the standard established herein.

1-4.3 Additional Users.

Additional users include:

- Headquarters staff, Air Force Installation and Mission Support

Center (AFIMSC) detachments, and Primary Subordinate Units (PSUs).

- Major command staff/regions.
- Installation commanders.
- Installation facilities management.
- Installation technical proponents.
- Program directors.
- Facility/program operations staff.

1-5 RESPONSIBILITIES.

1-5.1 Air Force Civil Engineer Center (AFCEC).

AFCEC establishes standards and criteria for Air Force PMEL design and construction and provides technical assistance to the design agents and base PMEL managers.

1-5.2 Air Force Metrology and Calibration (AFMETCAL).

AFMETCAL manages the Air Force Metrology and Calibration program.

1-5.3 Base Civil Engineer (BCE).

Ensures this FC is referenced in all PMEL project design documents, and reviews A/E Design Documents to ensure compliance. Hosts preplanning workshops prior to the development of programming documentation for new construction or upgrades.

1-6 SCOPE OF FACILITY.

The PMEL Facility is composed of the Administrative Area, the Calibration and Repair (C/R) Area and the Support Areas. The scope may vary depending on the location and mission requirements. All of the program areas are described in greater detail in Chapters 2 and 4. These criteria apply to Type II and Type III PMELs.

1-7 REFERENCES.

Appendix A contains a list of references used in this document. If the publication date of the code or standard is not included, use the latest available issuance of the reference.

1-8 GLOSSARY.

Refer to Appendixes B and C for definitions of acronyms, abbreviations, and terms.

1-9 PROGRAM AREAS.

1-9.1 Administrative Support, Calibration and Repair, and Support Area.

Tables 1-1a through 1-1d list the core and optional functional program areas for PMEL facilities. These functional program areas are administrative support, calibration and repair, support and special requirements. These are traditional for a typical PMEL, and core areas may be adjusted to accommodate mission requirements. The administrative support area includes equipment check-in, a service entrance, technical library, conference room, break room, and offices. The C/R area includes force and pressure measurement, equipment storage, azimuth reference, a temperature/humidity-sensitive area, a night vision area, and shield room, if survey indicates a need. The support area includes an equipment cleaning room, shipping and receiving, a liquid flow calibration area, and covered equipment area. A 68 degree room, if required, is a separate modular control module.

Table 1-1a. Functional Program Areas

Program Area	Description
Administrative Support Area	
Equipment check-in and check-out, vestibule, and lobby	Minimal entry space in front of control and/or vestibule. Usually combined with the waiting and equipment check-in and pickup. Include a customer service counter to separate the customer from the equipment storage and processing areas. Provide a waiting area with seating and computerized check-in as required for customers.
Service entrance	Service entrance (with canopy) for oversized equipment entry with sealed double doors between the calibration and repair area and the building exterior. Fully enclose the canopy to create an insulated entryway in extreme climates.
Conference room, classroom & training room	Conference room for meetings, planning, and classroom for training personnel.
Break room, copier, and work layout	Break area, copier, and layout space. Food and beverages. May have refrigerator and self-serve (vending). Include copy machine with electrical outlets and work table for drawings and paperwork and small storage area.
Restrooms/janitor supply room	Restrooms for PMEL staff/visitors and janitor supply room with supplies.
Technical library	Library containing technical orders (TOs), equipment descriptions, maintenance manuals, and Air Force manuals and instructions.
Offices	
Flight Chief/Site Manager’s office	Private office.
Laboratory Chief’s office	Private office
Administrative offices	Offices for administrative staff.
Quality Assurance Supervisor office	Private office

Table 1-1b. Functional Program Areas

Program Area	Description
Calibration and Repair (C/R)	

C/R area	This area is maintained under a positive pressure at specified temperature and humidity levels. Various functions occur within this area; some require specific areas or rooms. The C/R area includes: the shield room, technical library, force and pressure measurement, equipment storage, azimuth reference, and a 68 degree room, if required. A positive static pressure as compared to surrounding areas is required to prevent infiltration of dust-laden air. Excess ventilation air for pressurization and a continuous air barrier system to control infiltration and exfiltration in buildings to maintain air tightness is required. Air locks are required for entry into the C/R area. Locate the C/R area adjacent to other conditioned areas.
Temperature/humidity sensitive area	This is a special temperature/humidity sensitive controlled area for PMELs that do not have a requirement for a 68 degree room. The temperature and humidity requirements for this area are **1**\ 73 ± 1.8°F (22.8 ± 1°C) and a relative humidity of 35, +10/-15%. The temperature may not vary more than 1°F (0.5°C) in any one-hour period during normal system operation. Maximum temperature gradient across the room is 1.8°F (1°C). /**1**/
Force and pressure measurement area	Safety screens or shields may be required in the immediate vicinity of force and pressure calibration equipment to protect operators and other laboratory personnel from flying projectiles, high pressure gas, or fluids.
Night vision area	Night vision calibration area for testing under controlled conditions of lighting, temperature, and humidity. Calibration of the night vision ANV-126 test set should be done in a room with ambient lighting levels of less than 0.1 foot candle (1.08 lux) in the general area of the test set. The ANV-20/20 low light level calibration requires total darkness during the adjustment procedures for night vision test set calibration.
Shield room	Usually constructed of copper screening to minimize effects of excessive electromagnetic interference (EMI) or radio frequency interference (RFI), a shield room typically is not required unless EMI/RFI survey results indicate a need.

Table 1-1b. Functional Program Areas (Continued)

Program Area	Description
Calibration and Repair (continued)	
Azimuth reference	If an external azimuth reference line is required, the line can range in length up to one mile terminating at a target mount, depending on location. However, only a few selected PMELs are designated as azimuth verification facilities. The primary azimuth references are established within the facility by an optical target collimator located on an isolated pier. The directions of the external line and the normals to the collimator are determined by observing Polaris (the North Star) from outside the facility. Transfer of direction from Polaris and/or the line to the optical reference is accomplished using a precision theodolite. The PMEL verification facility is an environmentally-controlled facility. Facilities must be located to permit laying out unobstructed lines of sight to the target monument, ranging 45 degrees either side of astronomic north, and in an area relatively free from vibrational disturbances such as heavy local traffic. The test area in the PMEL must provide a steady state internal environment with regard to temperature and air movement. Since total darkness is necessary to conduct azimuth reference surveys, ensure appropriate lighting design is provided. Stable piers are provided for the optical reference collimator and temperature is maintained at 73 ± 6 °F (22.8 ± 3.3 °C) throughout the year.
Liquid flow calibration area	A specially-equipped, isolated area required in PMELs to perform liquid flow meter calibration using propylene glycol as primary test fluid. The enclosure housing a liquid flow calibration area must be constructed of non-combustible or fire resistive materials as defined by the National Fire Protection Association (NFPA). This generally refers to masonry, reinforced concrete, or protected steel construction. The facility also must be equipped with a minimum of two exits, separated to preclude both being cut off in the event of a localized fire. Ensure that doors swing out in the direction of egress per NFPA 101, *Life Safety Code* and NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*. Outward-swing exit doors are required where chemicals are used for testing. Floor space is determined by considering the type and number of flow calibrators needed for the mission. Double doors are required to facilitate installation of flow calibrator units. The liquid flow room is located outside the calibration and repair area.

Table 1-1c. Functional Program Areas

Program Area	Description
Special Requirements	
68 degree room (modular control module)	This is a special temperature controlled area in some PMELs where a 68 degree room is required to maintain a closely-controlled environmental area for calibration and use of higher-accuracy dimensional TMDE. These conditions can be maintained using an off-the-shelf, self-contained, environmental control module, as an option. The environmental control system must maintain 68 ± 1 °F (20° ± 0.5 °C) and an optimum relative humidity of 35, +10/-15%. The temperature may not change more than 1 °F (0.5 °C) in any one hour period during normal system operation.

Table 1-1d. Functional Program Areas

Program Area	Description
Support Area	
Equipment cleaning room	A specially-equipped and isolated area is required for cleaning and washing mechanical, electrical, and electronic equipment. The TMDE cleaning room is separate from the C/R area, and supplied with utilities for cleaning parts. Requirements for the area are determined by the types of equipment to be serviced. Each cleaning unit requires a minimum 15 ft^2 (1.4 m^2) additional floor space. A stainless steel sink and drain board with hot and cold water and exhaust hood is required. Provide an equipment canopy-type exhaust hood with a wall-mounted manual timer, with capability of variable operation up to 2 hours (i.e., twist type or similar occupant-controlled timer). Where a canopy-type hood would pull fumes into the breathing zone, consider installing a bench-style slot-type hood to pull fumes away from the breathing zone. The drying oven for standard cleaning rooms requires 212 cfm (6 m^3/min) for the purge blower intake and exhaust. Provide a vacuum port in the equipment cleaning room.
Shipping and receiving	A shipping and receiving area is required to facilitate loading and unloading of customer equipment for shipment and for short term storage. Install gasket-type stops, astragals, and automatic door bottoms on air lock doors located closest to the C/R area. Seal joints between doors and frames with gaskets.
Covered equipment area	Provide a protected entrance for unloading equipment: either a double-entry door with a drive-through canopy; or a service entry with a roll-up door large enough to allow a small truck or van to back into the unloading area. Quantity and size of equipment handled and weather conditions should determine which entry is appropriate. Consider a covered entry for extreme or cold weather.

CHAPTER 2 FUNCTIONAL REQUIREMENTS

2-1 DESIGN APPROACH.

The design criterion in this section simplifies construction or renovation to a wide variety of PMELs, including the basic requirements which apply to any PMEL. All Air Force construction projects, regardless of scope, shall comply with A7C Policy Memorandum*, "Air Force Sustainable Design and Development (SDD) Implementing Guidance*."

2-1.1 Structural, Mechanical, Electrical, and Plumbing Requirements.

Using the internal and site layouts, locate interfaces between the facility structure and equipment items. Verify the design contains openings, conduit, and raceways to install cables, equipment, and piping with minimum disruption to finished work. During the pre- design stages of the project, the PMEL supervisor must provide the design agent with technical data for any equipment which requires special connections.

2-1.2 The Commissioning Process and Verification of Operation.

The commissioning process ensures that a facility and its components will perform as designed and intended. Optimally, the commissioning process starts during planning and programming prior to design. It continues during design with review of design information, performance data in specifications, and evaluation of submissions. During construction, the commissioning process includes checklists, scheduling of tests, testing and verification, and documentation. Commissioning includes witnessing field tests, adherence to specified performance criteria. Commissioning of building systems is critical to ensuring their expected operation. Commissioning of heating, ventilation, and air conditioning (HVAC) systems must be provided by certified commissioning agents as required by UFC 1-200-02, *High Performance and Sustainable Building Requirements*, and construction documents must follow Unified Facilities Guide Specification (UFGS) 01 91 00.00 40, *Commissioning,* and UFGS 23 08 00.00 10, *Commissioning of HVAC Systems*. Performance testing must be conducted during both peak seasons to ensure compliance with functional and performance requirements as described for each space. Certified commissioning agents will have in-depth knowledge of commissioning processes and technical expertise on projects of similar scope, size, and complexity.

2-1.3 Environmentally Safe Materials and Indoor Air Quality.

Ensure that mission and user requirements, as well as occupant health and safety are considered during design, construction and operations for material selection and environmental systems. Hazardous materials used in the laboratory must be considered in the design. The user will provide the design agent a list of hazardous materials, including quantity, use, and location in the laboratory. Refer to UFC 1-200-02.

2-2 SPACE REQUIREMENTS.

The space requirements for PMEL office spaces and functional area rooms are found in Air Force Manual (AFMAN) 32-1084, *Facility Requirements*. The space requirements are based on the typical PMEL. The size of the PMEL varies depending on the inventory and type of facility (Type II or Type III).

2-3 FUNCTIONAL LAYOUT.

2-3.1 Functional Layouts for Overall Building.

Figures 2-1 through 2-4 show the functional layouts for the overall building, and the C/R, support, and administrative areas.

Figure 2-1 Overall Building Functional Layout

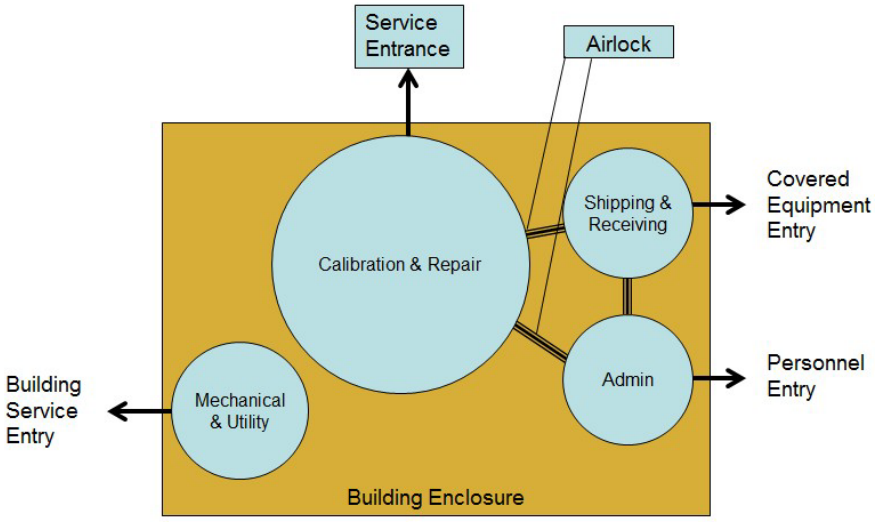


Figure 2-2 Calibration and Repair Area Functional Layout

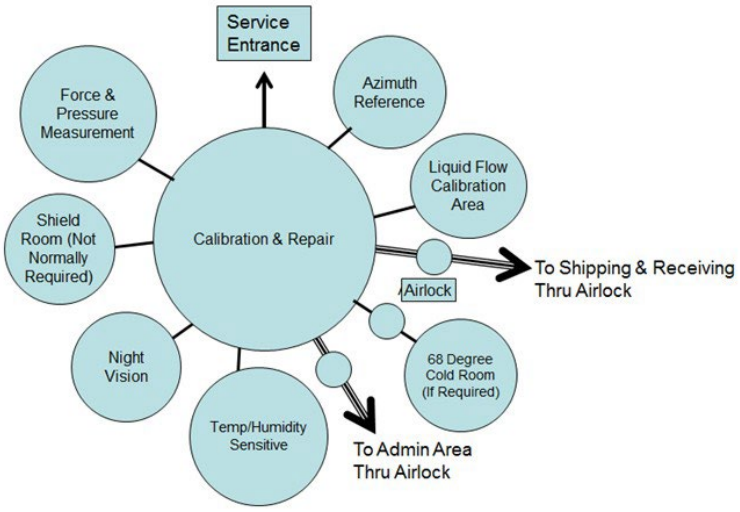


Figure 2-3 Support Area Functional Layout

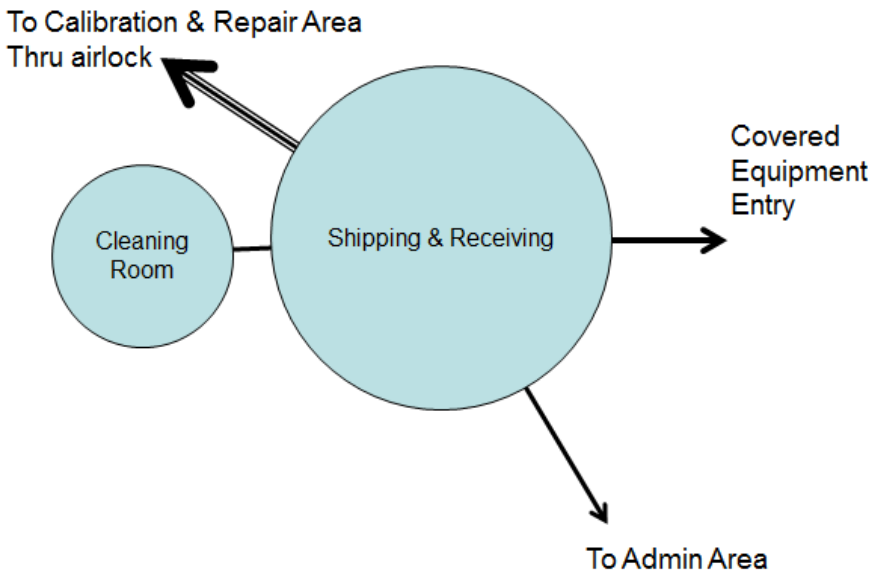
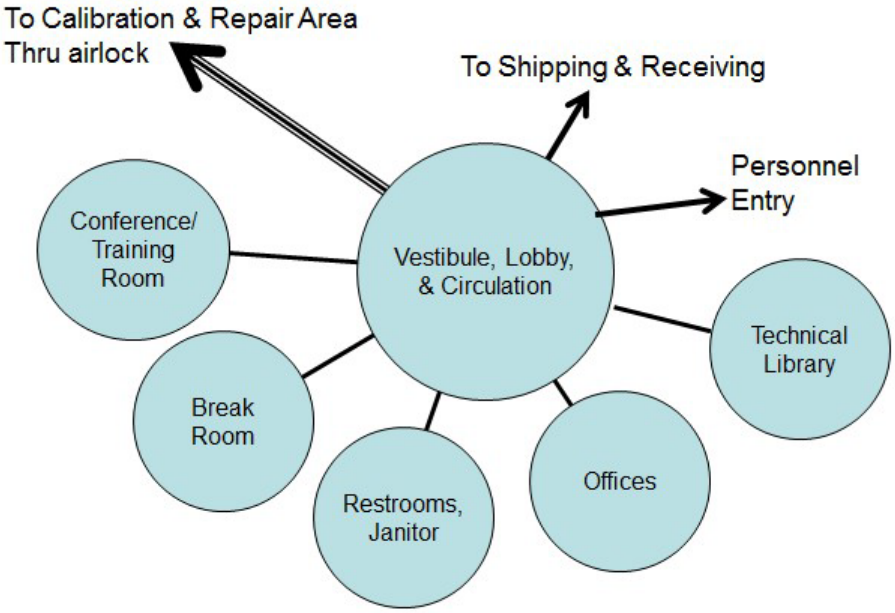


Figure 2-4 Administrative Area Functional Layout



2-3.2 Alterations to Existing Facilities.

Figures 2-1 through 2-4 illustrate acceptable layouts for the overall building. These layouts may have to be modified to accommodate alterations to existing structures. However, proposed modifications must be sent to AFMETCAL for approval. Existing

buildings being considered for modification should be assessed as to whether they can support all the core and optional spaces and dimensional requirements.

2-3.3 Other Considerations.

Consider the site of the existing facility and its limitations with regard to the PMEL requirements. Only permanent facilities should be considered for conversion to a PMEL facility. Ensure that existing buildings can accommodate the environmental temperature requirements of a PMEL facility.

Quantities of workload, physical size of workload, proposed workload, or expansion of workload are the primary factors in determining the design of PMEL support areas. From quantities of equipment that will be received, processed, and stored daily, initial floor space requirements can be estimated. Human engineering and the integration of other PMEL operations must be considered to determine location and layout of the support areas. Equipment storage areas must be isolated from visitors for security and to prevent unauthorized movement of equipment.

2-3.4 Location of Rooms, Spaces, and Equipment.

Locate rooms, spaces, and equipment to ensure orderly workflow, and provide security and property management. Incompatible areas should not be in close proximity; e.g., equipment that vibrates should not be near the C/R area when vibration may affect measurements. Moisture-generating areas such as restrooms and break rooms should not be near the C/R area. Limit outside walls in the C/R area as much as possible.

North and east exposures are preferred. Ensure traffic from movement of equipment, technicians, and customers are isolated from the C/R area. Where possible, design doors and air locks to allow movement of large PMEL equipment and appropriate material handling equipment within the facility. Whenever practical, locate the C/R area adjacent to other environmentally-conditioned areas.

CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *General Building Requirements*. UFC 1-200-01 provides guidance on applicability of model building codes, government-unique criteria for typical design disciplines and building systems, and guidance regarding accessibility, antiterrorism, security, high performance sustainability requirements, and safety. Use this FC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein. This chapter provides general criteria only and consists mainly of references to the technical design criteria documents and general considerations. Chapter 4 provides the specific design requirements for PMEL facilities.

3-2 STRUCTURE.

3-2.1 Foundation.

The foundation is site specific and must be designed upon known geotechnical considerations, by an engineer knowledgeable of the local conditions. Facilities must be located to permit laying out unobstructed lines of sight to the target monument, ranging from 45 degrees either side of astronomic north, which is specific to PMELs with Azimuth Reference only. Refer to UFC 3-101-01, *Architecture*, for additional guidance.

3-2.2 Vibration.

The PMEL facility site must be isolated from sources of vibration such as railroads, local heavy vehicle or aircraft traffic, crane or machine operations, foot traffic, or similar disturbances. An infrequently used option is constructing the facility below ground level. An acceptable vibration level for a PMEL is anything less than 10 µin (0.25 µm) displacement peak for frequencies from 0.1 to 30 Hz. The maximum acceleration peak is 0.001 g for frequencies from 30 to 200 Hz. To minimize vibration, apply the guidance in paragraphs 3-2.2.1 through 3-2.2.8.

3-2.2.1 Expansion and Isolating Joints.

Use expansion/isolation joints in the concrete floor on the outside toe of the walls defining the conditioned area to isolate the thermal mass of the floor and reduce vibration transmission. Use vibration isolating joints in the utility room where walls and floor adjoin the main structure.

3-2.2.2 Vibration Equipment Location.

Locate vibration-generating equipment such as blowers, compressors, heating and air conditioning units, vacuum pumps, and transformers on separate, isolated utility pads. Equipment that vibrates should not be located near the C/R area.

3-2.2.3 Specialized Shock Mounts.

Use specialized shock mounts, air bag supports, or isolated massive blocks.

3-2.2.4 Steel Spring Type Isolators.

Mount air conditioning equipment (condenser/compressor or fan coil units) to the structure using steel spring type isolators which limit vibration transmission to 0.001 g or less.

3-2.2.5 Flexible Boots.

Use flexible boots or connectors to reduce vibration transmission through ductwork, piping, and rigid tubing.

3-2.2.6 Rigid Conduit Contact.

Do not allow rigid conduit such as feeders, subfeeders, and their supports to contact other non-supporting objects.

3-2.2.7 Flexible Neoprene-Jacketed Conduits.

Use flexible neoprene-jacketed conduits for connections to vibration producing equipment. Install flexible bonding ground straps to ensure continuity of the ground.

3-2.2.8 Air Bearings and Isolators.

Use vibration isolators or air bearings mounted on workbenches and surface plates where extensive isolation techniques cannot be used. This will reduce vibration transmitted to sensitive instrumentation in contact with these surfaces.

3-2.3 Structural Elements in the Superstructure.

Use masonry walls, metal studs, steel joists, steel columns, and steel beams in the superstructure. Where possible, locate specially conditioned areas within the structure so the walls are interior partitions. The building must be single-story, ground floor, and concrete slab construction; exterior doors must not face prevailing winds. Ensure proper floor load bearing design to account for ancillary equipment. Interior partitions must extend above the vapor barrier of the ceiling.

3-3 EXTERIOR DESIGN.

In general, the building’s image, theme, and fixtures must be consistent with the functions offered. The building design should reflect the local geographical and cultural environment and comply with the appropriate Service and Installation architectural standards.

3-3.1 Exterior Finishes.

The exterior color, texture, and design should be consistent with the programs offered and the local environment in accordance with Installation standards. They should also be appropriate for the building type.

3-3.2 Entrances/Exits.

The main facility entrance to the lobby should serve as a welcome and transition point; elements such as a covered entry are very desirable. In cold climates, provide a canopy (or a recess) at required egress doors to ensure that doors can open completely without obstruction from snow and ice. The number and location of exits must comply with UFC 3-600-01, *Fire Protection Engineering for Facilities,* to preclude being cut off in the event of a localized fire.

3-3.2.1 Covered Equipment Entry.

Provide a protected entrance for unloading equipment: either a double-entry door with a drive through canopy; or a service entry with a roll-up door large enough to allow a small truck or van to back into the unloading area. Quantity and size of equipment handled and weather conditions should determine which entry is appropriate.

3-3.2.2 Service Entrance (Oversized Equipment Entry).

Where oversized equipment cannot be moved through the air lock, provide a set of tightly-sealed double doors between the C/R area and the building exterior. Equip doors with low leakage seals to prevent exfiltration from pressurized C/R areas. Provide a canopy to shield equipment and the laboratory from precipitation when moving oversized equipment in and out. Fully enclose the canopy to create an insulated entryway in extreme climates.

3-3.3 Exterior Walls and Mold.

Comply with current industry standards, UFC 3-101-01, and UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*, during design to help prevent the development of mold in exterior walls.

3-3.4 Doors and Windows.

Provide windows to allow natural light into the facility, considering antiterrorism and energy conservation/sustainable design issues (reference paragraphs 2-1 and 3-6). All windows and unused doors or other openings shall be sealed to prevent non-conditioned air infiltration and dust contamination from outside. Design and arrange doors opening into the PMEL to maintain effective dust and temperature controls. Minimize the number of doors for personnel passage consistent with fire and safety regulations.

3-3.5 Exterior Signage.

The main entrance should be equipped with a clearly visible sign that provides the program hours of operation. Ensure that signage complies with Installation requirements and UFC 3-120-01, *Design: Sign Standards*. Sign placement and type are site-specific, but signs must be strategically located, adequately lit, and of sufficient size to permit proper viewing by individuals approaching the facility.

3-3.6 Utility Rooms.

Mechanical equipment is usually housed separately from major electrical equipment, which should be located in a dedicated electrical utility room. It is critical that equipment fits the space without crowding and allows adequate space for maintenance. Designers should plan on equipment utilizing a minimum of 15 percent of the total structure area. Utility rooms must be structurally (seismically) separate from the rest of the PMEL building. Mechanical and electrical utility rooms must comply with UFC 3-401-01, *Mechanical Engineering*, UFC 3-501-01, *Electrical Engineering*, and UFC 3-520-01, *Interior Electrical Systems*.

3-4 INTERIOR DESIGN AND CONSTRUCTION.

Interior walls should be Type I or Type II construction as outlined in the International Building Code® using noncombustible materials. Interior walls and ceiling should be insulated and have as much thermal mass on the controlled area side of the wall as possible. If the wall is stud construction, use two layers of 5/8-inch (16-millimeter) gypsum board on the C/R side, with batt insulation, air barrier, and 1/2-inch (13-millimeter) gypsum board on the outside. Tape and seal all gypsum board and seal the sill plate. Good workmanship is essential in finishing each joint and seam of the walls to minimize air infiltration and exfiltration. Refer to UFC 3-101-01 for additional guidance. Interior construction should be extremely durable. Use no hollow core wood doors. All interior glass must be tempered safety glass and mirrors must be made of break-resistant materials. Do not place exterior windows (except for optical windows, as required) in the C/R area; however, sealed glass viewing ports may be installed in calibration areas to permit viewing without entering. Pass-through windows are not permitted.

3-4.1 Interior Wall and Ceiling Construction.

3-4.1.1 Vapor Barriers for Walls and Ceilings.

Vapor barriers usually are placed on the warm side of a wall and ceiling. If the primary method of environmental control is cooling, or if heating and cooling are used about equally, place the vapor barrier away from (outside) the conditioned area. This will reduce the probability of moisture buildup, and result in fewer penetrations of the vapor barrier, since most power outlets will be facing into the conditioned area. Where heating is the primary method of environmental control, place the barrier toward the inside of the wall and the ceiling. On concrete masonry units, use foil-face rigid insulation on the outside of the wall. Fur out and finish the wall. Install a vapor barrier underneath new floor slabs. Seal all penetrations in walls, ceilings, and floors.

3-4.1.2 Air Barrier Systems for Walls and Ceilings.

Provide a continuous air barrier system to control air infiltration and exfiltration in environmentally-controlled areas. The purpose of the air barrier is to make the walls and ceiling airtight with materials having a low air permeance or resistance to air flow, to seal the joints and penetrations, and to control air pressure relationships within the building. An air barrier must be provided between spaces that have either significantly different temperature or humidity requirements. Provide excess ventilation air for pressurization and a continuous air barrier system to control infiltration and exfiltration to maintain air tightness. Avoid selecting materials that are too air-permeable, such as fiberboard, perlite board, and uncoated concrete block in air barrier systems.

3-4.2 Clean Construction Protocol.

Cleanliness within a PMEL facility is necessary to: (1) protect precise measurement surfaces from abrasive damage caused by dust particles; (2) prevent contamination of fluids, chemicals, and metals used during the calibration process; although cleanliness and particle filtration requirements for most PMELS are not as stringent as for clean rooms, incorporating clean construction protocol (CCP) in design and construction contracts is recommended.

3-4.3 Interior Finishes.

Finishes should take into account the intended uses, be appropriately durable, and be low maintenance. Finishes should have good acoustical, noise reducing characteristics. All interior finishes must comply with UFC 3-600-01. Facility interior design must comply with Air Force corporate facilities standards, UFC 3-120-10, *Interior Design*, and Air Force interior design standards, as well as applicable installation or agency design standards and policies. Prepare surfaces to prevent, or at least reduce, dust accumulation. Clean concrete masonry thoroughly to remove dirt, fungus, grease, oil, glaze, loose particles, and scale. Fill voids to give a smooth surface without pits or holes. Repair joints, cracks, holes, and other surface defects in gypsum wallboard so the surface is flush and smooth. Where there are painted surfaces, use a smooth, non- chalking, mildew-resistant semi-gloss finish which will stand up to frequent cleaning.

Use light neutral tints, such as light blue or beige, to prevent eye fatigue, increase light reflectivity, and improve lighting efficiency.

3-4.4 Counters and Cabinets.

Counters, casework, and workbenches should be of high-quality and durable construction. Specify Architectural Woodwork Institute (AWI) Premium or Custom for finishes per *AWI Architectural Woodwork Standards*. Workbenches and surface plates mounted on vibration isolators or air bearings should be used in PMELs where extensive isolation techniques cannot be used. This will reduce vibration transmitted to sensitive instrumentation in contact with these surfaces.

3-4.5 Non-conductive Floor Covering.

Non-conductive floor covering has a minimum resistance of 1 x 10^9 ohms (1 giga-ohm). Non-conductive flooring is required to protect personnel servicing equipment where voltages up to 3,000 volts may be present. [Note: Vinyl flooring is inherently non- conductive, provided conductive materials (such as carbon, graphite, etc.) have not been added to reduce the resistance to modify it as either conductive (2.5 x 10^4 to 1 x 10^6 ohms) or static-dissipative (1 x 10^6 to 1 x 10^9 ohms)]. Sheet vinyl is recommended because its smooth, continuous surface simplifies daily cleanup including chemical and mercury spills. Epoxy resin flooring is a suitable alternative, provided it is non-conductive.

3-5 SITE DESIGN AND ORGANIZATION.

The site design and all exterior features must comply with the antiterrorism standards in paragraph 3-6.

3-5.1 Landscaping.

Refer to UFC 3-201-02, *Landscape Architecture*, for landscaping requirements and any base or agency design standards.

3-5.2 Parking and Access Drives.

Provide adequate parking for both staff and patrons with the appropriate access drives. Comply with UFC 3-201-02. Also refer to AFMAN 32-1084.

3-5.3 General Site Lighting.

Ensure that parking areas and the facility have adequate lighting for safety, evacuation, and security measures. Comply with UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*. Include parking and lighting requirements in final site plan.

3-5.4 Service Drive.

The size of required service vehicles should be verified by the designer prior to planning the service access areas. Provide a service vehicle apron and consolidate service access when possible.

3-6 ANTITERRORISM.

Refer to UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*, for antiterrorism requirements. Provide controlled access, including protection from unauthorized entry, and security for maintaining classified equipment and documents.

3-7 SERVICES.

3-7.1 Plumbing.

Design domestic hot and cold water, sanitary and storm drainage, propane, fuel oil, and natural gas systems to meet the requirements of UFC 3-420-01, *Plumbing Systems*, and local Installation standards.

3-7.2 Fire Protection.

Refer to UFC 3-600-01 for fire protection requirements. The PMEL facility must have a complete automatic sprinkler system and a fire alarm evacuation system conforming to UFC 3-600-01.

3-7.3 Lighting.

Provide lighting and control systems throughout the facility in accordance with UFC 3-530-01. Refer to Chapter 4 for specific lighting design criteria for each functional area.

3-7.3.1 Illuminance.

Facilities require a minimum uniform illumination, depending on the task requirement, calculated at the midlife of the tubes, as measured at bench level in the various areas. Light shall be evenly distributed to minimize glare, spectral reflection, and radiant heat to the extent that measurements are nominally unaffected by any of these parameters. Refer to TO 00-20-14, *Technical Manual: Air Force Metrology and Calibration Program,* for specific absolute minimum illumination levels in various PMEL rooms. The following areas should have a minimum 50 foot-candles (538 lux) design level: equipment storage, restrooms/toilets, janitor's closet, bench stock, stairways, corridors, halls, airlocks, elevators, shipping docks, and utility/storage rooms. Other areas in the PMEL not listed above will have a minimum 100 foot-candles (1076 lux) design lighting level.

Additional general lighting shall be used for tasks that are difficult to perform within the ambient light level. Other areas must conform to UFC 3-530-01. Provide zone lighting by work area when required, and locate switches near the air lock entrances. Motion sensor lighting is prohibited in the C/R areas. Provide lighting controls per ASHRAE Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, in areas not involved with the calibration process.

3-7.3.2 Emergency Lighting.

Provide emergency lighting in accordance with NFPA 101, Section 7.9. Evaluate the standard carefully, as its requirements may not include considerations for the unique layout and equipment configurations in a metrology facility. Installed emergency lights are recommended. Ensure emergency lights have a battery backup installed. If portable lights are mounted on the wall, locate an electrical receptacle near the light.

3-7.3.3 Hazardous (Classified) Area Lighting.

Class 1 Division 2 hazardous area light fixtures should be used in hazardous (classified) areas housing pressurized flammable liquids. Protect luminaries located above hazardous classified areas as required in NFPA 70, Article 501, Section 130, (B)(1) through (B)(3).

3-7.4 Electrical.

Provide electric service, distribution equipment, wiring receptacles, grounding, interior and exterior lighting, control, emergency lighting, telephone, communication systems, fire alarm, other health and safety alarms, and intrusion systems in accordance with NFPA 70, UFC 3-520-01, and the latest Installation design requirements. Service grounding system and all wiring methods must meet the current NFPA 70 requirements. All service equipment must be Underwriters Laboratories (UL) listed. Alternately, published proof from an approved independent testing laboratory may be provided.

3-7.4.1 Voltage Regulation.

Voltage drop of the building wiring system will not exceed 3% to any outlet. Provide outlets for technical testing with regulating equipment to maintain voltage within ±2 percent of the basic voltage, except 28 Vdc, which will be regulated to ±3%. Time constant (response time) of the voltage regulators should not exceed 0.3 seconds, and total harmonic distortion must not exceed 5%. Power conditioning and continuation interface equipment (PCCIE) must be supplied by the using agency.

3-7.4.2 Types of Electrical Power.

Normally, electric service will be provided at 480 Vac, 3-phase, 60 Hz. Table 3-1 lists possible PMEL power requirements for testing. This list does not include lighting and air conditioning requirements. Power demand varies depending on the workload of the individual PMEL. The PMEL superintendent will assist the Base Civil Engineer in determining power requirements and equipment heat loads, and identifying any special mission requirements. Design 400 Hz distribution systems to the requirements of UFC 3-555-01N, *400 Hertz Medium Voltage Conversion/Distribution and Low Voltage* Utilization *Systems* (note: motor generator is not real property installed equipment [RPIE]).

Table 3-1. Power Requirements for PMEL Facilities Testing

Nominal System Voltage	Phase	Frequency
277/480	1 & 3	50/60 ± 1 Hz
120/240	1 & 3	50/60 ± 1 Hz
120/208	1 & 3	50/60 ± 1 Hz
208 or 240	1	50/60 ± 1 Hz
120/240	1 & 3	400 ± 10 Hz
120/208	1 & 3	400 ± 10 Hz
28	DC	N/A
220/240	1 & 3	50/60 ± 1 Hz

3-7.4.3 Tagging and Labeling.

Tag or label electrical power outlets, connectors, or receptacles with a technical description of the type or amplitude of a voltage source, the power rating, and phase or connection scheme, and indicate the breaker servicing them.

3-7.4.4 Wiring Installation.

Install electrical wiring in metal raceways, concealed but accessible, in attics, plenums, or utility housings. Install wiring for frequencies greater than 60 Hz in nonferrous raceways and label with the correct frequency. Extend utilities into the C/R area within utility chases concealed in walls and partitions. Do not use under-the-ceiling utility services. Direct overhead utility connections to workbenches and stations are permitted if the most feasible and economical and if the design minimizes dust collection. Use gaskets and seals to maintain room pressure and prevent dust infiltration where ducts, pipes, and conduit penetrate walls.

3-7.4.5 Grounding.

Install grounding in accordance with the National Electrical Code, and Air Force Instruction (AFI) 32-1065, *Grounding Systems*. The resistance to ground of the service ground must be 10 ohms or less. Where 10 ohms cannot be obtained with basic electrode configuration due to high soil resistivity, rock formations, or other terrain features, consider alternate methods for reducing the resistance to earth. Power the C/R area from (an) isolation transformer(s) with an electrostatic shield between the primary and secondary windings installed as a separately derived system as close as practical to the loads. A table, bonded at each end to a static bus bar, may be used in place of the equipotential plane, as appropriate.

3-7.4.6 Electromagnetic Interference/Radio Frequency Interference (EMI/RFI).

The amount of EMI/RFI generated by nearby overhead high voltage lines, radio and TV transmitters, and microwave antennas determines the suitability of a site, and the extent of internal facility shielding required. Most building sites not close to sources of EMI/RFI will meet the electromagnetic requirements for PMELs, since average

magnetic field in the vicinity of overhead electrical distribution lines drops off rapidly with distance. However, EMI from overhead high voltage power lines, radio/TV transmitters and aircraft operations may introduce calibration errors. With maximum currents of up to 243 amperes, average maximum field exposure is approximately 13.53 milligauses at zero feet (zero meters) and 2.48 milligauses at 100 feet (30.5 meters). These levels of exposure would be acceptable for most laboratories. EMI/RFI levels should be reevaluated whenever generators are installed after a PMEL is operational. If excessive EMI/RFI is suspected, contact AFMETCAL.

3-7.4.7 Internal Electromagnetic Interference (EMI/RFI) Control.

Within the laboratory itself, interference suppression should include RF-shielded lenses, ballast RF suppressors, and power line filters for fluorescent lighting. EMI/RFI is best controlled by following the guidance in Military Standard (MIL STD) 188-124B, *Grounding,* Bonding*, and Shielding for Common Long Haul Tactical Communication Systems Including Ground Based Communications - Electronics Facilities and Equipments*; MIL STD 188-125-1, *Department of Defense Interface Standard: High-Altitude Electromagnetic Pulse (HEMP) Protection for Ground-Based C4I Facilities Performing Critical, Time-Urgent Missions*, *Part 1*, *Fixed Facilities*; Military Handbook (MIL HDBK) 419, *Grounding, Bonding, and Shielding for Electronic Equipment and Facilities*; and MIL HDBK 423, *High-Altitude Electromagnetic Pulse (HEMP) Protection for Fixed and Transportable Ground-Based C4I Facilities*.

3-7.4.8 Electrical Outlets and Cabling.

Computer network, intercom, and telephone conduits and outlets should be installed during construction at enough locations to meet current layout and future expansion needs. Cabling should be installed in conduit in the walls, and in metal raceways above suspended ceilings. A doorbell should be installed on the customer entry door. Electrical power loads should not be on the same circuits providing electricity to the calibration areas.

3-7.4.9 Emergency Electrical Power Disconnects.

Emergency electrical power switches or disconnects are recommended at a central location in every room of the calibration area. They should be well-marked, unobstructed, and have a lockout feature. Electrical power switches should not turn off the overhead lights.

3-7.4.10 Electrical Receptacles.

Location and type of electrical receptacles must match the purpose of the equipment served and comply with the National Electrical Code (NEC). It is recommended to locate electrical receptacle high on the wall for portable emergency lights and at mid-wall level for connecting to work benches located along the walls. Do not use the common 60 Hz, 120 Vac receptacles for 28 Vdc, 50 Hz, or 400 Hz services. Install receptacles in accordance with NEC Articles 406, 501, 502, 503, and 647 as shown below:

- Install sufficient number of receptacles and circuits to allow for future changes in layout due to relocation or addition of new measurement systems.

- Install general-use receptacles so that they are accessible every four feet. Do not install a general purpose receptacle in the center of a wall where large equipment or furniture is typically located. Do not install more than six duplex receptacles on a single circuit and situate circuits so that each room has access to at least two circuits.

- Install and mark receptacles in hazardous locations in accordance with NEC Articles 501, 502, and 503.

- Determine placement of special-use receptacles by the location of equipment to be supported. Provide one additional circuit above work benches to allow for future expansion of work bench or services. Mark special-use receptacles in accordance with NEC Article 647.7.

3-7.4.11 Main Power Panels or Services.

If possible, especially in locations having frequent inclement weather, no two adjacent receptacles should be on a single circuit.

3-7.4.12 Backup Power.

Provide a means for connecting a portable backup power unit to serve critical circuits within the PMEL. Use a double-throw switch; and, if feasible, provide a matching plug and receptacle approved by the Base Civil Engineer. Locate the switch for easy access by a power unit. Comply with isolated neutral requirements in NEC 250-5(d), *Alternating-Current Circuits and Systems to be Grounded, Separately Derived Systems*.

3-7.4.13 Electrical Utility Room.

Install electrical facility equipment such as transformers, power distribution systems, frequency converters, rectifiers, and voltage regulators in the utility room. The 28 Vdc power supply and the 400 Hz motor-generator or frequency converter will be provided by the using agency and installed by the contractor. Follow applicable portions of the NEC and Occupational Safety and Health Administration (OSHA) standards. Provide PCCIE for testing and powering sensitive electronic equipment. The using agency (PMEL) must obtain PCCIE through the PCCIE program office, AFLCMC/HBZBD, 6039 Wardleigh Road, Building 1206, Hill AFB UT 84056, (801)-777-5752. PCCIE maintenance is the responsibility of the using agency.

3-7.4.14 Antenna Ports.

An antenna port must be installed in a PMEL facility during construction. Port location is dependent on the location of certain instruments (e.g., precise time (GPS) receivers).

Antenna port penetrations through the walls in the C/R area should be properly finished and sealed to prevent loss of positive pressure.

3-7.5 Communications and Data.

A phone and intercom system is required to allow two-way conversation between rooms in the PMEL facility. Provide conduit runs and terminal boxes to support the intercom, telephone, and computer systems as part of facility design. Include data outlets in walls, recessed floor boxes, and offices to provide internet connection for work areas.

Confirm the technical design requirements for the phone and intercom system with the Laboratory Manager. Provide local area network (LAN) internet connections to work benches for access to technical manuals and maintenance procedures as required.

3-7.6 Alarm System.

Provide an alarm system for intrusion detection to protect equipment and assets. The calibration area environment shall have an alarm system which will relay an alarm when the temperature or humidity is out of tolerance. Provisions for an alarm system must be identified during the planning/programming process.

3-7.7 Heating, Ventilating, and Air Conditioning (HVAC).

Design the HVAC system to meet the requirements of UFC 3-401-01, UFC 3-410-01, and UFC 3-410-02, *Lonworks® Direct Digital Control for HVAC and Other Local Building Systems*.

3-7.7.1 HVAC Design Criteria.

Climatic design criteria will be obtained from UFC 3-400-02, *Design: Engineering Weather Data*. Systems will be designed and sized to maintain space temperature and humidity requirements at the following ambient load conditions:

- The 0.4% dry bulb temperature and the corresponding mean coincident wet bulb temperature.
- The 1% humidity ratio and the corresponding mean coincident dry bulb temperature.
- The 99% dry bulb temperature and the corresponding mean coincident wet bulb temperature.

3-7.7.2 HVAC Systems Required.

Provide separate HVAC zone controls to meet the environmental requirements of the following areas: C/R, administration, support, and shipping and receiving. Provide HVAC system(s) specific to the building (i.e., NOT connected to a central system servicing other buildings). Where a 68 degree room is required, a modular environmental enclosure system can be considered as an option.

3-7.8 HVAC Design Considerations.

3-7.8.1 Equipment Heat Gain.

The using agency must provide the test and measurement equipment specifications, approximate equipment location, and use patterns so that heat gains can be accurately estimated during the predesign stages of the project.

3-7.8.2 Design Analysis.

The HVAC design analysis for new facilities or renovation of existing facilities must include a psychometric analysis documenting that the system meets the PMEL design criteria. The analysis must provide calculations of system cooling load, energy/mass transfer through conditioning equipment and fans, and a system schematic indicating the dry bulb and wet bulb temperatures (or humidity ratios) of outside air, mixed air, supply air, and return air flow streams. The cooling load for this analysis must be based on the load conditions as previously identified. Refer to UFC 3-401-01 and UFC 3-410-01 for details on HVAC design analysis. Provide capability to tie into the base-wide Energy Management Control System (EMCS), if available.

3-7.8.3 Ventilation Air.

Supply ventilation air to satisfy UFC 3-410-01 given the number of occupants and to provide for air exhausted from hoods, etc., to meet the positive pressure requirements for the rooms and the building as a whole. Integrate static pressure monitoring of individual rooms to ensure proper control of ventilation air. See paragraph 3-7.9.5 regarding use of a dedicated outdoor air system. Refer to UFC 3-410-04N, *Industrial Ventilation,* and UFC 3-410-01, for further details on ventilation air systems.

3-7.8.4 Ventilation Filtering.

Filter ventilation air before it enters an air handler, heat recovery equipment, or preconditioning equipment. Use extended media filters with a Minimum Efficiency Reporting Value (MERV) of 8 or greater, in accordance with ASHRAE 52.2-2012, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*.

3-7.8.5 HVAC Zone Design.

Provide single zone controls to isolate environmental requirements for each major PMEL area. Size the cooling coils for each space to maintain the required temperature and relative humidity under the location design conditions listed in UFC 3-400-02. Determine the minimum acceptable room air change rate from UFC 3-410-01. The design requirement is to provide an even temperature, consistent with required temperature gradients, throughout the controlled spaces.

3-7.8.6 Air Distribution.

Design the air distribution system to circulate air throughout the facility to prevent stratification. Use non-unidirectional air flow pattern control. Specifications apply within the space 3 feet to 4.9 feet (0.9 meter to 1.5 meters) above the floor (working area); air velocity in the working area must be 25 ± 9.8 fpm (7.6 ± 3 meters per minute). Keep noise level below 45 dB as measured by a meter meeting ANSI/ASA S1.4, *American National Standard Electroacoustics – Sound Level Meters*. Locate heat-generating equipment (such as temperature baths) to prevent heat buildup; also isolate high-heat-generating equipment to maintain temperature within required limits. Localized exhaust may be used for this purpose, provided makeup air requirements do not adversely affect system operation. Locate and select supply air diffusers to ensure even-conditioning of the space. Locate return air grills above heat producing equipment to quickly remove excess heat and minimize temperature fluctuations.

3-7.8.7 HVAC System Response.

The system must heat, cool, humidify, and dehumidify as required at all anticipated flow rates. Design and construction documents must specify: the maximum difference in temperature and humidity between supply air and room air (to establish the rate of change of the room environment); and the number, type, and location of room thermostats and humidistats and how the environmental system should respond to their signals. Duct design should not rely on adjusting dampers on diffusers or grills for control because of the effect on air distribution patterns. Where required, provide dampers inside ducts and install access panels.

3-7.8.8 Air Locks for Calibration and Repair (C/R) Area.

Access into the C/R area is only through air locks. Provide a shoe cleaner at the entrance to the air lock, including a grounded touch pad to dissipate electricity. Use a minimum 6-foot (1.8-meter) -wide air lock at the entrance to the C/R area, with a door opening at least 5 feet (1.5 meters) wide to accommodate large equipment. The air lock must be at least 9 feet (2.7 meters) long to ensure both sets of doors are not open at the same time. Door interlocking systems are not necessary. Double doors are preferred (exception: a sliding door may be used). If double doors are used, install a pair of 3-foot (0.9-meter) -wide double doors to allow movement of large pieces of equipment when necessary. Do not position air lock doors in-line with building entry doors. Air lock doors must have 24- by 30-inch (610- by 760-millimeter) shatterproof glass vision panels (or the closest standard size that fits) and bumpers to prevent equipment and cart damage. Air will flow from the C/R area through the air lock toward the administrative or shipping and receiving areas. Install gasket-type stops, astragals, automatic door bottoms on air lock doors located closest to the C/R areas, and a properly sized grille above the inside air lock doors to permit air flow through the air lock. Seal joints between doors and frames with gaskets.

3-7.8.9 Modular Environmental Enclosure Considerations.

Provide an off-the-shelf, self-contained, environmentally-controlled module where a 68 degree room is required, as an option. Typically, they are more cost effective and

provide better environmental control for the stringent environmental requirements. Their self- contained environmental system provides temperature and relative humidity control, and dust particle filtration. The modular structure is normally installed inside the PMEL, but separate from the C/R area. Before contracting construction of a modular environmental enclosure, consider: (1) size (fits the space); (2) possible vibration and electromagnetic interference; and (3) volume and type of work to be processed. The environmental enclosure system should include the following line items as shown in Table 3.2.

Table 3-2. Modular Environmental Enclosure Design Considerations

Design Features
External duct work, plumbing, wiring, painting, and testing as part of the installation
An electrical supply system providing protection from voltage surges, spikes, or transient noise.
Control equipment with good earth ground.
A suitable drain for condensate disposal in the fan-coil area.
A smooth concrete floor for the enclosure installation, with maximum deviation in the horizontal plane of 3/8 in (9.5 mm).
Non-conductive vinyl floor covering.
If required for the humidification system, a year-round supply of potable water operating at a flow rate and pressure required by the system.

3-7.9. HVAC Equipment Selection.

3-7.9.1 Maintainability.

To ensure maintainability, select and locate equipment to provide adequate access for servicing, filter replacements, and coil removal.

3-7.9.2 Moisture Carryover.

To preclude moisture carryover, coil face velocities must not exceed 550 fpm (167.6 m/min).

3-7.9.3 Cooling Coil Characteristics and Performance Requirements.

Specify cooling coil characteristics and performance requirements in the construction bid documents. These requirements include total cooling capacity, sensible capacity, coil design entering and leaving air conditions (wet and dry bulb temperatures), design airflow rate, face velocities, coil sensible heat ratio, and entering chill water temperature.

3-7.9.4 Dehumidification and Energy Consumption.

Select equipment that will meet the design requirements for dehumidification and provide the lowest life cycle cost and energy consumption.

3-7.9.5 Dedicated Outdoor Air System (DOAS).

DOAS systems should be considered, with other options, for humidity control and supplying ventilation air, especially in high-humidity areas. The DOAS supplies a volume of preconditioned makeup/outside ventilation air to the calibration areas of the PMEL. The system must be equipped with heating and cooling (chilled water/glycol) coils and controls to temper outside air to a neutral dry bulb temperature and regulate humidity levels. In some climates, an air-to-air heat exchanger may be beneficial to precondition makeup air. Humidity in non-administrative areas will be controlled by regulating the humidity in the outside/makeup air system. Coils must meet 99% design conditions. Ensure that DOAS systems are designed to handle both the ventilation and zone-generated latent loads. In humid areas, the amount of conditioned outside air required to dehumidify the calibration areas (see Figure 2-2) may exceed the amount required for ventilation and makeup. In these cases, a portion of the return air can be drawn through this system and dehumidified with the outside air stream. To facilitate inspection and cleaning of coils, install access doors between coils, and ensure coils are no more than eight rows deep. Also consider using desiccants in areas of high humidity. Refer to UFC 3-410-01 for further design details.

3-7.9.6 Ducted Return Air System.

Provide a fully-ducted return air system. Use of the space above the ceiling as a plenum is not allowed.

3-7.9.7 Piping Insulation.

Insulate piping with an operating temperature below dew point with jacketed insulation meeting the cold piping requirements of UFGS 23 07 00, *Thermal Insulation for* Mechanical *Systems*. The insulation jacket must be sealed to provide an exterior vapor barrier.

3-7.9.8 Maintenance Access.

Sufficiently safe access space must be provided for the maintenance of valves, variable air volume (VAV) boxes, dampers, controls, and other HVAC components.

3-7.9.9 Equipment Compliance with Design.

Construction specifications must provide documentation that HVAC equipment submittals for proposed equipment are in compliance with the design specifications. Design calculations should recognize the effect of brief deviations in outside temperature and humidity beyond those listed. Careful application of the weather data

found in UFC 3-400-02 is essential to develop designs that meet critical environmental control requirements. The designer should optimize the selection of cooling equipment to take into account all aspects of performance, reliability, maintainability, and capital and maintenance costs. Calculate equipment sizing as described in UFC 3-410-01.

3-7.9.10 Chilled Water Equipment Selection.

A chilled water system with reheat is the recommended option to maintain required temperature tolerances in PMELs. A central building chilled water system with modulating control is most satisfactory for the required 40 to 42 °F (4.4 to 5.5 °C) water. The optimum supply and return water temperature differential must be determined by life cycle cost analysis. Select compressors that are the most efficient over the range of anticipated loads.

3-7.9.11 Recording Devices, Monitoring and Alarms.

Temperature and humidity must be monitored and recorded continuously, and pressure must be monitored. The recording system must be continuous, and use self-contained sensors/recorders, or remote sensors with centrally-located recorders. Sensors are required in each separate room in the calibration area, and a minimum of one set of sensors for every 2000 ft^2 (186 m^2) of calibration area. When selecting recording devices, consider accuracy and response time; critical environments require immediate response and high accuracy. Mount sensors in the center of the room away from walls, vibration, sunlight, and supply air diffusers, as near as possible to the most critical area of measurement. If the PMEL facility is monitored by a base-wide EMCS system, the system will transmit an alarm when any space goes out of tolerance for temperature, humidity, or pressure. Notice of the alarm will be communicated by automatic notification back to PMEL staff. Both the recording device and the alarm system will indicate real time. All sensors, including wall-mounted assemblies, will be removable for calibration. Refer to TO 00-20-14.

3-7.9.12 Accuracy of Recording Devices.

The following requirements apply to temperature and humidity recorders:

- Recording devices monitoring 68 °F (20 °C) C/R areas must be accurate to a minimum of ± 0.5 °F (± 0.28 °C), ± 5% RH.
- Recording devices monitoring 73 °F (22.8 °C) C/R areas must be accurate to a minimum of ± 2.0 °F (± 1.11 °C), ± 5% RH.
- Recording devices must be calibrated across the full range for the area being monitored.
- If a computerized system is used to record environmental data, the time between data samples shall not exceed 15 minutes.
- Daily or weekly charts must be used when not using computerized or roll type recording devices.

3-7.9.13 Room Filtration.

The 68 degree room must have a filtration system which satisfies a particle count not exceeding 700 particles per ft^3 (24,700 particles per m^3) of atmosphere, 5 microns and larger; and 100,000 particles per ft^3 (3,530,000 particles per m^3) of atmosphere, 0.5 microns and larger. Accurately describe filter installation to ensure easy access and quick changing of filters, minimizing air system shutdown. Install diaphragm-activated draft gages with remote audible alarms across all filter banks to signal when filter replacement is required. (Reference UFC 3-410-01 for details on filter requirements.)

For all other spaces, air filters will have a MERV of 8 when tested by an acceptable atmospheric dust spot test. (Reference ANSI/ASHRAE 52.2-2012.)

Add filter specification and installation requirements to the maintenance manual for the building.

3-7.10 Compressed Air and Nitrogen Systems.

3-7.10.1 Compressed Air and Nitrogen Supply.

Compressed air and nitrogen must be supplied considering the requirements for the type and number of flow calibrators necessary to accommodate the workload. Compressed air delivered to flow calibrators must be of instrument quality conforming to the requirements of ANSI/ISA-S7.0.01, *Quality Standard for Instrument Air*.

Compressed nitrogen must conform to the requirements of Defense Logistics Agency (DLA) A-A-59503A (Commercial Item Description) *Nitrogen, Technical*, Type I, Class I Grade B. Service must be adequate to support the simultaneous operation of all major systems in the facility. Refer to NFPA 55, *Compressed Gases and Cryogenic Fluids Code*, for safety considerations for compressed air and nitrogen gas.

3-7.10.2 Compressed Air Quality.

Use oil-free, dry, compressed air for technical use in the C/R area. Compressed air for the equipment cleaning room must be supplied from an oil-free compressor. The compressed air supplied to the cleaning stations must have an adjustable regulator with a 0-35 psig range at the stations. Compressed air must conform to ANSI/ISA S7.0.01, with minimum pressure of 120 psig (827 kPa). The pressure of compressed air used at work benches should be reduced with a precision valve and a 0-827 kPa gauge.

Compressed air quality for technical use in the C/R area or for operating TMDE must satisfy operating manuals for the TMDE to be serviced. In no case will the oil content of compressed air be greater than 24 ppm (wt) and the compressed air no greater than -40 °F (-40 ºC) atmospheric dew point. (For more information on atmospheric dew point, refer to the latest version of ASHRAE's *Fundamentals* Handbook, chapter

on psychrometrics). Reduce the line pressure at the work stations, generally to 15 psig (103 kPa), depending on mission requirements. This quality may be achieved using dryers fitted with appropriate pre-filters or coalescent air filters that remove oil and particulates. Provide an in-line oil monitor to check quality. Supply a refrigerated dryer for high flow requirements. Minimum filter requirement for equipment cleaning areas for the incoming airline is 75 microns. All air lines into the laboratory must have an automatic blow-down valve ahead of each filter. Each top connection and line tie must lead off the top of the line. The number of outlets and total capacity may vary by individual laboratory; but normally, a minimum 20 scfm (9.4 L/s) is needed. Each PMEL organization will determine specific requirements and incorporate them into the design criteria. Install the air compressor in the utility room as **2**\ furniture, fixtures, and equipment (FF&E) /**2**/ and size it to satisfy total facility requirements. Mark compressed air lines to show pressure and appropriate piping color code for the service.

3-7.10.3 Dry Nitrogen.

Water-pumped dry nitrogen (oil free) is required for technical use. It must conform to DLA A-A-59503A. Install dry nitrogen cylinders in the utility room. Piping run to the C/R area must be rated at 1600 psig (11032 kPa). Mark nitrogen lines to show pressure.

Review design requirements to determine the number of lines required.

3-8 SUSTAINABLE DESIGN.

Use an integrated approach to the planning and design of PMEL Facilities that minimizes energy consumption and optimizes life cycle cost renewable energy possibilities. Comply with the guidance in UFC 1-200-02, which addresses Air Force sustainable policy.

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CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-1 PMEL FUNCTIONAL AREA DESIGN CRITERIA.

This chapter identifies the specific design requirements for each functional area. Tables 4-1 through 4-13 provide this data in a standard Functional Data Sheet format.

Table 4-1. Administrative Offices

Description/ Usage	The administrative offices consist of a mix of private and open office space. Locate the site manager's office and the administrative staff near the main laboratory entrance to control building access and to receive visitors. Generally speaking, the following office spaces are provided: Flight Chief or Site Manager, Laboratory Chief, Administrative and support staff, and Quality Assurance Supervisor. The main laboratory entrance is usually combined with a waiting and equipment check-in and pickup area. Refer to AFMAN 32-1084 for office space sizes and requirements.
Min. Ceiling Ht.	9 ft (2.74 m) finished ceilings to provide a finished surface and to conceal conduits
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. Static dissipative carpet may be added for offices. **Ceiling.** Acoustical Ceiling Panels (ACP). Provide air-tight, dust-tight ceiling access panels for environmental system balancing and required maintenance. **Windows.** Where possible, locate offices on exterior wall and provide windows for natural light admission.
Plumbing	Drinking fountain.
HVAC	Reference the most recent Air Force or installation policy on temperature set points for HVAC systems.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Ensure an adequate number of circuits to power all equipment. Provide standard duplex outlets in closed offices as required. Install additional outlets for data, telephones and to operate shared equipment such as printers, fax, etc.
Lighting	100 foot-candles (1076 lux) ambient lighting.
Communication	**CCTV.** None required. **CATV/Internal Video:** None required. **PA/Audio.** One speaker, with controls in the Flight Chief's/Site Manager's office. **Telephone.** One line per staff plus one additional line for fax and copier. **Data.** One outlet per staff plus one outlet for each printer, copier, scanner, etc. **Security.** None required.
Casework/Built-in Equipment	A custom-built customer service counter to separate customer incoming equipment storage from the completed equipment storage and calibration areas.
Furnishings Fixtures & Equipment (FF&E)	**Private Offices**—Furniture for 120 ft^2 (11 m^2) or 100 ft^2 (9.3 m^2) office: desk, credenza, filing cabinet, desk chair, and two side chairs. **Workstations**—Furniture for 64 ft^2 (6 m^2) workstation: desk chair and side chair for open offices. Workstation systems furniture must provide adequate space for filing and overhead storage.
Special Requirements	Side lights next to the office doors for supervision and security.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers
Min. net ft^2 (m^2)	

Table 4-2. Conference Room/Training Room

Description/ Usage	This space is used as a conference and training room for related PMEL business. In sizing the room, consider number of personnel that will use the room; and training aids and furnishings required. Locate near the Flight Chief's/Site Manager's office and provide space for special PMEL projects.
Min. Ceiling Ht.	9 ft (2.74 m)
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. Static dissipative carpet may be added. **Ceiling.** ACP; air-tight, dust-tight ceiling access panels for environmental system balancing and required maintenance.
Plumbing	None required.
HVAC	Reference the most recent Air Force or installation policy on temperature set points for HVAC systems.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Ensure an adequate number of circuits to power all equipment. Provide standard duplex outlets in closed offices as required. Install additional outlets for data, telephones and to operate equipment such as printers, fax.
Lighting	100 foot-candles (1076 lux) ambient lighting. Provide dimmable recessed lighting for training purposes.
Communication	**CCTV.** Outlets as required for coverage. **CATV/Internal Video.** One outlet as required. **PA/Audio.** One speaker. **Telephone.** One line with conference room capability. **Data.** Minimum of one outlet. Consider providing additional outlets for training purposes for internet data connection. **Security.** None required.
Casework/Built-in Equipment	Storage closet for training materials and audio-visual cart. Provide an electrically operated retractable screen, a built-in computer projector, and conference call capability.
Furnishings Fixtures & Equipment (FF&E)	CCTV cameras per the outlet count. Tables, chairs, bulletin board with tack surface and dry-erase board. Consider providing overhead projector, printer, and TV, VCR, and DVD player.
Special Requirements	Consider the acoustics of the space and features to eliminate potential distractions. Provide a minimum sound transmission coefficient (STC) rating of 50 to 55. Provide a vision panel in the door.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers
Min. net ft^2 (m^2)	

Table 4-3. Shipping, Receiving, and Equipment Storage

Description/ Usage	Shipping and receiving area dedicated to customer support for test items. Includes control counter to receive and pickup test items. Install equipment storage area in conjunction with shipping and receiving.
Min. Ceiling Ht.	10 ft (3.05 m)
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. **Ceiling.** ACP; air-tight, dust-tight ceiling access panels for environmental system balancing and required maintenance.
Plumbing	Work sink with hot and cold water connections and a floor drain.
HVAC	Reference the most recent Air Force or installation policy on temperature set points for HVAC systems
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Outlets per code and additional outlets as necessary to operate any dedicated equipment.
Lighting	100 foot-candles (1076 lux) ambient lighting.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** One speaker. **Telephone.** One line with internal two-way communication. **Data.** One outlet per staff member, plus one outlet for each printer, copier, scanner, etc. **Security.** None required.
Casework/Built-in Equipment	Work bench(s) within the storage area for equipment inspection and review. Secure storage area for equipment, tools, supplies, and test items. Include adequate shelving, bins, and open end cubicles to store equipment. Install additional areas as required for storage, depending on volume of workflow.
Furnishings Fixtures & Equipment (FF&E)	None required.
Special Requirements (Covered Equipment Area)	A protected entrance for unloading equipment: either a double-entry door with a drive-thru canopy; or a service entry with a roll-up door large enough to allow a small truck or van to back into the unloading area. The quantity and size of equipment handled and weather conditions should determine which entry is appropriate.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers
Min. net ft^2 (m^2)	

Table 4-4. 68 Degree Room

Description/ Usage	Where a 68 degree room is required, provide an area in the PMEL, with utilities, to install an off the shelf modular environmental control module. The 68 degree room is used to maintain a closely-controlled environmental area for calibration and use of higher accuracy dimensional TMDE.
Min. Ceiling Ht.	10 ft (3.05 m)
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. **Ceiling.** ACP; air-tight, dust-tight ceiling panels for environmental system balancing and required maintenance.
Plumbing	None required.
HVAC	68 ± 1 °F (20 ± 0. 6 °C) and an optimum RH of 35, +10/-15%. The temperature may not vary more than 1 °F (0.6 °C) in any one hour period during normal system operation. Maximum temperature gradient across the room is 2 °F (1.1 °C). A minimum positive static pressure of 0.05 inch of water (12.5 pascals) compared to ambient pressure is required to prevent infiltration of dust-laden air.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Outlets per code and additional outlets as necessary to operate any dedicated equipment.
Lighting	100 foot-candles (1076 lux) ambient lighting using permanent overhead-recessed vapor-proof/dust-resistant fixtures sealed with gaskets to prevent air or moisture leakage and dust accumulation/intrusion from the interstitial area.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Onespeaker. **Telephone.** One line with internal two-way communication. **Data.** One LAN Internet connection per work bench, and a WLAN signal, if required. **Security.** None required.
Casework/Built-in Equipment	Work bench(s) within the storage area for equipment inspection and repair.
Furnishings Fixtures & Equipment (FF&E)	Modular environmental enclosure system will be provided, per user requirements, to meet environmental requirements. The modular structure is normally erected inside the building, along with the environmental control system, electrical system, laboratory equipment, and furniture. Typically, the modular system is more cost effective based on life cycle cost.
Special Requirements	The 68 degree room must have a filtration system which satisfies a particle count not exceeding 700 particles per ft^3 (24,700 particles per m^3) of atmosphere, 5 microns and larger; and 100,000 particles per ft^3 (3,530,000 particles per m^3) of atmosphere, 0.5 microns and larger. Design the filter installation to ensure easy access and quick changing of filters, minimizing air system shutdown. Install diaphragm-activated draft gages with remote audible alarms across all filter banks to signal when filter replacement is required.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers
Min. net ft^2 (m^2)	

Table 4-5. Calibration and Repair (C/R) Area

Description/ Usage	This area is maintained under a positive pressure at specified temperature and humidity levels. Air locks are required for entry into the C/R area. Locate the C/R area adjacent to other conditioned areas. Use only oil-free, dry, compressed air.
Min. Ceiling Ht.	10 ft (3.05 m)
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. **Ceiling.** ACP; air-tight, dust-tight ceiling panels for environmental system balancing and required maintenance.
Plumbing	None required.
HVAC	73 ± 6°F (22.8 ± 3.3 °C) for Type II and Type III PMELs. Size cooling coils to maintain an optimum operational RH level of 35, +10/-15%. Refer to UFC 3-400-02. A minimum positive static pressure of 0.05 inch of water (12.5 pascals) compared to ambient pressure is required to prevent infiltration of dust-laden air. Exhaust ventilation systems must accommodate the fume hoods over the temperature calibration baths.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Outlets per code and additional outlets as necessary to operate any dedicated equipment, such as printers, fax, etc.
Lighting	100 foot-candles (1076 lux) ambient lighting using permanent overhead-recessed vapor-proof/dust-resistant fixtures sealed with gaskets to prevent air or moisture leakage and dust accumulation/intrusion from the interstitial area.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Onespeaker. **Telephone.** One line with internal two-way communication. **Data.** One LAN internet connection per work bench plus an outlet for printer/copier/ scanner. Ensure WLAN signal is available, if required. **Security.** None required.
Casework/Built-in Equipment	Work bench(s) within the storage area for equipment inspection and repair.
Furnishings Fixtures & Equipment (FF&E)	A monolithic surface of gypsum or plaster construction with finished joints between the walls and ceiling. If the wall is stud construction, use two layers of 5/8-in (16-mm) gypsum board. Install compressive base sill plate seals under all walls enclosing this area. Tape and seal all wall and ceiling penetrations (conduit, pipe, duct and light fixtures, etc.) to ensure positive pressure in the area.
Special Requirements	Air locks: Use a minimum 6 ft- (1.8 m-) wide air lock at the entrance to the C/R area, with a door opening at least 5 ft (1.5 m) wide to accommodate large equipment. Install gasket-type stops, astragals, and automatic door bottoms on airlock doors located closest to the C/R Area. Seal joints between doors and frames with gaskets.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers.
Min. net ft^2 (m^2)	

Table 4-6. Temperature/Humidity Sensitive Area

Description/ Usage	This is a special temperature/humidity sensitive (T/H S) controlled area for PMELs that do not have a requirement for a 68 degree room.
Min. Ceiling Ht.	10 ft (3.05 m)
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. **Ceiling.** ACP; air-tight, dust-tight ceiling panels for environmental system balancing and required maintenance.
Plumbing	None required.
HVAC	The temperature and humidity requirements for this area are 73 ± 2 °F (22.8 ± 1.1 °C) and an RH of 35, +10/-15%. Though room temperature may vary by 4 °F (2.2 °C), the temperature may not vary more than 1 °F (0.5 °C) in any one hour period during normal system operation. Maximum temperature gradient across the room is 2 °F (1.1 °C). A minimum positive static pressure of 0.05 inch of water (12.5 pascals) compared to ambient pressure is required to prevent infiltration of dust-laden air.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Outlets per code and additional outlets as necessary to operate any dedicated equipment.
Lighting	100 foot-candles (1076 lux) ambient lighting using permanent overhead-recessed vapor-proof/dust-resistant fixtures sealed with gaskets to prevent air or moisture leakage and dust accumulation/intrusion from the interstitial area.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Onespeaker. **Telephone.** One line with internal two-way communication. **Data.** One LAN internet connection per work bench plus an outlet for a printer, copier, and scanner. Ensure WLAN signal is available, if required. **Security.** None required.
Casework/Built-in Equipment	Work bench(s) within the storage area for equipment inspection and repair.
Furnishings Fixtures & Equipment (FF&E)	A modular clean room may be provided to meet these requirements. Modular environmental enclosure systems are available as controlled laboratories for high precision metrology. The self-contained environmental system provides temperature and relative humidity control, and dust particle filtration. The modular structure is normally erected inside a building, along with the environmental control system, the electrical system, laboratory equipment, and furniture.
Special Requirements	None required.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers.
Min. net ft^2 (m^2)	

Table 4-7. Liquid Flow Calibration Area

Description/ Usage	A specially-equipped, isolated area required in PMELs to perform liquid flow meter calibration using propylene glycol. Ensure that doors swing out in the direction of egress per the NFPA 101. Determine floor space by considering the type and number of flow calibrators necessary for the mission. Include space for work benches, tool storage, and systems furniture as required.
Min. Ceiling Ht.	10 ft (3.05 m), or high enough to reasonably clean mission equipment.
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. **Ceiling.** ACP; air-tight, dust-tight ceiling panels for environmental system balancing and required maintenance.
Plumbing	Supply chilled water considering the requirements of flow calibrator heat exchangers. Minimum service consists of 20 gpm (75.7 L/min) of 40 ± 5 °F (4.4 ± 2.7 °C) water for a low flow liquid flow calibrator and 25 gpm (94.6 L/min) of chilled water for a high flow liquid flow calibrator supplied using 1.5 inch tubing.
HVAC	Ventilate the area according to the requirements of 29 CFR 1910, *Occupational Safety and Health Standards*. Provide a ventilation rate of not less than 1 cfm per square foot of solid floor area. Temperature requirement is 73 ± 6 °F (22.8 ± 3.3 °C) and an RH of 35, +10/-15%. A minimum positive static pressure of 0.05 inch of water (12.5 pascals) as compared to ambient pressure is required to prevent infiltration of dust-laden air.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Outlets per code and additional outlets as necessary to operate any dedicated equipment. Each liquid flow calibrator requires a 3-phase, 208V, 20 amp outlet.
Lighting	100 foot-candles (1076 lux) recessed vapor-proof/dust-resistant fixtures.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** One speaker. Provide an emergency call/alarm in the liquid flow calibration area. **Telephone.** One line per staff. **Data.** LAN internet connections and ensure WLAN signal is available, if required. **Security.** None required.
Casework/Built-in Equipment	Install double doors to facilitate installation of large liquid flow calibration units and test equipment. Two sizes of liquid flow calibrators may be installed: low flow liquid flow calibrator footprint: 1.9 ft x 6.3 ft (0.6 m x 1.9 m); high flow liquid flow calibrator footprint: 2.17 ft x 13.9 ft (0.67 m x 4.24 m). The number of calibrators may vary from one to four, depending on mission.
Furnishings Fixtures & Equip. (FF&E)	Furniture for 64 ft^2 (6 m^2) workstation: desk chair and side chair for open offices. Workstation systems furniture must provide adequate space for filing and overhead storage.
Special Req.	Supply utilities, services, furnishings, tools, and equipment, including the following: Compressed air, cleaning system, exhaust system, work bench with lipped stainless steel top that drains into the sink, and a vacuum port. Supply oil-free dry compressed air at 80 psig (552 kPa) and 75 gpm (284 L/min) for a low flow liquid flow calibrator and 80 psig (552 kPa) and 150 gpm (568 L/min) for a high flow liquid flow calibrator.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers.
Min. net ft^2 (m^2)	

Table 4-8. Equipment Cleaning Room

Description/ Usage	A specially-equipped and isolated area required for cleaning and washing of mechanical, electrical, and electronic equipment. Install a drying oven meeting the requirements of the standard PMEL cleaning room. Install a bench type slot hood or canopy hood to remove fumes from calibration baths and gas monitors
Min. Ceiling Ht.	10 ft (3.05 m), or high enough to reasonably clean mission equipment.
Finishes	**Walls.** Ceramic wall tile or other hard surfaces approved for the cleaning room. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductivematerial. **Ceiling.** ACP; air-tight, dust-tight ceiling panels for environmental system balancing and required maintenance.
Plumbing	Hot and cold water supply piping and floor drain with mercury trap to be connected to the government supplied cleaning system and utility sink..
HVAC	Reference most recent Air Force or installation policy on temperature set points for HVAC systems. Exhaust ventilation systems must accommodate the fume hoods over temperature calibration baths. Install a bench style slot hood to pull fumes away from the breathing zone where a canopy type hood would allow fumes into the breathing zone. The drying oven requires 212 cfm (6 m^3/min) of room air for the purge blower intake and exhaust.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Dedicated 120/240 Vac single-phase 20 amp circuit hard-wired to a government- or contractor-supplied electronic drying oven with disconnect switch. This circuit should not be connected to the electrical distribution system serving the calibration area.
Lighting	100 foot-candles (1076 lux) ambient lighting using permanent overhead-recessed vapor-proof/dust-resistant fixtures sealed with gaskets to prevent air or moisture leakage and dust accumulation/intrusion from the interstitial area.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** One speaker and an emergency call/alarm in the equipment cleaning room that sounds at the control counter in the event of an emergency. **Telephone.** None required. **Data.** None required. **Security.** None required.
Casework/Built-in Equipment	Install a cleaning unit and drying oven in the equipment cleaning room. Each cleaning unit or drying oven requires 15 ft^2 (1.4 m^2) of floor space. See the Power and HVAC sections above for electrical and exhaust requirements.
Furnishings Fixtures & Equip. (FF&E)	Install a built-in eye-wash system for safety requirements. A vacuum port will be provided in the equipment cleaning room. Install a deep industrial sink and work bench with lipped stainless steel top that drains into the sink. **2**\ Properly size air compressor to meet facility requirements. /**2**/
Special Req.	Locate the cleaning and washing area outside the calibration area. Supply utilities, services, furnishings, tools, and equipment, including the following: compressed air with oil-free compressor, cleaning system, drying oven, and exhaust vent system. Install a vacuum port in the equipment cleaning room.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers.
Min. net ft^2 (m^2)	

Table 4-9. Copy/Work/Break Room

Description/ Usage	This space is used as a staff workroom for copying, meetings, breaks, and lunches.
Min. Ceiling Ht.	9 ft (2.74 m)
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. Static dissipative carpet may be added for copy/ work/break room. **Ceiling.** ACP; air-tight, dust-tight ceiling panels for environmental system balancing and required maintenance.
Plumbing	Two-compartment countertop sinks with hot and cold water supply. Floor drain. If an icemaker is desired, provide a cold water connection.
HVAC	Reference the most recent Air Force or installation policy on temperature set points for HVAC systems
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Outlets per code; one additional outlet at counter height for convenience; additional outlets necessary to operate dedicated equipment such as the copier, fax machine, printers, coffee machine, refrigerator, time clocks, microwave, and various other office machines.
Lighting	100 foot-candles (1076 lux) lighting fixtures with dimmable lights.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Onespeaker. **Telephone.** One line. **Data.** Outlets as required for equipment. **Security.** None required.
Casework/Built-in Equipment	Two separate solid-surface countertops: one for food/break functions and one for administrative functions as required
Furnishings Fixtures & Equipment (FF&E)	Copier, fax machine, printers, table, chairs, microwave, coffee machine, refrigerator, bulletin board with tack surface, dry-erase board, and other office equipment as required.
Special Requirements	Locate copy/work/break room on exterior wall and provide windows for natural light admission. Provide a vision panel in the door.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-10. Public Toilets/Janitor's Closet

Description/ Usage	These toilet rooms are used primarily by visitors, PMEL staff, and customers checking in or picking up equipment. They should be located near the main laboratory entrance in the waiting room and equipment check-in and pickup area.
Min. Ceiling Ht.	9 ft (2.74 m)
Finishes	**Walls.** Epoxy or enamel painted moisture-resistant gypsum wall board with a ceramic tile wainscot. Consider full ceramic tile walls with integral patterns. Use a dark-colored epoxy grout. **Floor.** Ceramic tile with integral patterns. Use a dark-colored epoxy grout. **Ceiling.** Epoxy or enamel painted moisture-resistant gypsum board. None needed for janitor's closet.
Plumbing	Wall-hung water closets, wall-hung urinals and lavatories based on the applicable code for the calculated occupancy of the laboratory. Floor drain and a keyed hose bib.
HVAC	Ventilate exhaust to the outside per code. Provide 8 to 12 air changes per hour.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Outlets per code.
Lighting	50 foot-candles (538 lux) lighting fixtures
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Onespeaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Casework/Built-in Equipment	Solid-surface countertop with either underhung or integral sink. Solid composite toilet and urinal partitions. Consider permanent ceramic-tile partitions. Toilet accessories: toilet paper dispensers, paper towel dispenser with integral trash receptacle, robe hooks, grab bars, sanitary napkin disposal (female water closet stalls), seat cover dispensers, and soap dispensers. Mirror.
Furnishings Fixtures & Equipment (FF&E)	None required.
Special Req.	Janitor's closet associated with or in proximity of these toilets. This closet includes a floor mop sink with hot and cold water and a hose connection, a floor drain, and storage for pails, mops, vacuums, and related cleaning supplies and equipment. Include a lockable door (which can be opened from the inside) with a vision panel. Lockable cabinets for cleaning supplies. Exhaust ventilation in janitor's closet to remove chemical fumes.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-11. Night Vision Area

Description/ Usage	Night vision calibration area for testing under controlled conditions of lighting, temperature, and humidity. The night vision ANV-126 NVD Infinity Focus System should be calibrated in a room with ambient lighting levels of less than 0.1 foot-candles in the general area of the test set. The ANV-20/20, field deployable, low light level calibration system requires total darkness during the adjustment procedures for the night vision test to accomplish calibration.
Min. Ceiling Ht.	10 ft (3.05 m)
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. **Ceiling.** ACP; air-tight, dust-tight ceiling panels for environmental system balancing and required maintenance.
Plumbing	None required.
HVAC	73 ± 6 °F (22.8 ± 3.3 °C) and a RH of 35, +10/-15%. A minimum positive static pressure of 0.05 inch of water (12.5 pascals) compared to ambient pressure is required to prevent infiltration of dust-laden air.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Outlets per code and additional outlets as necessary to operate any dedicated equipment.
Lighting	During non-test conditions, provide 100 foot-candles (1076 lux) ambient lighting. Night vision calibration lighting levels must meet minimum requirements of the test set being calibrated.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Onespeaker. **Telephone.** One line with internal two-way communication. **Data.** LAN internet connections and ensure WLAN signal is available, if required. **Security.** None required.
Casework/Built-in Equipment	Work bench(s) within the night vision area for equipment inspection and review. Secure storage area for equipment, tools, supplies, and test items. Include adequate shelving, bins, and open end cubicles to store equipment. Install additional areas as required for storage, depending on volume of workflow.
Furnishings Fixtures & Equipment (FF&E)	None required.
Special Requirements	None required.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers.
Min. net ft^2 (m^2)	

Table 4-12. Force and Pressure Measurement Area

Description/ Usage	The Force and Pressure Measurement area may require safety screens in the immediate vicinity of the force and calibration equipment to protect operators and other personnel from flying projectiles, high pressure gas, or fluids. This area is part of the C/R area, but can be part of the Dimensional Measurement lab.
Min. Ceiling Ht.	10 ft (3.05 m)
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. **Ceiling.** ACP; air-tight, dust-tight ceiling panels for environmental system balancing and required maintenance.
Plumbing	None required.
HVAC	73 ± 6 °F (22.8 ± 3.3 °C) for Type II and Type III PMELs. An optimum operational RH level is 35, +10/-15%. A minimum positive static pressure of 0.05 inch of water (12.5 pascals) compared to ambient pressure is required to prevent infiltration of dust-laden air.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Outlets per code and additional outlets as necessary to operate any dedicated equipment.
Lighting	100 foot-candles (1076 lux) ambient lighting using permanent overhead-recessed vapor-proof/dust-resistant fixtures sealed with gaskets to prevent air or moisture leakage and dust accumulation/intrusion from the interstitial area.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Onespeaker. **Telephone.** One line with internal two-way communication. **Data.** One outlet per work bench. Ensure WLAN signal is available, if required. **Security.** None required.
Casework/ Built-in Equipment	Work bench(s) for equipment inspection and repair.
Furnishings Fixtures & Equipment (FF&E)	Safety screens to protect personnel, as required.
Special Requirements	If double doors are used, install a pair of 3-ft-wide double doors to allow movement of large pieces of equipment when necessary. Consider placing force and pressure measuring equipment in isolated parts of the room or space as an added measure for personnel and equipment protection.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers.
Min. net ft^2 (m^2)	

Table 4-13. Technical Library

Description/ Usage	The library contains TOs, equipment descriptions, maintenance manuals, Air Force Manuals and Instructions. It is used by PMEL technicians, supervisors, and staff to provide data for precision measurement calibration activities, including library research and internet downloads of technical manuals.
Min. Ceiling Ht.	9 ft (2.74 m)
Finishes	**Walls.** Painted gypsum wall board with flush and smooth surface to reduce dust. **Floor.** Vinyl (non-conductive) plastic floor covering of continuous length or other suitable non-conductive material. Static dissipative carpet may be added to the technical library if located outside the C/R area.
Plumbing	None required.
HVAC	Reference the most recent Air Force or installation policy on temperature set points for HVAC systems.
Fire Protection	Refer to UFC 3-600-01 for fire protection requirements.
Power	Outlets per code; one additional outlet at counter height for convenience; additional outlets necessary to operate dedicated equipment such as a copier, fax machine, printer, and various other office machines.
Lighting	100 foot-candles (1076 lux). Consider dimmable lights.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** One speaker. **Telephone.** One line. **Data.** Minimum of four LAN internet outlets for library research. **Security.** None required.
Casework/Built-in Equipment	Bookshelves to house technical library collection
Furnishings Fixtures & Equipment (FF&E)	Copier, fax machine, printers, table, chairs, bulletin board with tack surface, dry-erase board, and other office equipment as required.
Special Requirements	None required.
For use during project execution by the appropriate Service agency	
Occupancy	Staff, customers.
Min. net ft^2 (m^2)	

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APPENDIX A REFERENCES

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS

www.ashrae.org

ANSI/ASHRAE 52.2-2012, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*

ASHRAE Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

ASHRAE Handbook: Fundamentals

AMERICAN NATIONAL STANDARDS INSTITUTE

http://ansi.org

ANSI/ASA S1.4, *American National Standard Electroacoustics – Sound Level Meters*

ANSI/ISA S7.0.01, *Quality Standard for Instrument Air*

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

http://www.awinet.org

AWI Architectural Woodwork Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

http://www.nfpa.org

NFPA 101, *Life Safety Code*®

NFPA 501.130B, *Standard on Manufactured Housing*

NFPA 45, *Standard on Fire Protection for Laboratories Usin g Chemicals*

NFPA 55, *Compressed Gases and Cryogenic Fluids Code*

NFPA 70, *National Electrical Code*®

CODE OF FEDERAL REGULATIONS (CFR)

https://www.osha.gov/law-regs.html

29 CFR 1910, *Occupational Safety and Health Standards*

DEPARTMENT OF DEFENSE

MIL-HDBK-419A, *Grounding , Bonding, and Shielding for Electronic Equipments and Facilities*

MIL-HDBK-423, *High-Altitude Electromagnetic Pulse (HEMP) Protection for Fixed and Transportable Ground-Based C4I Facilities*

MIL-STD-188-124B, *Grounding, Bonding and Shielding for Common Long Haul/Tactical Communication Systems Including Ground Based Communications-Electronics Facilities and Equipments*

MIL-STD-188-125-1, *Department of Defense Interface Standard: High-Altitude Electromagnetic Pulse (HEMP) Protection for Ground-Based C4I Facilities Performing Critical, Time-Urgent Missions (Part 1 - Fixed Facilities)*

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/dod/ufc

UFC 1-200-01, *DoD Building Code*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

UFC 3-101-01, *Architecture*

UFC 3-120-01, *Design: Sign Standards*

UFC 3-120-10, *Interior Design*

UFC 3-201-02, *Landscape Architecture*

UFC 3-400-02, *Design: Engineering Weather Data*

UFC 3-401-01, *Mechanical Engineering*

UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*

UFC 3-410-02, Lonworks® *Direct Digital Control for HVAC and Other Local Building Systems*

UFC 3-410-04, *Industrial Ventilation* UFC 3-420-01, *Plumbing Systems* UFC 3-501-01,

Electrical Engineering

UFC 3-520-01, *Interior Electrical Systems*

UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

UFC 3-555-01N, *400 Hertz Medium Voltage Conversion/Distribution and Low Voltage Utilization Systems*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UNIFIED FACILITIES GUIDE SPECIFICATIONS

https://www.wbdg.org/dod/ufgs

UFGS 01 91 00.00 40, *Commissioning*

UFGS 23 07 00, *Thermal Insulation for Mechanical Systems*

UFGS 23 08 00.00 10, *Commissioning of HVAC Systems*

UNITED STATES AIR FORCE

http://www.e-publishing.af.mil/ AFI 32-1065, *Grounding Systems*

AFMAN 32-1084, *Facility Requirements*

AFMAN 32-1094, *Criteria for Air Force Precision Measurement Equipment Laboratory Design and Construction*

TO 00-20-14, *Technical Manual: Air Force Metrology and Calibration Program* (http://www.wpafb.af.mil/shared/media/document/AFD-120724-063.pdf)

A7C Policy Memorandum, “Sustainable Design and Development (SDD) Implementing Guidance”
https://www.wbdg.org/dod/sustainability/policy-mandates

DEFENSE LOGISTICS AGENCY

DLA A-A-59503A, *Nitrogen, Technical*

APPENDIX B GLOSSARY

°C	degrees Celsius
°F	degrees Fahrenheit
µin	microinch
µm	micrometer
A/E	Architect and Engineer
ACP	acoustical ceiling panels
AFCEC	Air Force Civil Engineer Center
AFI	Air Force Instruction
AFIMSC	Air Force Installation and Mission Support Center
AFMAN	Air Force Manual
AFMETCAL	Air Force Metrology and Calibration
ALC	Air Logistics Complex
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
AWI	Architectural Wordwork Institute
BCE	Base Civil Engineer
BIA	Bilateral Infrastructure Agreement
C/R	Calibration and Repair
CATV	community access television (cable)
CAV	constant air volume
CCP	clean construction protocol
CCTV	closed-circuit television
cfm	cubic feet per minute

CFR	Code of Federal Regulations
CONUS	continental United States
dB	decibel
DLA	Defense Logistics Agency
DOAS	Dedicated Outdoor Air System
DoD	Department of Defense
DVD	digital versatile disk
EMCS	energy management and control system
EMI	electromagnetic interference
FC	Facility Criteria
FF&E	furnishings, fixtures, & equipment
ft	feet
ft^2	square feet
ft^3	cubic feet
fpm	feet per minute
g	gravitational acceleration (9.81 m/s^2, 32.2 ft/s^2)
gpm	gallons per minute
GPS	Global Positioning System
HEMP	high-altitude electromagnetic pulse
HNFC	Host Nation Funded Construction
HQ USACE	Headquarters United States Army Corps of Engineers
Ht	height
HVAC	heating, ventilation, and air conditioning
Hz	hertz
ISA	Instrument Society of America

kPa	kilopascal
L/min	liters per minute
L/s	liters per second
LAN	local area network
m	meter
mm	millimeter
m/min	meters per minute
m/s^2	meters per second squared
m^2	square meter
m^3	cubic meter
m^3/min	cubic meter per minute
MERV	minimum efficiency reporting value
MIL HDBK	Military Handbook
MIL STD	Military Standard
NAVFAC	Naval Facilities Engineering Command
NEC	National Electrical Code
NFPA	National Fire Protection Association
OCONUS	outside continental United States
OSHA	Occupational Safety and Health Administration
PA	public address
PCCIE	Power Conditioning and Continuation Interface Equipment
PMEL	Precision Measurement Equipment Laboratory
ppm/wt	parts per million per weight PSU Primary Subordinate Unit
PWC	Performing Work Center
RPIE	Real Property Installed Equipment

psig	pounds per square inch gage
RFI	radio frequency interference
RH	relative humidity
scfm	standard cubic feet per minute
SDD	Sustainable Design and Development
SES	Senior Executive Service
SOFA	Status of Forces Agreement
STC	sound transmission coefficient
T/H S	Temperature/Humidity Sensitive
TMDE	Test, Measurement, and Diagnostic Equipment
TO	Technical Order
U.S.	United States
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specification
UL	Underwriter’s Laboratory
Vac	volts alternating current
VAV	variable air volume
VCR	video cassette recorder
Vdc	volts direct current
WLAN	wireless local area network

APPENDIX C DEFINITION OF TERMS

For additional definitions, reference TO 00-20-14, *Air Force Metrology and Calibration Program*.

Air Force Metrology and Calibration Program (AFMETCAL Program): An Air Force program that provides measurement standards and equipment, professional and technical metrologists, performing work centers (PWCs), a system of worldwide Precision Measurement Equipment Laboratory (PMEL) facilities, measurement equipment users, calibration data, and integrated planning. This program ensures the reliability and accuracy of systems, subsystems, and equipment. The program provides for the calibration and repair of Test, Measurement, and Diagnostic Equipment (TMDE).

Calibration: A comparison between equipment items, one of which is a measurement standard of known accuracy, to detect, correlate, adjust, and report any variation in the accuracy the other item(s).

Metrology: The science or system of weights and measures used to determine conformance to technical requirements. This includes the development of standards and systems for absolute and relative measurements.

Precision Measurement Equipment Laboratory (PMEL): The base-level AFMETCAL Program focal point. It is the activity authorized to possess and use base measurement standards. PMELs use base measurement standards to maintain working standards. The workin g standards are used to maintain (troubleshoot, align, repair, and calibrate) TMDE designated as PMEL responsibility. Authorizations for PMEL equipment and facility requirements are tailored to meet specific requirements for supported missions. PMELs are the base-level link for measurement transfer and maintenance self- sufficiency for all systems in the Air Force. PMEL types include:

Type IIA. A base-level PMEL with a 68 degree room providing support to an Air Logistics Complex (ALC) and/or a large geographical area.

Type IIB. A base-level PMEL established to support aircraft, missiles, ground systems and/or other equipment on base or in the local area.

Type IIC. A base-level PMEL with a 68 degree room supporting research, development, test or evaluation programs, as well as other operational and support functions.

Type III. A PMEL supporting a specific mission. It normally receives calibration support from a Type II PMEL.

Type IV. A PMEL that supports a specific weapon system. It uses a transportable measurement system in fixed and deployed locations. A Type IV PMEL receives calibration support from a Type II PMEL.

UFC 4-310-03
12 August 2020

UNIFIED FACILITIES CRITERIA (UFC)

DOD FUELS LABORATORY STANDARDS

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UNIFIED FACILITIES CRITERIA (UFC)

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U.S. ARMY CORPS OF ENGINEERS MANDATORY CENTER OF EXPERTISE FOR PETROLEUM, OIL, AND LUBRICANTS (POL) MCX (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
NEW SUMMARY SHEET

Document: UFC 4-310-03, *DoD Fuels Laboratory Standards*, dated 7 March 2019

Superseding: None

Description: This new UFC provides general criteria and standard procedures for the design and construction of military land-based laboratory facilities which test liquid fuels.

Reasons for Document:

- Provide uniform requirements for construction of DoD fuels laboratories based on required fuel testing requirements.
- Provide requirements for planning, facility design, and construction documentation required for new fuel laboratory facilities.
- Provide requirements for modernization or expansion of existing fuel laboratories, if improvements can be justified in terms of obsolescence, expanded operational requirements, safety, environmental compliance, or excessive maintenance costs.

Impact:

- Creates a single source for common DOD fuels laboratories criteria.
- Enable designs and construction to meet appropriate uniform requirements for specific fuel testing locations to ensure proper fuel quality for use within DoD.

Unification Issues

None

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This UFC contains criteria and guidance for design and construction of military land-based laboratory (lab) facilities that test liquid fuels.

1-2 APPLICABILITY.

This UFC should be used by facility planners, engineers, and architects for individual project planning and preparing engineering and construction documentation. Requirements apply to both new construction and to modernization or expansion of existing fuel laboratories when improvements can be justified in terms of obsolescence, expanded operational requirements, safety, environmental compliance, or excessive maintenance costs. Operations and maintenance personnel should use this UFC for facility design, modifications, and improvements.

1-3 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, General Building Requirements. UFC 1-200-01 provides applicable model building codes and government-unique criteria for typical design disciplines and building systems, as well as requirements for accessibility, antiterrorism, security, high performance and sustainability, and safety. Use this UFC in addition to UFC 1-200-01 and other UFCs and government criteria referenced herein.

1-4 CYBERSECURITY.

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service implementation policy.

1-5 SERVICE HEADQUARTERS SUBJECT MATTER EXPERTS (SME)

Policies, obligations, and responsibilities of the military branches may vary; consult the SME at the appropriate Service headquarters for interpretation.

- Army: Headquarters, U.S. Army Corps of Engineers, POL Facilities Proponent (CECW-EC).
- Air Force: The Air Force Fuels Facilities SME (AFCEC/COS). When applicable, route requests through the Regional Fuels Engineer (USAFE/PACAF) prior to the Air Force Fuels Facilities SME.
- Navy/Marine Corps: NAVFAC POL Facility SME (NAVFAC EXWC, CI11).

1-5.1 Service Provider Subject Matter Expert (SME).

DLA Installation Support for Energy (DLA DS-FEI) is the Executive Agent as defined in DoD 4140.25M.

1-6 WAIVERS AND EXEMPTIONS.

For specific interpretations, waivers, or exemption, contact the appropriate Service headquarters SMEs and refer to MIL-STD-3007 for the waiver process.

Recommended UFC language generated from recurring waivers and exemptions will be considered by the Fuels Discipline Working Group (FDWG), with supporting rationale for inclusion included on voting agendas.

1-7 REFERENCES.

Appendix A lists references related to laboratory facilities contained in this UFC. The publication date of the code or standard is not included; the latest available issuance of the reference has been used.

1-8 PROJECTS OUTSIDE OF CONTINENTAL UNITED STATES.

For fueling projects located outside of CONUS, use host nation standards (if more stringent), this UFC, and applicable Service policy.

1-9 GLOSSARY.

Appendix B contains abbreviations and acronyms, and definitions of terms.

CHAPTER 2 TECHNICAL REQUIREMENTS

2-1 BASIC LAB REQUIREMENTS.

Laboratories are classified as Type A, B, or C to match testing required in MIL-STD-3004. These requirements apply to all labs. Requirements for counter space, ventilation, and electrical are summarized in Table 2-1. Specific requirements for each lab are determined by the tests performed in the lab.

2-1.1 Petroleum Products.

Petroleum products are hazardous due to toxic, explosive, flammable, and environmentally damaging properties.

2-1.2 Codes, Standards and Regulations.

Design must conform to all applicable criteria and guidance, including local and federal codes, military standards, and installation standards. Approved DD Form 1391 must specify what lab type is required to meet assigned tasks to support MIL-STD-3004.

Use references listed in Appendix A. Other standards may be acceptable provided they satisfy minimum requirements for the testing lab.

2-1.3 Architectural.

2-1.3.1 Floors.

To retain shower water and fuel spills, recess for laboratory room floors a minimum of 6 in. (150 mm), or provide another means of permanent spill control. If only eyewash units are used, the floor does not need to be recessed, but must be sloped 1/8-inch per foot to a floor drain. Floors must be designed to support minimum loads of 150 pounds per square foot (7.18 kilopascals). The finish should be monolithic, without seams or joints, to resist fuel spills. Flooring must incorporate a cove-type base of the same material as the flooring.

2-1.3.2 Cabinets.

Cabinets must be of metal construction and sourced from a manufacturer that specifically designs and builds laboratory fixtures. Coordinate with the user as to the type of cabinets that will be required.

2-1.3.3 Countertops.

Where fuel or chemicals may contact countertops, a standard 4-inch (100 millimeter) chemical- and fuels-resistant backsplash must be installed. Counters must be made of an epoxy resin or other type of material typically used for chemical analysis. For instrumentation, countertops must support 150 pounds per square foot (7.18 kilopascals) minimum load. Countertops typically are black, but verify with the user the

color needed to accommodate types of testing. At some installations, a white epoxy resin countertop may be required for the visual test.

2-1.4 Mechanical.

2-1.4.1 Heating, Ventilating and Air Conditioning (HVAC) System.

Labs work spaces must have dedicated HVAC systems and must provide a minimum outdoor air ventilation rate in accordance with ASHRAE 62.1 and comply with UFC 3-410-01.

- Lab HVAC systems must work seamlessly. When a lab hood is energized, conditioned make-up air must enter the lab to replace the air being exhausted. The design must ensure minimum turbulence around the hood, and ensure all components work together in a variety of scenarios; e.g., lab hoods are normally shut down when not in use; fresh air would normally go to minimum volume when the building is unoccupied.
- Lab rooms must maintain slightly negative air pressure relative to the rest of the building (adjacent rooms) 24 hours per day, 7 days per week.

2-1.4.1.1 Lab Operating Temperature.

Operating temperature must be maintained at 73° F +/- 5° F (23 +/- 2 ° C), 55° F (13° C) maximum dew point, and humidified if relative humidity drops below 30%.

2-1.4.1.2 Recirculation of Air from the Laboratory.

Recirculation of air from the laboratory to other portions (offices) of the building is prohibited, per NFPA 45.

2-1.4.1.3 Exhaust.

Labs must provide exhaust 24 hours per day, 7 days per week, from within 6 inches of the lab floor; i.e., the exhaust intake must be mounted no more than 6 inches above the lab floor. For C type labs, maintain a minimum airflow of 50 cubic feet per minute (25 liters/second).

2-1.4.1.4 Energy Recovery Systems.

Use of energy recovery systems must be considered. To prevent possible cross-contamination, do not use recovery wheels with fume hoods.

2-1.4.1.5 High Performance and Sustainable Building Requirements.

Comply with UFC 1-200-02.

2-1.4.2 Plumbing.

Comply with UFC 3-420-01.

2-1.4.3 Sinks.

Sinks must supply both hot and cold running water. For cleaning lab glassware, hot water must be supplied at 130° F (54° C).

2-1.5 Electrical.

This UFC applies to facilities within the United States. Installations outside the United States may have location-specific power requirements.

2-1.5.1 Primary Power Distribution.

A dedicated service transformer is required for facility primary power distribution. The transformer must step down voltage from the installation primary voltage to 120/208V three-phase power. HVAC and other mechanical loads typically require three-phase power. When part of a larger building, laboratories must have dedicated distribution panels.

2-1.5.2 Stand-By-Generator.

This UFC does not require use of a stand-by generator, nor does any specific service or installation have a requirement that the fuels laboratory have emergency power. However, the laboratory must be considered inoperable and possibly uninhabitable during a prolonged power outage. At a minimum, the facility must have backup power capability via a quick connection point through a manual transfer switch (MTS). A built-in stand-by generator with automatic transfer switch (ATS) may be justified based on the power reliability of a specific installation and the criticality of the laboratory mission.

2-1.5.3 Service Entrance Conductors.

Service entrance conductors must be extended from the service transformer or MTS to a main distribution panel (MDP) in the mechanical room. The MDP must be service entrance-rated and equipped with molded case circuit breakers. Feeders must be extended from the MDP to feed the large mechanical loads and 208Y/120V panel boards. The 208Y/120V panel boards must feed lighting, small mechanical loads, receptacle loads, and other 120V or 208V equipment. Identify laboratory equipment utilizing 208V for disconnect placement.

2-1.5.4 Lab Equipment Transformer.

Some lab equipment may be available only as 240V, requiring a second transformer with a 120/240V single-phase secondary. Identify laboratory equipment requiring 240V for disconnect placement.

2-1.5.5 Lighting.

Design lighting to intensities recommended in UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*. In general, laboratory lighting will be non-hazardous,

but specific areas/locations may require special lighting; e.g., the hazardous storage area must have explosion-proof fixtures.

- Provide occupancy sensor controls and manual override switches throughout the facility. LED lighting is acceptable in place of fluorescent.
- Exit signs and emergency light fixtures must have battery backup; exit lights will use LED lamps.

2-1.5.6 Electrical Outlets and Switches.

Electrical outlets and switches must be located above counter- or tabletop-height. Space regular duplex outlets (120V) every 4 feet along countertops to support various equipment items. Dedicated 208V and 240V outlets must positioned to accommodate equipment that requires power other than 120V. Consult the end user regarding these specific power requirements. As a minimum for each laboratory, provide two 240V outlets near the ends of counters to allow use by either countertop or floor-standing equipment.

2-1.5.7 Lighting Building Exterior Walls.

Illuminate building exterior walls using full cut-off wall pack LED fixtures controlled via photocell mounted on the exterior of the building -- not on the roof.

2-1.5.8 Facility Grounding.

The facility must be grounded in accordance with NFPA 70, *National Electrical Code*®. Execute underground connections by exothermic process. Existing systems must be tested and supplemented as needed to obtain a ground resistance of 25 ohms or less.

2-1.5.9 Personnel and Equipment Grounding Bar.

Provide a personnel and equipment grounding bar for all laboratory countertops. Provide a personnel grounding touch pad or bar at laboratory entrances.

2-1.5.10 Lightning Protection.

Provide lightning protection per UFC 3-575-01 and NFPA 780.

2-1.5.11 Exterior Raceways.

Use rigid steel conduit or intermediate metal conduit (IMC) in exposed locations. Install electric metallic tubing (EMT) where concealed in walls and above finished ceilings. Exposed exterior conduits or exposed conduits in hazardous classified areas must be rigid galvanized steel. Use PVC underground. Transition PVC conduit to PVC-coated rigid steel conduit for below grade elbows and where conduits rise through concrete slabs.

2-1.5.12 Electrical Classification.

Electrical installations in the laboratory work areas are considered non-classified with exceptions identified in paragraphs 2-2.4, 2-.3.2, and 2-3.4.

[C] 2-.1.5.12 The laboratory work areas are non-classified due to following mitigating factors:

- Procedural limits on fuel quantity to be tested or stored within the laboratory.
- Storage of fuel samples in ventilated cabinets or otherwise approved containers.
- Training of operators and the area being off limits to non-essential personnel.
- Reasonable expectation that any fuel spills will be cleaned up immediately.
- Physical separation of the hazardous storage area (a hazardous area) from the laboratory.
- Required fire sprinklers.
- Combustible gas monitors in larger labs with piped in Hydrogen, Oxygen, Acetylene or other gases which would increase the fire potential.
- Use of fume hood(s) and dedicated HVAC system to remove any fuel vapors.
- Elevating all electrical outlets to at or above counter-top height. The test equipment itself is not hazardous area rated, therefore requiring the rest of the electrical system to be hazardous area rated would not increase safety.
- Open flame tests are required in the laboratory, but would be prohibited in a hazardous area.

2-1.6 Fire Protection Requirements.

Comply with UFC 3-600-01 and NFPA 45.

Determine what chemicals and fuels will be tested and stored in the lab. Document and include client requirements in the design analysis. Table 2-2 lists some typical chemicals and fuels. Chemical/sample storage rooms must be classified as Class 1, Division 2, and Group D, in accordance with NFPA 70. Lab facilities must be Type I or Type II construction (IBC Classification).

2-1.7 Emergency Eyewash and Shower.

Provide an OSHA emergency eyewash and shower supplied per Appendix D of UFC 3-420-01. Designers must review availability of existing utilities and evaluate conditions at each site.

2-2 TYPE A TESTING LAB.

Requirements for counter space, ventilation, electrical, and other features are listed in Table 2-1.

2-2.1 Facility Description.

A facility capable of performing a Type A Test is described in MIL-STD 3004. These facilities are the largest of the DoD laboratories, very expensive, and few in number relative to Type B and C labs. Because requirements for labs are project-specific, a single uniform standard is not practical, making requirements for smaller labs, as a minimum, apply to all types. Examples of Type A labs include Wright Patterson AFB, Vandenberg AFB, RAF Mildenhall, Kadena Air Base, NAS Patuxent River, and New Cumberland Army Depot.

a. The Type A test consists of a complete conformance specification acceptance test. Sample size must include 1 gallon (3.8 liters), with 5 gallons (18.9 liters) for special tests, as specified in MIL-STD 3004.

b. Table 2-1 is a list of tests; Figure 2-1 provides a diagram of a Type A laboratory.

2-2.2 Architectural.

2-2.2.1 Design.

Building size must be based on space requirements, as indicated in Table 2-1 or as approved by the Service Control Point identified in UFC 3-460-01, to provide the user with a complete operational facility. Finishes of building exteriors must follow installation standards for materials.

2-2.2.2 Handicapped Accessibility.

Handicapped accessibility requirements will be incorporated into the building design in accordance with the ADA-ABA American with Disabilities Act and Architectural Barriers Act Accessibility Guidelines for Buildings and Facilities.

2-2.2.3 Building Requirements.

Use Table 2-1 to determine space layout. Multiple test stations may be added as required to accomplish the number of tests for each station. The functional areas for a large laboratory facility must include the spaces described in paragraphs 2-2.2.3.1 through 2-2.2.3.9, as a minimum:

2-2.2.3.1 Laboratory Rooms.

Approximate size of lab rooms should be between 2,000 and 3,200 net square feet (185 and 298 net square meters). Size maybe adjusted as required for a larger lab with rooms or areas being added for additional requirements.

a. A Type A lab must be sized to handle all required testing for the basic lab requirements, including fuels and lubricating oils. Fuels and lubricants typically tested inside the lab include:

- aviation gasoline (AVGAS)
- biofuels
- biomass fuel
- biodiesel
- diesel fuel
- ethanol, fuel grade
- gasoline
- heavy distillates
- aviation turbine fuel (e.g., JP-5, JP-8, Jet A, F-24)
- kerosene
- LNG, LPG
- natural gas
- petroleum and crude oil feedstocks
- petroleum coke and fly-ash
- lube oil

b. For typical fuel tests conducted inside the lab, see Table 2-1.

c. A Type A lab must be set up to allow individual testing of the items listed above and can be separated into two testing rooms. One room must be large -- approximately 1,800 net square feet (167 net square meters) -- with a flash room and balance room located adjacent to the lab. The other must be a minimum of 500 net square feet (47 net square meters), adjacent to the larger room. Each room/lab area must be set up to test the listed items and must be laid out to allow separate areas for each test (reference Table 2-1). Several testing stations could be combined into one. When required, include additional space in each Type A lab for a filtration room or equipment storage.

2-2.2.3.2 Non Hazardous Storage Room.

This room (or rooms) is used to store non-hazardous chemicals, and will include noncombustible storage compartments and work tables.

a. Size: The approximate size of this area should be 400 net square feet (37 net square meters).

b. Flooring: Flooring must be monolithic in type, without seams or joints, and must resist chemical and fuel spills. A cove base of the same material must extend up approximately 8 in. (200 mm).

c. Walls: Walls must be constructed using steel studs with a maximum 16 in. (400 mm) on center, covered with 5/8-in. (16-mm) gypsum wallboard or concrete masonry, and a backsplash or wainscot at all casework. Backsplash or wainscot must be chemical- and fuels-resistant.

d. Counters: Counters must be epoxy resin-type typically used for chemical analysis, resistant to chemical and fuel spills, and easily cleaned. Most counters are black; but the color must be selected by the using agency as appropriate to support its testing operations.

e. Ceilings: Ceilings must consist of 5/8-in. (16 mm) gypsum wallboard over steel studs, mounted at 16 in. (400 mm) on center. The minimum ceiling mounting height must be 8 ft (2400 mm) above the finish floor. Ceilings must be painted with one coat of primer and two coats of semi-gloss paint. Color must be selected from manufacturer standard paint samples.

2-2.2.3.3 Hazardous Storage Room.

The hazardous storage room provides space for the storage of chemicals and flammable and hazardous materials. Refer to Table 2-2 for a list of potential chemicals that may be stored in this room. This room must have direct access to the exterior. In addition, a storage area for pressurized bottles must be located on the exterior of the building adjacent to the hazardous storage room, and also have exterior access.

a. Flooring: Reference paragraph 2-2.2.3.2.b.

b. Walls: Reference paragraph 2 2.2.3.2.c.

2-2.2.3.4 Filtration Room.

The filtration room must be approximately 250 net square feet (23 net square meters), and adjacent to the laboratory areas to provide filtered air into the laboratory. This room (or area) may be inside the laboratory or within a support area.

2-2.2.3.5 Balance Room and Flash Room.

Each of these rooms must be approximately 150 net square feet (13 net square meters) each. Locate both rooms next to and with access into the laboratory areas. Provide backsplash or wainscot that is chemical- and fuel-resistant.

a. Counters: Reference paragraph 2-2.2.3.2.d.

b. Ceilings: Reference paragraph 2-2.2.3.2.e.

2-2.2.3.6 Administrative Office Spaces.

Provide a minimum of one open office approximate size of 375 net square feet (35 net square meters) and one single office approximately 150 net square feet (12 net square meters). Administration offices must be separated from the lab area but must be adjacent to it for ease of access. Size the administration office area to accommodate the number of assigned staff.

a. Walls: Walls must be constructed using steel studs with a maximum 16 in. (400 mm) on center, and covered with 5/8-in. (16-mm) gypsum wallboard.

b. Flooring: Flooring may be resilient or porcelain tile.

c. Ceilings: Use acoustical tile for ceilings.

2-2.2.3.7 Break Room Spaces.

Provide a break area of approximately 300 net square feet (28 net square meters) adjacent to office areas and away from the hazardous storage and laboratory areas. The break room must include space for a counter, table, and refrigerator.

a. Walls: Reference paragraph 2-2.2.3.6.a.

b. Flooring: Reference paragraph 2-2.2.3.6.b.

c. Ceilings: Reference paragraph 2-2.2.3.6.c.

2-2.2.3.8 Support Space.

Mechanical, electrical, and communication rooms must be sized to accommodate equipment required for the building. Rooms must be accessible from the exterior of the building, or comply with current security requirements. Walls must constructed using steel studs at a minimum of 16 in. (400 mm) on center, covered with 5/8-in. (16-mm) gypsum wallboard or painted concrete masonry. Flooring may be resilient or porcelain tile, or sealed concrete. Ceilings for these spaces may be exposed to the underside of any metal decking or roof.

2-2.2.3.9 Toilet and Locker Rooms.

Men’s and women’s toilet and locker rooms must be sized according to the number of people that will be using the spaces. Locate these rooms between the break room and laboratory to achieve separation and promote proper industrial hygiene.

a. Walls: Walls must be constructed using steel studs with a minimum 16 in. (400 mm) on center, covered with 5/8-inch (16-mm) gypsum wallboard.

b. Tile: Wallboard must be covered with a porcelain tile wainscot with backboard in the toilet room and locker area, and full-height porcelain tile with backboard in the shower room.

c. Flooring: Shower flooring should include shower pans or porcelain tile. Flooring for the toilet and locker areas can be ceramic or porcelain tile.

d. Ceilings: Ceilings must be 5/8-in. (16 mm) gypsum wallboard.

2-2.3 Mechanical.

Comply with requirements in paragraph 2-3.3 for a Type B lab.

2-2.4 Electrical.

In addition to the basic lab requirements of paragraph 2-1.4, Type A labs must be equipped with combustible gas monitors with alarms as indication of either an HVAC failure or piped natural gas (or other gas) leak creating a potentially dangerous buildup of explosive gases.

Type A labs must also have hazardous areas that require electrical explosion-proofing. These areas are classified Hazardous, Class 1 Division 1:

- Hazardous storage room
- Areas within 5 feet (1524 mm) of hazardous storage cabinets (or refrigerator)
- Interior of lab fume hoods
- 5 feet (1524 mm) around any fuel waste containers larger than 5 gallons (18.9 liters).

2-3 TYPE B TESTIG LAB.

Requirements for counter space, ventilation, electrical, and other items are listed in Table 2 1.

2-3.1 Facility Description.

A Type B testing lab is a facility capable of performing Type B tests, as described in MIL-STD 3004. A Type B-1 test consists of a partial analysis comprising the checking of principal characteristics most likely to have been affected in the course of moving the product. A Type B-2 test consists of a partial analysis to check characteristics susceptible to deterioration due to age. Examples of Type B labs include Hunter Army Airfield, Ft Rucker, Ft Campbell, Chibana, FLC Norfolk, FLC Jacksonville, Naval Station Rota, and FLC Point Loma. See Figure 2-2.

A Type B-3 test consists of partial analysis for contaminations -- in particular, for controlling the return (or reintroduction) of pipeline interface products. Sample sizes must include 1 gallon (3.8 liters), and 5 gallons (18.9 liters) for special tests, as indicated in MIL-STD 3004. For a minimum list of tests, see Table 2-1.

2-3.2 Architectural.

2-3.2.1 Architectural Design.

Size of building must be based on tests as indicated in Table 2-1 to provide the user with a complete operational facility. Size of this type of facility may be increased as mission at each installation dictates. Minor modifications to the configuration may be

developed during review conferences. Finishes of the exterior of buildings for this project must follow base standards for exterior materials.

2-3.2.1.1 Handicapped Accessibility.

Handicapped accessibility requirements will be incorporated into the building design. The design must follow the ADA-ABA American with Disabilities Act and Architectural Barriers Act Accessibility Guidelines for Buildings and Facilities.

2-3.2.2 Building Requirements.

Functional areas for a medium-sized laboratory facility must include spaces as described in paragraphs 2-3.2.2.1 through 2-3.4.

2-3.2.2.1 Laboratory Room.

The laboratory room contains testing supplies, laboratory casework, laboratory counters tops, and small storage cabinets. Finish materials -- flooring, walls, casework, and countertops -- must resist flammable and combustible liquids. The approximate size of the laboratory room must be between 1,200 and 2,000 net square feet (112 and 186 net square meters).

Laboratory casework must be designed and installed to provide an efficient working environment. Required built-in equipment includes laboratory hoods, work tables, and laboratory casework.

a. Counters: Counter heights must be adjusted to allow for a proper working height with required equipment from a standing position. Laboratory counters must be a black epoxy resin material typically used for a laboratory rooms, and resistant to chemical and fuel spills and easily cleaned.

b. Cabinets: Cabinets must be constructed using metal that will resist rusting and must conform to industry standards for scientific laboratory equipment. Cabinets must be flush-front in construction, with interiors built for storage of equipment and flammable or combustible liquids. Upper storage cabinets must have glass fronts.

c. Flooring: Flooring must be a monolithic type without seams or joints, and resistant to chemical and fuel spills.

d. Walls: Reference paragraph 2-2.2.3.2.c.

Fuels and lubricants tested inside the lab typically include:

- aviation gasoline (AVGAS)
- biofuels
- biodiesel
- diesel fuel
- ethanol, fuel grade

- fuel oil, gas oil, bunker fuel
- gasoline
- aviation turbine fuel (JP-5, JP-8, Jet A, F-24, etc.)
- kerosene
- lube oil

For fuel testing typically done inside the lab, see Table 2-1.

2-3.2.2.2 Chemical Analysis Room.

The approximate size of the chemical analysis room is 260 net square feet (24 net square meters). Adjust the size as needed to accommodate the number of personnel assigned to this area. Casework must be designed and installed to provide an efficient working environment.

a. Counters: Counters must be made of black epoxy resin, typically used for chemical analysis, and must resist chemical and fuel spills and be easily cleaned. Adjust counters to heights correct for working with required equipment from a standing position.

b. Cabinets: Reference paragraph 2-3.2.3.1.b.

c. Flooring: Reference paragraph 2-2.2.3.2.b.

d. Walls: Reference paragraph 2-2.2.3.2.c.

2-3.2.2.3 Non Hazardous Storage Room.

This space houses non-hazardous chemicals, and will include noncombustible storage compartments and work tables. The approximate size is 200 net square feet (37 net square meters).

a. Flooring: Reference paragraph 2-2.2.3.2.b.

b. Walls: Walls must be constructed using steel studs with a maximum 16 in. (400 mm) on center, covered with 5/8-in. (16-mm) gypsum wallboard or concrete masonry, and a backsplash or wainscot at all casework.

2-3.2.2.4 Hazardous Storage Room.

The hazardous storage room is used to store hazardous and nonhazardous chemicals, along with noncombustible storage compartments and work tables. The approximate size of the hazardous storage room is 100 net square feet each (10 net square meters each).

a. Counters: Counters must be black epoxy resin material typically used for chemical analysis, resistant to chemical and fuel spills, and must be easily cleaned.

b. Flooring: Reference paragraph 2-2.3.2.2.b.

c. Walls: Reference paragraph 2-2.2.3.2.c.

d. Ceilings: Reference paragraph 2-2.2.3.2.e.

2-3.2.2.5 Filtration Room.

The filtration room must be approximately 250 net square feet (23 net square meters), and adjacent to the laboratory areas to provide filtered air into the laboratory. This room (or area) may be inside the laboratory or within a support area.

2-3.2.2.6 Balance Room and Flash Room.

Each of these rooms must be approximately 150 net square feet (13 net square meters) each. Locate both rooms next to and with access into the laboratory areas. The balance area may be located within the laboratory if only one table is required. Casework must be designed and installed to provide an efficient working environment.

a. Counters: Counters must be an epoxy resin type typically used for chemical analysis. Counters must be resistant to chemical and fuel spills and must be easily cleaned. Color of counters must be selected from standard color of epoxy resin types. Counter heights must be adjusted to allow for a proper working height with required equipment from a standing position.

b. Cabinets: Reference paragraph 2-3.2.2.1.b.

c. Flooring: Reference paragraph 2-2.2.3.2.b.

d. Walls: Walls must be constructed using steel studs at 16 inches (400 mm) on center covered with 5/8-in. (16-mm) gypsum wallboard, with a backsplash or wainscot at casework that is chemical and fuels resistant.

e. Ceilings: Reference paragraph 2-2.2.3.2.e.

2-3.2.3 Administrative Office Spaces.

Size the administration office area to accommodate the number of assigned staff. Provide a minimum of one open office approximate size of 375 net square feet (35 net square meters) and one single office approximately 150 net square feet (12 net square meters). Administration offices must be separated from the lab area but must be adjacent to it for ease of access.

a. Walls must be constructed using steel studs with a maximum 16 in. (400 mm) on center, and covered with 5/8-in. (16-mm) gypsum wallboard.

b. Flooring may be resilient or porcelain tile. Use acoustical tile for ceilings.

2-3.2.3.1 Support Spaces.

Mechanical, electrical, and communication rooms must be sized to accommodate equipment required for the building. Rooms must be accessible from the exterior of the building, or comply with current security requirements. Walls must constructed using steel studs at a minimum of 16 in. (400 mm) on center, covered with 5/8-in. (16-mm) gypsum wallboard or painted concrete masonry. Flooring may be resilient or porcelain

tile, or sealed concrete. Ceilings for these spaces may be exposed to the underside of any metal decking or roof.

2-3.2.3.2 Toilet and Locker Rooms.

Men's and women's toilet and locker rooms must be sized according to the number of people that will be using the spaces. Locate these rooms between the break room and laboratory to achieve separation and promote proper industrial hygiene. Walls must be constructed using steel studs with a minimum 16 in. (400 mm) on center, covered with 5/8-inch (16-mm) gypsum wallboard. Wallboard must be covered with a porcelain tile wainscot with backboard in the toilet room and locker area, and full-height porcelain tile with backboard in the shower room. Shower flooring should include shower pans or porcelain tile. Flooring for the toilet and locker areas can be ceramic or porcelain tile. Ceilings must be 5/8-in. (16 mm) gypsum wallboard.

2-3.3 Mechanical.

Items described in paragraphs 2-3.3.1 and 2-3.3.2 are required in addition to Type C++ requirements (paragraph 2-4.3).

2-3.3.1 Lab Operating Temperature.

Lab operating temperature must be maintained 24 hours a day, 7 days a week, or as directed by project requirements.

2-3.3.2 Hazardous Storage Room.

The hazardous storage room is classified as a Class 1 Division 1 Hazardous Space which requires all equipment associated with the room to be explosion-proof. The room must be exhausted 24 hours per day, 7 days a week, to remove vapors and ensure a slightly negative air pressure relative to the rest of the building (adjacent rooms).

2-3.4 Electrical.

In addition to the basic lab requirements of paragraph 2-1.4, Type B labs must be equipped with combustible gas monitors with alarms as indication of either an HVAC failure or piped natural gas (or other gas) leak allowing a dangerous buildup of potentially explosive gases.

Type B labs will also have hazardous areas that require electrical explosion-proofing. These areas are considered Hazardous (Classified) Locations, Class 1 Division 1:

- Chemical storage room
- Areas within and 5 feet (1524 mm) around hazardous storage cabinets (or refrigerator).
- Interior of fume hoods

- 5 feet (1524 mm) around any fuel waste containers larger than 5 gallons (18.9 liters).

2-4 TYPE C TESTING LAB.

Requirements for each lab are determined by the tests performed in the lab. Requirements for counter space, ventilation, electrical, and other items are listed in Table 2-1.

2-4.1 Facility Description.

A Type C lab is a facility capable of performing a Type C test, as described in MIL STD 3004. A Type C test consists of a quick, simple, partial analysis for verification of product quality, and to ensure no change has taken place. Type C tests are sometimes referred to as identifications tests. A number of labs are referred to as C++ labs. The Air Force has C++ labs at many installations capable of all of the C-level tests, plus several additional tests. In the Air Force C++ labs, a lab fume hood and additional counter space is required. For a list of tests, see Table 2-1.

Fuels and lubricants tested inside the lab typically include:

- AVGAS
- aviation turbine fuel (JP-5, JP-8, Jet A, F-24)
- gasoline
- E85
- diesel
- kerosene
- B20
- burner fuel oils
- lube oil

Examples of C Type labs include Ft Polk, Ft Irwin, Quantico, Ft Drum. Typical Type C++ labs are found on Air Force Bases, including Eglin, Grand Forks, Ellsworth, and Holloman. See Figures 2-3 and 2-4.

2-4.2 Architectural.

2-4.2.1 Handicapped Accessibility.

These labs will accommodate able-bodied individuals only. If the Type C or C++ lab is part of a larger building, and the building must be designed in accordance with ABA/ADA, the Type C or C++ lab does not need to be designed in accordance with ABA/ADA.

2-4.3 Mechanical.

Paragraphs 2-4.3.1 through 2-4.5 are required in addition to basic lab requirements (paragraph 2-1.3).

2-4.3.1 Lab Operating Temperature.

Lab operating temperature must be maintained during normal business hours; night setback is acceptable unless otherwise directed by project requirements.

2-4.3.2 Fume Hood.

2-4.3.2.1 Science Fume Hood.

A science fume hood must be of benchtop design, categorized as an Educational Fume Hood, with a minimum opening of 18 in. x 8 in. (457 mm x 200 mm), and minimum working space of 24 in. wide (W) x 13 in. deep (D) x 22 in. high (H) (610 mm W x 330 mm D x560 mm H); ducted; exhausting approximately 100 cfm (50 liters/sec).

The hood may be designed to operate while the sash (hood access door) is in the partially-opened position only. In addition:

- An on/off switch for the exhaust fan must be provided near the fume hood.
- Exhaust ductwork must be sealed.
- Exhaust streams must be exhausted directly to the building exterior.
- Face velocity must be designed to 100 fpm (0.5 m/s).
- Exhaust fan must be located on the roof, in accordance with NFPA 45.
- Exhaust fan must be of spark-resistant construction.
- Exhaust fan motor must be explosion-proof if located in the air stream.
- Exhaust stack discharge velocity must be at least 3,000 fpm (15 m/s).
- Exhaust must be a minimum of 30 ft (9 m) from any building fresh air intake.
- Exhaust must be labeled “WARNING – Chemical Laboratory Exhaust”
- Exhaust stack must discharge vertically and be located a minimum of 10 ft (3 m) above adjacent roof lines.

2-4.4 Lab Fume Hood.

For a typical Air Force C++ lab, a 47- or 60-in. (1200- or 1525-mm) lab fume hood is required (size is dictated by the number of samples/tests to be performed on a daily basis), and must be ducted, approximately 750 cfm (354 liters/sec) or 1000 cfm (472 liters/sec), respectively. The hood must be designed to operate while the sash (hood access door) is in any position (fully opened to fully closed). Good ventilation is

achieved by using a lab fume hood in a small room, even when the test is not performed in the hood. In addition:

- An on/off switch for the exhaust fan must be provided near the fume hood.
- Exhaust duct work must be chemical-resistant.
- Exhaust duct work must be sealed.
- Exhaust duct work must not be manifolded together with other lab hoods on a constant volume system.
- Exhaust streams containing concentrations of flammable vapors above the lower explosion limit (LEL) must not be connected to a centralized exhaust system, per ANSI/ASSE Z9.5, *Laboratory Ventilation*.
- Hood must be equipped with a flow indicator, flow alarm, or face velocity alarm indicator set to alarm when the face velocity falls outside the range of 80 to 100 fpm (0.4 to 0.5 m/s).
- Face velocity must be designed to 100 fpm (0.5 m/s).
- Exhaust fan must be located on the roof in accordance with NFPA 45.
- Exhaust fan must be of spark-resistant construction.
- Exhaust fan motor must be explosion-proof if located in the air stream.
- Exhaust stack discharge velocity must be at least 3,000 fpm (15 m/s).
- Exhaust must be a minimum of 30 feet (9 m) from any building fresh air intake.
- Exhaust must be labeled “WARNING – Chemical Laboratory Exhaust”.
- Exhaust stack must discharge vertically and be located a minimum of 10 ft (3 m) above adjacent roof lines.
- Controls (air, water, gas,) must be located exterior to the hood within easy reach.

During commissioning, the following tests and measurements must be performed in accordance with ANSI/ASSE Z9.5:

- Airflow visualization tests
- Cross drafts velocity tests
- Exhaust flow measurements
- Face velocity tests
- Hood static pressure measurement
- Tracer gas testing

2-4.4.2 Make-up Air for Fume Hood.

Make-up air for the fume hood must meet the lab operating temperature requirements.

2-4.4.3 Vacuum Pump.

A vacuum pump must be provided serving the lab fume hood if required by the appropriate fuel test. The vacuum pump must be installed higher than the hood for the vacuum line to drain back into the fume hood. An on/off switch must be located near the fume hood. The vacuum pump requires good ventilation, so installation in the same room as the lab hood is adequate. **Note:** A vacuum pump is not required for a Type C testing lab.

2-4.4.4 Floor Drains.

Floor drains must be provided for emergency showers. Drains must be equipped with a positive sealing plug which is inserted in the drain at all times when not in use, or some other means of stopping the drain system. Drains are opened only as needed or after liquid is approved for discharge into the drain system.

2-4.4.5 Deionizer Water Tap.

A water supply tap for a Type II deionizer water equipment (typically wall-mounted) must be provided for Type C++. Provide a deionizer tap for Type C only when requested.

2-4.4.6 Glassware Cleaning.

The lab must be designed for glassware cleaning (dishwasher), but is not required for Type C and C++ labs unless the number of daily samples is high enough based on installation throughput and manpower requirements.

a. Prior to cleaning glassware, all fuel from testing is dumped into containers which are either recycled or properly disposed of. Lab personnel are trained not to dump fuels (hazardous waste) into any sink or floor drain. Glassware is essentially empty, except for any residual fuel clinging to the container. Detergents used to clean and break down the residual fuel from the glassware are subsequently dumped into the drain system.

b. There is no state or federal regulation which requires special treatment of discharge from a DoD fuels lab operating under these conditions. A local or host nation requirement may specifically address and require oil/water separators, intermediary containment basins, or some other means to address residual fuel. A large lab with high quantities of samples might justify environmental concerns to assure safe discharge.

2-4.5 Electrical.

See Basic Lab Requirements, paragraph 2-1.4.

2-5 FIGURES.

Figure 2-1 Bubble Diagram Type A Laboratory

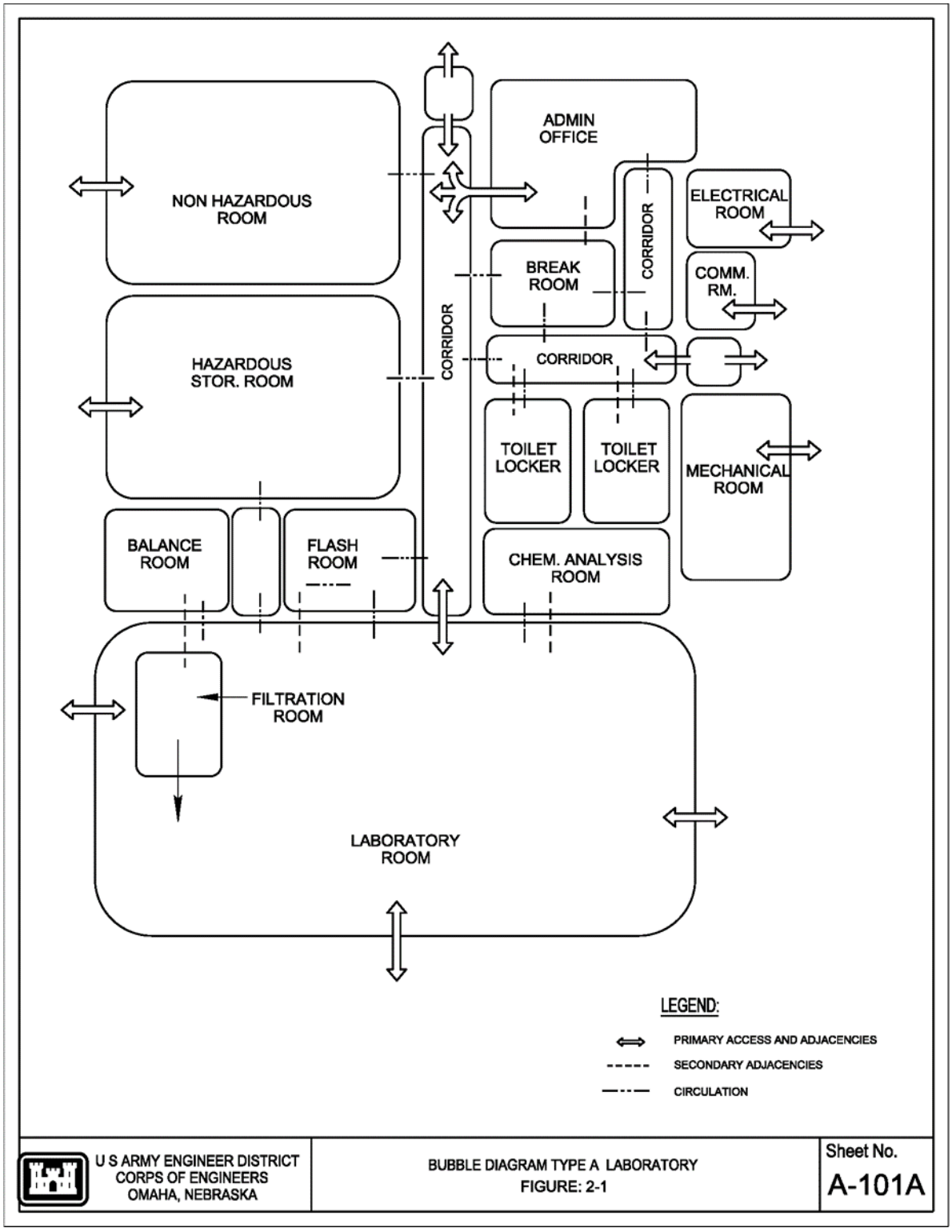


Figure 2-2 Bubble Diagram Type B Laboratory

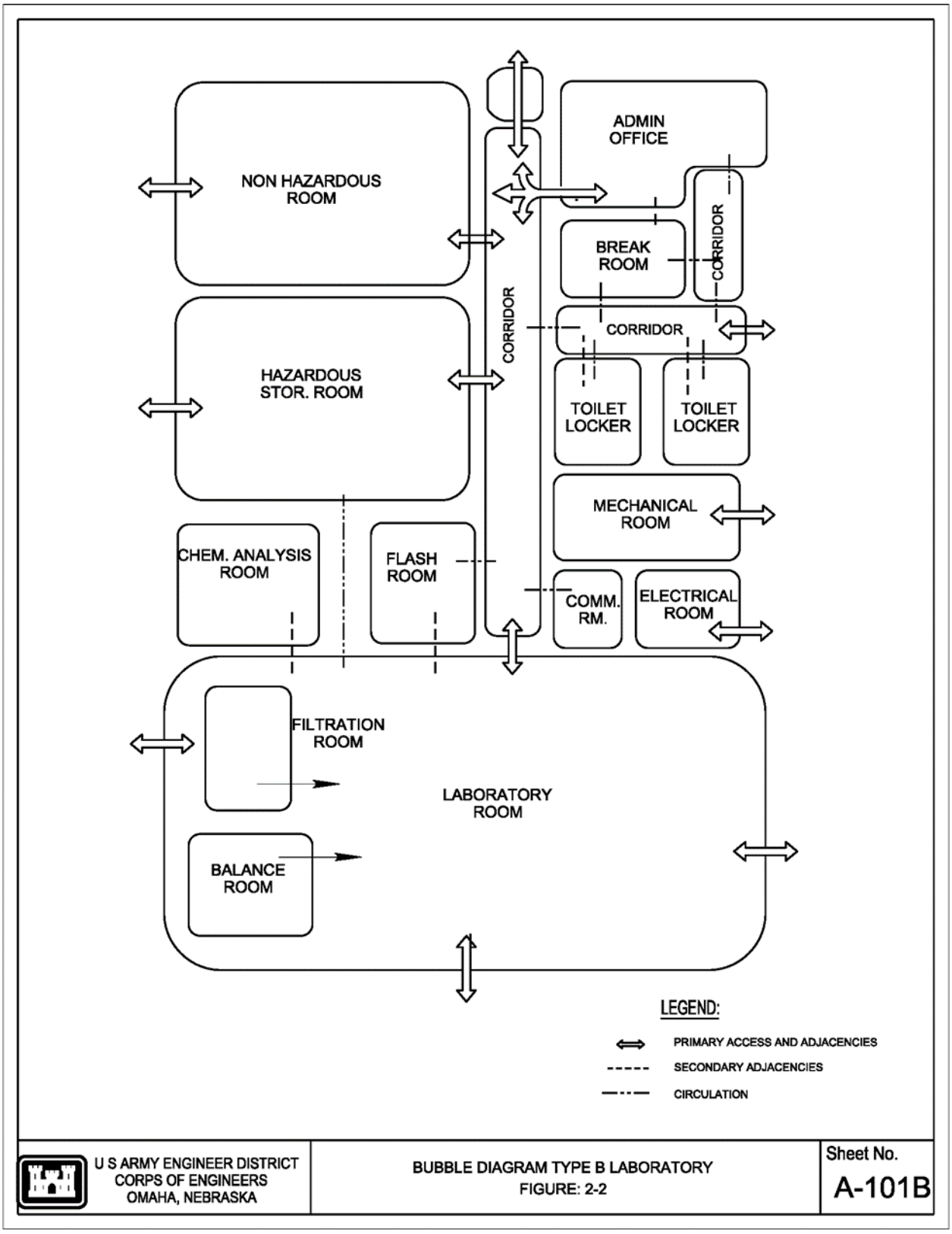
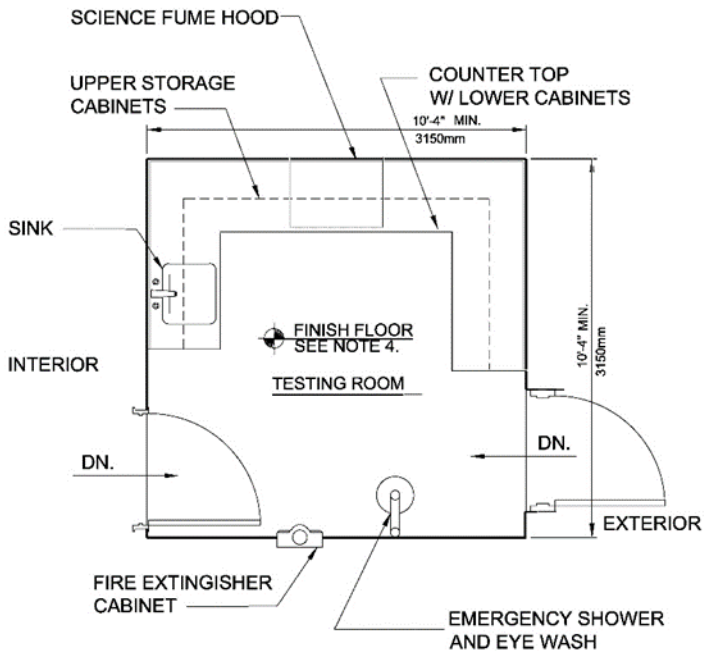


Figure 2-3 Typical C Laboratory Floor Plan



NOTES:

1. INCLUDED IN DESIGN SHOULD PROVIDE SUPPORT SPACES INCLUDING BUT LIMITED TO OFFICE SPACES, MECHANICAL, ELECTRICAL, COMMUNICATION ROOMS, AND TOILET FACILITIES.

2. INTERIOR WALLS MUST BE FIRE RATED A MINUMUM OF 1-HOUR RATED CONSTRUCTION AROUND THE LABORATORY.

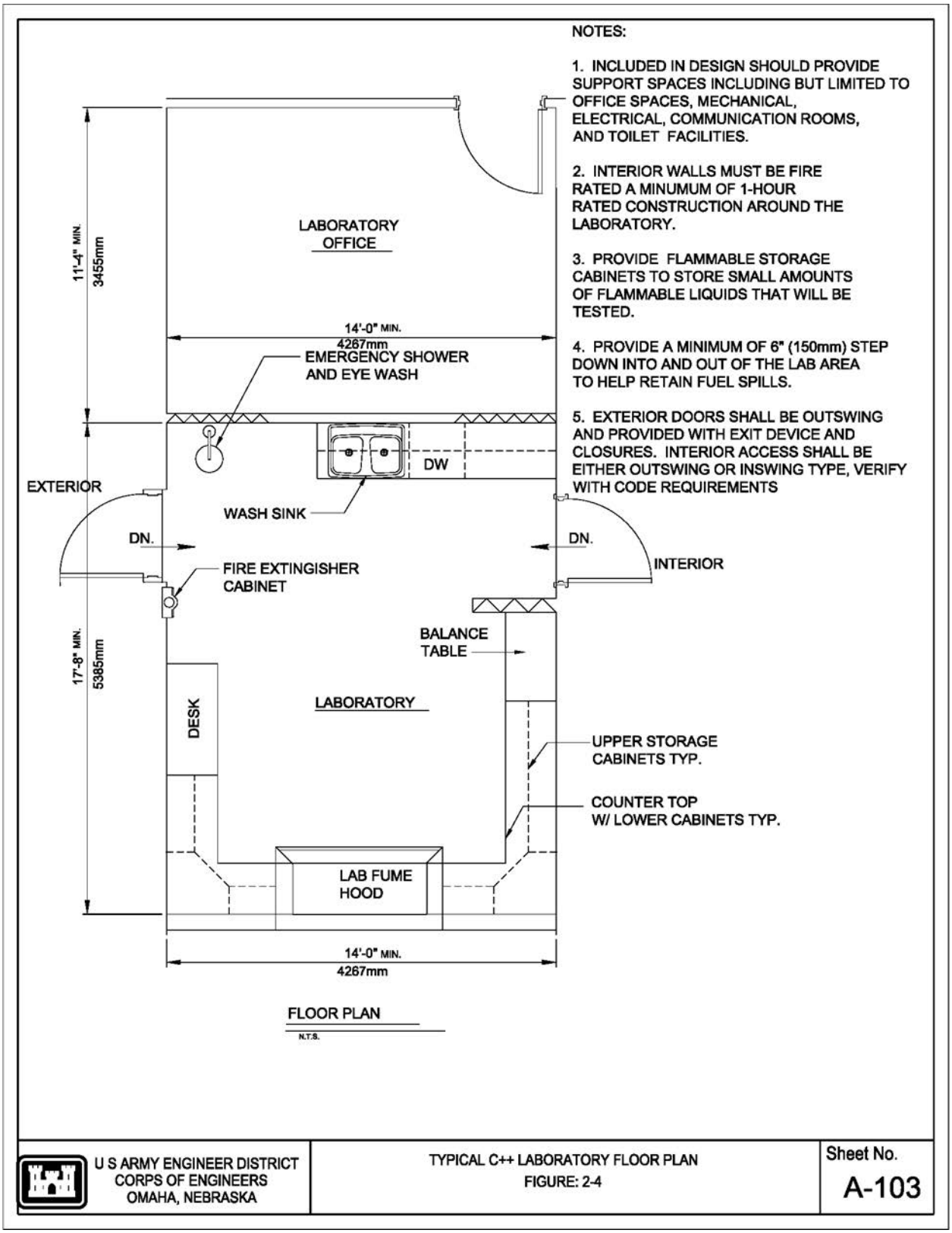
3. PROVIDE FLAMMABLE STORAGE CABINET TO STORE SMALL AMOUNTS OF FLAMMABLE LIQUIDS THAT WILL BE TESTED.

4. FINISH FLOOR OF TESTING ROOM SHALL BE A MINIMUM OF 6" (150mm) BELOW FLOORS IN ADJACENT INTERIOR ROOMS WHEN AN EMERGENCY SHOWER IS INSTALLED.

5. EXTERIOR DOORS SHALL BE OUTSWING AND PROVIDED WITH EXIT DEVICE AND CLOSURE. INTERIOR ACCESS SHALL BE EITHER OUTSWING OR INSWING, VERIFY WITH CODE REQUIREMENTS.

U S ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA	TYPICAL C LABORATORY FLOOR PLAN FIGURE 2-3	Sheet No. A-102

Figure 2-4 Typical C++ Laboratory Floor Plan



2-6 TABLES.

Table 2-1 Fuels Laboratory Equipment Reference

Fuel Type	Test	Counter (Inches)	Good Ventilation or Science Fume Hood	Lab Fume Hood	Vacuum Pump	Comp Air	Natural Gas Propane	Distilled Water	120V*	240V*	Sink	Nitrogen cylinder	Dessicator	Explosion Proof Refrigertr	Testing Oven **	Ice Maker	Bal ***	Test Time Minutes	Lab Type A	Lab Type B-1	Lab Type B-2	Lab Type B-3	Lab Type C
J E T F U E L	Appearance	30	X															10	X	X	X	X	X
	Color (visual)	20	X															10	X	X	X	X	X
	Density or API Gravity	20	X															20	X	X	X	X	X
	Flash Point ^	36	X				X [4]		X									45	X	X	X	X	X
	Particulate Matter +	36		X	X				X	X			X	X	X		X	170	X	X	X	X	
	Distillation	36	X						X	X	X [5]							90	X	X	X	X	
	Copper Strip Corrosion	36	X						X		X [5]							230	X	X	X	X	
	Freezing Point	30	X							X		X						60	X	X	X	X	
	Existent Gum	48		X		X				X	X		X		X			480	X	X	X	X	
	Vapor Pressure	[1]	X							X	X [5]					X		120	X	X	X	X	
	Water Reaction	30	X					X			X							30	X	X	X	X	
	Lead Content	36	X						X									90	X	X	X	X	
	FSII (& Other Additives) +	30	X					X										60	X	X	X	X	
	Filtration Time	48		X	X				X	X			X		X			170	X	X	X	X	
	Water Separation Index	30	X						X									30	X	X	X	X	
	Conductivity	30	X															10	X	X	X	X	
	Thermal Stability	48	X							X								480	X		X		
	Color (Saybolt)	30	X						X									15	X		X		
	Acid Number	48		X					X		X	X						30	X		X		
	Aromatics	TBD	X															TBD	X				
	Mercaptan Sulfur	TBD	X															TBD	X				
	Net Heat	TBD	X															TBD	X				
	Smoke Point	TBD	X															TBD	X				
	Naphthalenes	TBD	X															TBD	X				
	Hydroperoxides	TBD	X															TBD	X				
	BOCLE	TBD	X															TBD	X				
D I E S E L	Appearance	30	X															10	X	X	X	X	X
	Carbon residue Test	48		X						X								120	X	X	X	X	X
	Cloud Point	[2]	X							X								60	X	X	X		
	Pour Point	[2]	X							X								60	X		X		
	Copper Strip Corrosion	36	X						X		X							170	X		X		
	Cetane Index	N/A	X															10	X		X		
	Viscosity	48	X							X								120	X		X		
	H20 & Sediment/Centrifug	36	X						X									30	X		X		
	Particulate Contamination	36		X	X				X	X			X		X			170	X		X		
	Ash	TBD	X															TBD	X				
	Aromatics	TBD	X															TBD	X				
	Sulfur	TBD	X							X								TBD	X		X		
	Lubricity (HFRR)	TBD	X															TBD	X				
M O G A S	Appearance	30	X											X				10	X	X	X	X	X
	Vapor Pressure	[1]	X							X	X			X				120	X	X	X		
	Unwashed Gum	48		X		X				X	X		X	X	X			480	X		X	X	
	Oxidation Stability	[3]	X						X		X			X				480	X		X		
	Lead Content	36	X						X					X				360	X			X	

* Power supply voltage may vary by region and equipment requirements
[1] bath mounted on floor, 30 inches wide, 32 inches above ground
** two ovens required: a general oven for drying glassware and a separate oven for performing tes [2] mounted on floor, 48 inches wide
*** Balance to be located in an area isolated from air movement, perhaps a separate room [3] mounted to floor-standing platform (platform extends 1' above floor), bath sits on platform and is 1' square and 2' high
^ consider additional ventilation (fume hood, snorkel, spot ventilation) as recommended in ASTM [4] propane is normally provided with the test equipment, propane canister
+ additional test AF labs perform, designated (C++ Lab) [5] drain from equipment to sink or floor drain required
Note to designer: verify order of sampling and proximity to emergency eyewash/shower, electrical supply, fume hood, etc. to optimize safety and functionality

Table 2-2 Possible Products in a Flammable Storage Room

Note: This is not an all-inclusive list. In addition, fuel samples and other products may be used and stored in a typical Flammable Storage Room for DoD Fuels Laboratories.

PRODUCT CATEGORY	PRODUCT NAME
ALCOHOL	ETHANOL, ABSOLUTE
	ETHANOL, Denatured
	ISOPROPANOL
	METHANOL
SOLVENTS	
	TOLUENE
	TOLUENE HPLC Grade Certified
	PETROLEUM ETHER
	HEXANE
	HEXANE 99% Purity
	ISOOCTANE
	HEPTANE
	PENTANE
	ACETONE
	ACETONE High Grade
	XYLENE
	NAPTHA
	STODDARD SOLVENT
	DRYCLEANING SOLVENT
	LANCER ACID for Dishwasher
	LANCER CLEAR for Dishwasher
PETROLEUM PRODUCTS	FUEL & PACKAGED PETROLEUM PRODUCTS - VARIOUS

APPENDIX A REFERENCES

AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1, *Ventilation for Acceptable Indoor Air Quality*

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ANSI/AIHA/ASSE Z9.5, *Laboratory Ventilation*

UNIFIED FACILITIES CRITERIA

http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 1-200-01, *DoD Building Code*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*

UFC 3-420-01, *Plumbing Systems*

UFC 3-460-01, *Design: Petroleum Fuel Facilities*

UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*

UFC 3-575-01, *Lightning and Static Electricity Protection Systems*

INTERNATIONAL BUILDING CODE (IBC)

IBC, as modified by UFC 1-200-01

ARTICLE I. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*

NFPA 70, *National Electrical Code®*

NFPA 780, *Standard for the Installation of Lightning Protection Systems*

ARTICLE II. U.S. DEPARTMENT OF DEFENSE (DoD)

DOD 4140.25M, *DOD Management of Bulk Petroleum Products, Natural Gas, and Coal*

MIL-STD 3004, *Quality Assurance/Surveillance for Fuels, Lubricants and Related Products*

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APPENDIX B GLOSSARY

B-1 ACRONYMS AND ABBREVIATIONS

AF	Air Force
AFCEC	Air Force Civil Engineer Center
BIA	Bilateral Infrastructure Agreement
CONUS	Continental United States
DAF	Department of the Air Force
DoD	Department of Defense
EMC	Electrical Metallic Conduit
FLC	Fleet Logistics Center
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
HVAC	Heating, Ventilating and Air Conditioning
IMC	Intermediate Metallic Conduit
LED	Light-Emitting Diode
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MDP	Main Distribution Panel
MTS	Manual Transfer Switch
NAVFAC	Naval Facilities Engineering Command
OSHA	Occupational Safety and Health Administration
PVC	Polyvinyl Chloride Conduit
SOFA	Status of Forces Agreements
UFC	Unified Facilities Criteria
UL	Underwriter’s Laboratories
U.S.	United States

B-2 DEFINITION OF TERMS

Sash Operating door on lab fume hood

UFC 4-390-01
23 July 2003

UNIFIED FACILITIES CRITERIA (UFC)

OPERATION AND MAINTENANCE: UNMANNED PRESSURE TEST FACILITIES SAFETY CERTIFICATION MANUAL



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UNIFIED FACILITIES CRITERIA (UFC)

OPERATION AND MAINTENANCE: UNMANNED PRESSURE TEST FACILITIES SAFETY CERTIFICATION MANUAL

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

_____

This UFC supersedes Military Handbook 1039/2, dated 30 June 2000. The format of this document does not conform to UFC 1-300-01, however it will be reformatted at the next revision.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

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CHAPTER 1

INTRODUCTION

1-1 **PURPOSE AND SCOPE**. This UFC is comprised of two sections. Chapter 1 introduces this UFC and provides alternate requirements of other Tri-Service agencies. Appendix A contains the full text copy of the previously released Military Handbook (MIL-HDBK) 1039/2. This UFC serves as criteria until such time as the full text UFC is developed from the MIL-HDBK and other sources.

1-2 **APPLICABILITY**. This UFC applies to all Navy service elements and Navy contractors; all other DoD agencies may use either document unless explicitly directed otherwise.

1-2.1 **Air Force Requirements**. Air Force pressure vessels must be inspected in accordance with AFI 32-1068, *Heating Systems and Unfired Pressure Vessels* as a minimum. Air Force Bases may adopt as an alternative to AFI 32-1068, procedures of this UFC for inspection and certification of unfired unmanned pressure vessels.

APPENDIX A

MILITARY HANDBOOK 1039/2
UNMANNED PRESSURE TEST FACILITIES SAFETY CERTIFICATION MANUAL

ABSTRACT

This document is approved for use by all departments and agencies of the Department of Defense (DOD).

Unmanned pressure test facilities have been in use by DOD personnel for centuries. To date there has not been a requirement to have these specialized facilities certified. Certification has been a standard requirement for all other classes of pressure vessel and certification standards and criteria has been developed for each class of pressure vessel. One such standard is MIL-HDBK-1152, Inspection and Certification of Boilers and Unfired Pressure Vessels. This document has been used by public works boiler and pressure vessels inspectors in an attempt to certify unmanned pressure test facilities. However, the criteria contained in MIL-HDBK-1152 are inappropriate for this type of pressure vessel. This document is written with the hopes of providing criteria and guidance for the certification and safe use of these specialized types of pressure vessels.

UNMANNED PRESSURE TEST FACILITIES
SAFETY CERTIFICATION MANUAL

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Section 1: INTRODUCTION

1.1 System Certification. This document provides specific certification guidelines for the design, construction, modification, repair, operation, and maintenance of Department of Defense unmanned pressure test facilities. Except as noted in par. 1.4, Department of Defense unmanned pressure test facilities include all pressure vessels used for testing and evaluating equipment or for unmanned medical or physiological experiments. System certification is a recommended prerequisite for all unmanned pressure test facilities used or operated by Department of Defense personnel, military or civilian. This prerequisite pertains to in-service systems built by the Department of Defense or private industry and privately owned systems that are under contract and operated by Department of Defense personnel. Exemptions from system certification may be granted through an operational waiver granted by the NAVFAC System Certification Authority (SCA).

1.1.1 Objective. The objective of system certification is to verify, by means of an independent technical review and evaluation, that when approved operating and maintenance procedures are followed, the pressure vessel system provides acceptable levels of safety to personnel and property throughout its specified operating range. This objective is accomplished by performing a detailed review of the material and procedural adequacy of the system.

1.1.2 Principal Participants. The principal participants in the system certification process are: (1) the system sponsor, (2) the system applicant, and (3) the SCA, NAVFACENGCOM.

1.1.2.1 System Sponsor. The system sponsor is normally the organizational unit responsible for funding the development, construction, repair, alteration, operation and/or maintenance of the unmanned pressure test facility. For systems already in existence and having achieved initial certification (see Section 3), the sponsor will normally be the parent command.

1.1.2.2 System Applicant. The applicant is normally the organizational unit responsible for the day-to-day operation and maintenance of the system. The applicant applies to the SCA for certification, and deals directly with the SCA in all certification related matters.

The sponsor and the applicant may be the same organizational unit, as in the case of an Acquisition Manager applying for initial certification of a newly developed system. Throughout the remainder of this document, only the term applicant is used when discussing the certification process. This does not, however, exclude the sponsor from participation in the process wherever appropriate.

1.1.2.3 SCA. The certification process is most effective and least complicated when:

a) The applicant designates a single, knowledgeable individual to serve as the point of contact for the certification effort.

b) The applicant has a clear understanding of the certification process.

c) The SCA has a clear understanding of the candidate system.

d) The SCA and the applicant communicate freely and frequently.

The importance of a continuing exchange of information between the applicant and the SCA cannot be overemphasized. Through open discussions and negotiation, the applicant and the SCA can establish a realistic balance between cost and time considerations and system certification objectives. Also, the SCA will gain a better knowledge and understanding of the candidate pressure vessel system through frequent contact with the applicant.

The ability of the system either to fulfill its mission or to meet program goals, other than safety, is not within the purview of the SCA.

1.2 Standard DOD Syntax Summary. This document utilizes standard DOD syntax regarding permissive, advisory, and mandatory language. Intended word meanings are as follows:

a) "Must" has been used only when application of a procedure is mandatory.

b) "Should" has been used only when application of a procedure is recommended.

c) "May" and "need not" have been used only when application of a procedure is discretionary.

d) "Will" has been used only to indicate futurity. It is never to indicate any degree of requirement for application of a procedure.

1.3 Purpose. The purpose of this document is to describe the system certification process and to provide guidance in implementing a certification program. Technical information and justification submitted by the applicant forms the basis for determining the material and procedural adequacy of each system

to perform safely. This document describes the procedures and criteria used by the SCA that must be followed by the applicant.

Sections 2 through 5 provide detailed information about the certification process and the documentation required by the SCA. Appendices A and B provide technical requirements that must be met to successfully achieve certification. Appendix C provides guidance for the required documentation. Glossary contains a list of definitions. In hopes of achieving a more comprehensive understanding, readers are encouraged to review these definitions before proceeding with the remainder of the document.

1.4 Scope and Applicability. As stated previously, the scope of this document includes unmanned pressure test facilities used for testing and evaluation purposes or for unmanned medical or physiological experiments. It also includes the associated piping, mechanical, and electrical subsystems required to operate these pressure vessels. It further ensures the safety of operating personnel and the protection of property. Safety of the objects or subjects being tested is not within the scope of this document.

More specifically this document applies to pressure vessels of the classes described in Tables 1 and 2. Examples include, but are not limited to:

a) Pressure vessels used to subject test article(s) to a simulated Deep Ocean Environment using a liquid (incompressible) or gaseous (compressible) media
b) Pressure vessels that perform Medical Research using compressible test media (air, helium, helium/oxygen, hydrogen, hydrogen/oxygen, etc,)
c) Pressure vessels that perform helium soak (integrity) testing of components that will later be subjected to a Manned Hyperbaric Environment

Pressure vessels used for the storage of gases or liquids are covered by other standards such as MIL-HDBK-1152, American National Standards Institute (ANSI) NB-23, National Board Inspection Code, or Department of Transportation (DOT) specifications. Also, open tanks and towers used for testing equipment are not within the scope of this document.

1.4.1 Unmanned Pressure Test Facility Classification Criteria. Classification of the unmanned pressure test facility should be determined as follows:

a) First, choose the appropriate classification with regard to design pressure and size of the vessel in accordance with Table 1.

b) Secondly, review pressurization media of the test

facility in accordance with Table 2. The most restrictive classification derived from the two tables should apply.

For further clarification of certification requirements for each pressure vessel class, see Table 3.

1.5 System Certification Procedures. The basis for system certification will be the evaluation of the OQE (refer to par. 2.5.2 for definition) submitted by or in the custody of the applicant and such on-site surveys and audits as are deemed necessary by the SCA. Where applicable, OQE should, encompass areas of:

a) Design

b) System drawings

c) Materials of construction

d) Construction, fabrication, and assembly

e) Quality assurance/control

f) Testing

g) Operability

h) Maintainability

Table 1
Unmanned Pressure Test Classification

	=< 6" I.D. Any Length	> 6" I.D. to 5 ft^3	> 5 ft^3 to 50 ft^3	> 50 ft^3
< 15 psig	Not Required	Not Required	Not Required	Class C
15 to 150 psig	Not Required	Class C	Class B	Class A
> 150 to 600 psig	Class C	Class B	Class A	Class A
> 600 psig	Class B	Class A	Class A	Class A

Table 2
Pressurization Media

	< 15 psig	15 to 150 psig	> 150 to 600 psig	> 600 psig
Pressure Media Liquid	Not Required	Class C	Class B	Class B
Pressure Media Gas	Not Required	Class B	Class A	Class A
Pressure Media Hazardous[(1)] (Gas or Liquid)	Class A	Class A	Class A	Class A

[1]Hazardous Media is defined as any gas or liquid that is flammable, toxic, or poisonous

1.5.1 New System. For a new system design, the applicant should present OQE documenting the above areas to the SCA during one or more formal design/construction reviews as appropriate. Preparation and presentation of this OQE must be specifically required by the terms of the contract or specifications and is the responsibility of the applicant. For a newly fabricated system which is an exact duplicate (e.g., design, material, depth limits, temperature, environment, etc.,) of a certified system, on-site surveys of the configuration, quality control, testing records, previous certification documents, and a demonstration of the system may provide sufficient OQE.

1.5.2 Existing System. For a system already in existence and possibly in service, the assembly of sufficient OQE might require considerable effort. If OQE is not retrievable, the information may have to be recreated. To recreate OQE, the applicant may have to resort to nondestructive and/or destructive testing, inspection, and design review analysis. The applicant should consult with the SCA for direction as to the required OQE necessary to certify the existing facility based on its intended use.

The criteria required by this document will not necessarily cause the system certification of current tenure to be suspended or terminated prior to normal expiration. However, all recertifications and continuances should be judged using the criteria established by this document.

It must be recognized that new information that may become

available during the on-site survey, or subsequent to certification, may indicate the existence of an unsafe condition that previously had not been identified. In such cases, when the potential danger from the newly reported condition warrants, the SCA will direct a reevaluation of the system design. Suspension or termination of certification may result.

Section 2: THE SYSTEM CERTIFICATION PROCESS

2.1 Introduction. This section explains the major events during the system certification process and provides information for assisting the applicant in preparing the required documents (refer to Appendix C). Figure 1 represents the sequence of the major events and identifies whether the action is the responsibility of the SCA or the applicant. The Glossary defines the terms used throughout the certification process. These definitions should be reviewed before proceeding with the remainder of this document.

2.2 Application for System Certification. The certification process begins when the applicant submits a letter to the Commander, NAVFACENGCOM, in standard DOD format, requesting certification of his or her unmanned pressure test facility. The application should include the following items:

a) Identification of the applicant and a point of contact

b) General system description

c) Desired system use, type of intended testing

The SCA should respond to the application, making comments as appropriate, and request funding and request submission of the following documents:

a) Scope of Certification (SOC)

b) Milestone Event Schedule (MES)

c) System drawings

2.2.1 Scope of Certification (SOC). The applicant should submit a detailed list of all portions of the system and its ancillary equipment, which are expected to fall within the SOC as defined in the Glossary. The SOC boundaries will be approved or modified by the SCA.

As an aid in defining the SOC, especially for complex systems, the applicant is referred to the hazard analysis techniques described in the Hazard Analysis section of MIL-STD-882, System Safety Program Requirements. Additional guidance is provided by the hazard categories defined in par. 2.2.2 and Figure 2.

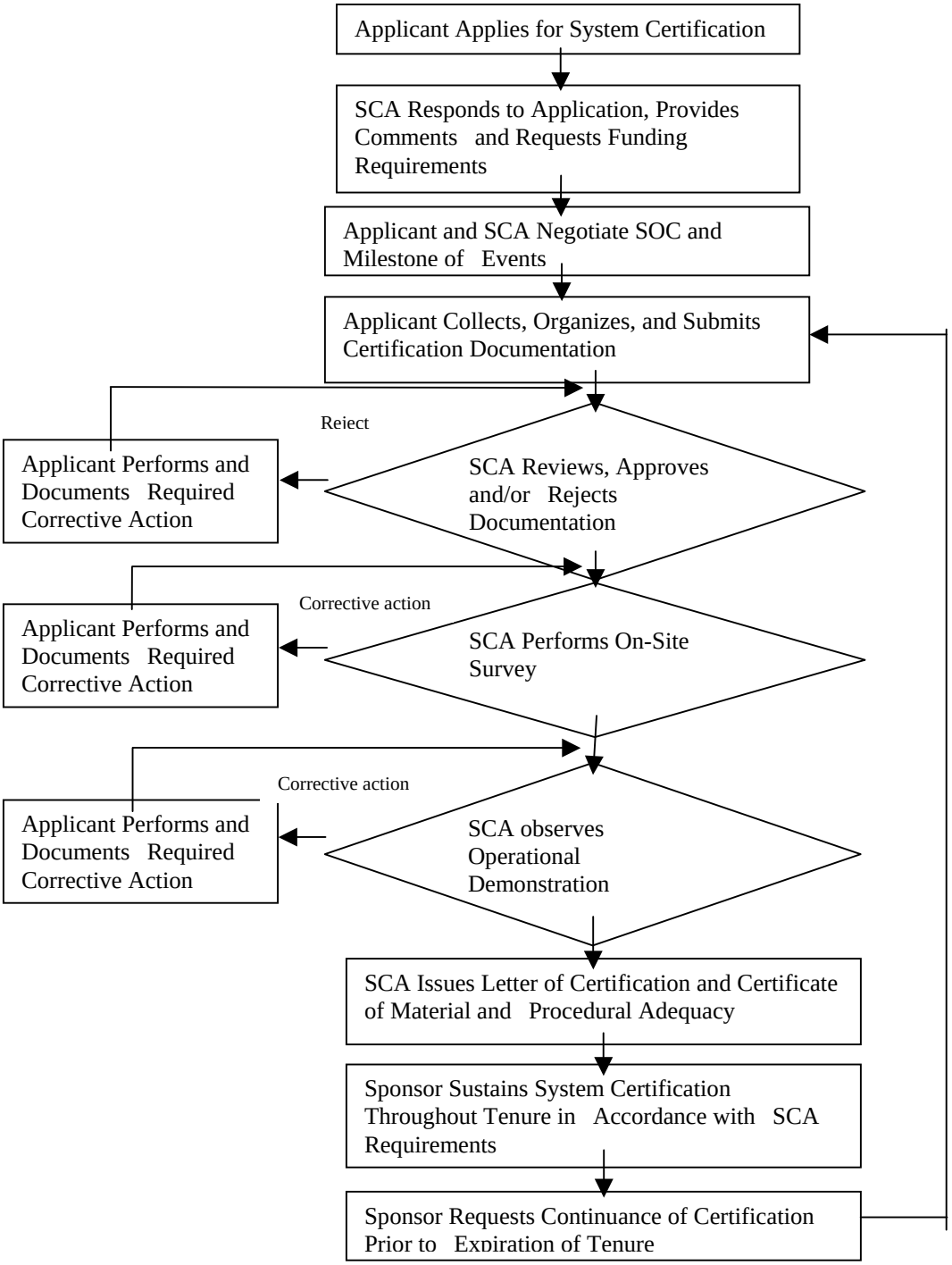


Figure 1
Certification Sequence of Events

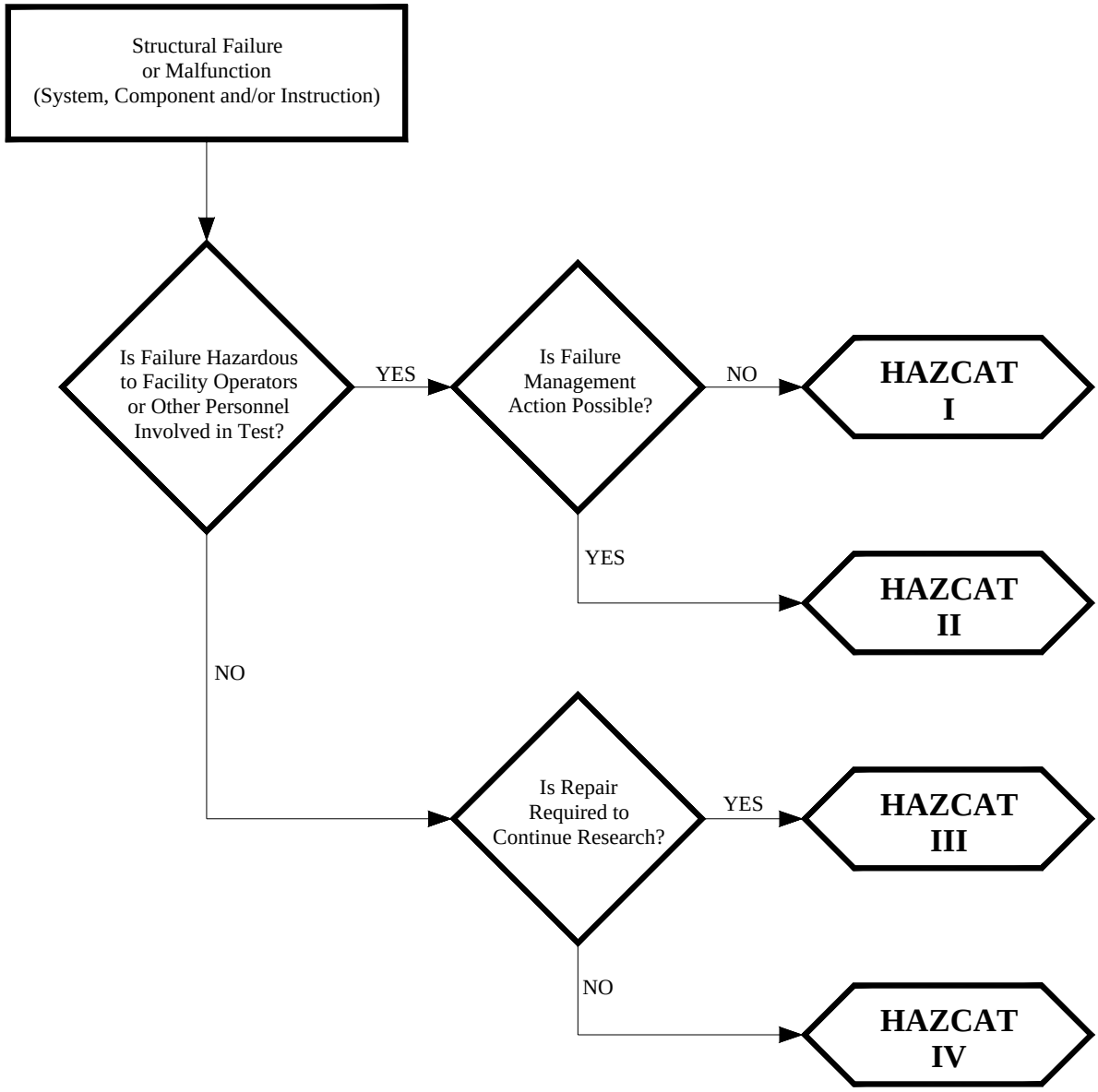


Figure 2
Hazard Category Identification

It is recognized that individual system designs will vary to such an extent that no single list can encompass the entire spectrum of SOC's. The following is a list of specific areas that generally require inclusion in the SOC. This list is provided for purposes of illustration and should not be considered as all inclusive or universally applicable:

a) Pressure hull, pressure vessels, hard structure, and appurtenances (penetrations, seals, etc.,).

b) Life support subsystems that provide an acceptable atmosphere for unmanned medical and physiological experiments.

c) Pressurization and depressurization systems including, but not limited to, piping systems and pressurized storage facilities.

d) Non-compensated equipment, subject to pressure, which may implode or explode.

e) Fire fighting devices or subsystems.

f) Electrical power subsystems that include internal and external electrical protective devices where failure could result in malfunction of a critical component or subsystem or create a shock hazard.

g) Subsystems and components that protect personnel directly or indirectly against the effects of accidents and hazards.

2.2.2 Hazard Category Criteria. In the analysis of a structural or functional failure of a system, equipment, or component, the following hazard category (HAZCAT) evaluation criteria are used (Figure 2 is used as a guide):

a) HAZCAT I. Catastrophic failure, which exposes operator/test personnel to hazards that would likely result in death, or severe injury (permanent total disability). Upon failure, operator action cannot be taken to manage or mitigate the hazards. Testing operations aborted.

b) HAZCAT II. Critical failure, which exposes operator/test personnel to hazards that would likely result in injury (permanent partial disability). Upon failure, operator action can be taken to manage or mitigate the hazards. Testing operations likely aborted.

c) HAZCAT III. Marginal failure, which would not likely expose operator/test personnel to any significant hazards. Upon failure, operator action is required to manage or repair the failure; otherwise testing operations must be aborted.

d) HAZCAT IV. Negligible failure, which would not likely expose operator/test personnel to any significant hazards. Testing operations may continue without management action.

Note – the above hazard categories do not contain a probability of mishap occurrence. These categories suggest a probability of end result associated with the hazard severity. HAZCAT I and HAZCAT II categories are acceptable only when the probability of mishap has been mitigated by design, testing, procedures, and inspection to improbable, as defined by MIL-STD-882.

2.2.2.1 HAZCAT Guidelines. Generally, most components within a specific system are all the same HAZCAT. Since HAZCAT I designation means a malfunction endangers the lives of operator/test personnel and no failure action is possible, stricter material selection and control; fabrication and installation procedures; and quality control testing is required on these items.

Likewise, HAZCAT II items have more stringent requirements than HAZCAT III and HAZCAT IV items. Additionally it is recognized that failure of a HAZCAT II item, such as a pressurized gage isolation valve, could result in operator death or severe injury. However, the probability that the severity would be as great as that encountered during failure of a HAZCAT I item (such as a pressure vessel) is considered improbable. Therefore, when determining HAZCAT boundaries, engineering judgment on a case basis, as well as consultation with the SCA, may be required.

The following guidelines are provided to assist in the determination of HAZCAT designations:

a) HAZCAT I items include the pressure boundary to which the operator/test personnel are exposed and the first pressure piping isolation valves connected to the pressure boundary. HAZCAT I items, dependent on design of the facility, may also include other system piping and components. For example, if hazardous gases or fluids exist, then all piping and components containing them would be HAZCAT I. Items include:

(1) Pressure vessel and hatches

(2) Pressure vessel view ports

(3) Pressure vessel penetrator fittings

b) HAZCAT II items include systems, equipment, and components which have sufficient isolation boundaries that injury can be precluded by securing the source of pressure, gas flow, fluid flow or electrical power. Items include:

(1) Ancillary piping, high pressure gages and instrumentation, and associated valves/components

(2) Electrical switch gear

c) HAZCAT III items include systems, equipment, and components that failure would compromise the research/test being conducted. Items include:

(1) Pumps

(2) Control valves

(3) Monitoring and control instrumentation

d) HAZCAT IV items include systems, equipment, and components that are not critical to the research or test evolution and can be repaired at a convenient time. Items include:

(1) Filtration equipment

(2) Building support systems

2.2.3 Milestone Event Schedule (MES). The certification MES should include a list of sequential events in the certification process with estimated dates of completion. The time required for documentation submissions, technical reviews and deficiency should be considered in the MES to ensure timely completion of the certification process prior to the desired system use date. Figure 3 is an MES for a typical system. It may be reproduced and filled in and submitted by the applicant. If it does not meet the needs of a particular system, the applicant may develop and submit one of original design. The initial MES may be submitted at the same time the initial SOC is submitted or may be submitted after the SOC has been approved by the SCA.

2.3 Submission of Supporting Documentation. Utilizing the approved SOC as a guide, the applicant should prepare and submit the following documentation in accordance with the MES:

a) Design review information.

(1) System drawings

(2) Design calculations

(3) Hazard analysis

b) Construction, fabrication, and assembly information

c) Quality program information

d) Test program information

e) Operating and emergency procedures

f) Maintenance procedures

g) Configuration management plan

Additional information may be required in the course of the certification process to fully justify any area that concerns the SCA.

2.4 Review and Approval of Supporting Documentation. All supporting documentation submitted should be reviewed by the SCA for technical adequacy and for conformance to the requirements of this document. When additional technical expertise is required, the SCA may obtain assistance from the headquarters technical staff or such other experts as may be appropriate. Design information should normally be reviewed during formal design reviews. Obtaining SCA concurrence with the design is strongly recommended prior to beginning construction.

2.5 On-Site Survey. As required, the SCA and his designated representative should conduct one or more on-site survey(s) of the system. The purpose of a survey is to verify that the "as-built" system has been fabricated in accordance with the approved documentation and that it can be operated safely and maintained effectively. Each survey should be officially requested in writing by the applicant and confirmed by the SCA. A request for a survey should be made to the SCA at least 90 days prior to the desired date of the survey. Normally, a survey should not be scheduled until after the system drawings and operating and emergency procedures have been approved.

2.5.1 Survey Team Personnel. The SCA will assemble a survey team to perform an on-site survey of the system. The type and complexity of the system will determine the size and make-up of the survey team. Typically, the areas of expertise of the survey team will include mechanical, electrical, hydraulic, ocean, and structural engineering. Quality assurance (QA) specialists may also frequently be included. For a relatively simple system, a single individual may represent the SCA.

2.5.2 Objective Quality Evidence (OQE). OQE is any statement of fact, either quantitative or qualitative, pertaining to verification of the quality of a product or service based on observations, measurements, or tests. Evidence will be expressed in terms of specific quality requirements or characteristics. These characteristics are identified in drawings, specifications, and other documents that describe the item, process, or procedure. One of the main objectives of the survey is to review

the OQE to ensure that the system is actually built as designed and that it will perform safely to the limits for which certification is requested. Accordingly, the survey team will review OQE in sufficient detail and depth to support a conclusion as to the acceptability of the system. The applicant should ensure, prior to a survey, that necessary OQE not previously submitted to the SCA is readily available for the survey team. Appendix C provides additional guidance on OQE.

SYSTEM:_____ INITIAL SUBMISSION DATE:_____ SCA APPROVAL:_____
REVISION:_____DATE:_____

EVENT																						
Design Review Information																						
Scope of Certification (SOC)																						
Pre-Survey Outline Booklet (PSOB)																						
Summary Description of System																						
Design Parameters																						
Subsystem Descriptions																						
Design Analysis																						
System Drawings																						
Operability & Maintainability Procedures																						
Justification of Materials																						
Toxic & Flammable Materials Data																						
Atmosphere Analysis																						
Hazard Analysis																						
Fabrication Procedures																						
Work Procedures																						
Process Instructions																						
Welding Procedures																						
Brazing Procedures																						
Assembly Procedures																						
Cleaning procedures																						
Quality Assurance Procedures/Data																						
Design & Drawing Control Data																						
Material Control Data																						
Fabrication & Manufacturing Control Data																						
Cleaning Control																						
Testing & Inspection Control																						
Test Plan																						
Individual Test Procedures																						
Test Procedures Index																						
Test & Inspection Results																						
Re-Entry Control Data																						
Operating																						
Maintenance Records																						
Correct Discrepancies																						
On-Site Survey																						
Correct Discrepancies																						
Certification Dive																						
Receipt of Certification																						

Figure 3
System Certification Milestone Event
Schedule
15

Instructions: For each event applicable to the applicant’s system, enter the date of completion in the appropriate box of the 24-month grid provided.

2.5.3 Survey Coverage. The survey should include, but not be limited to, a review of the following items:

a) As-built drawings and documentation of the system

b) Drawing control procedures and records

c) QA procedures, results, and records

d) Non-destructive testing (NDT) qualifications and records

e) Construction, fabrication, assembly, and test procedures results, and records (e.g., welding/brazing procedures, records, and personnel qualifications)

f) System proof and performance test procedures and results

g) System cleaning procedures and results, including sampling points and pass/fail criteria

h) Accessibility to vital equipment and components

i) Quality of workmanship

j) System component identification and color coding

k) Gauge, instrument, and relief valve calibration data

l) Repair and maintenance procedures and records

m) Re-entry control procedures and records

n) Operating and emergency procedures (OPs and EPs)

o) A physical review of system hardware to determine general material condition

p) Operational demonstration of the system using the OPs and EPs

2.5.4 Preparation for Survey. The applicant is responsible to make every effort to prepare in advance for the on-site survey. All formally documented procedures requiring SCA review and approval should have been provided to the SCA prior to requesting the survey. The system should be operationally ready and all obvious deficiencies corrected prior to commencement of the survey. The supporting OQE discussed throughout this document should be available at the survey site in an organized fashion. It is essential that qualified personnel, knowledgeable in all aspects of the system (operation, design, testing, QA, maintenance, etc.,), be available and ready to assist the survey

team. It is important to note that the applicant is responsible for the accuracy and completeness of documents presented regardless of their source. The applicant or designated representative should review all records and data supplied from industrial or support activities prior to the survey. Those that are incomplete or in error will be rejected and returned for correction. All documentation should be presented in an organized and audit ready form. The SCA should be able to quickly and easily trace the documentation to the hardware and vice versa.

2.5.5 Survey Guidelines. As in all safety related inspection programs, the intentional concealment of known deficiencies by either action or inaction is deliberate malpractice and could result in death or serious injury. Deficiencies that are known to the applicant and inadvertently overlooked by the survey team should be brought to the attention of the SCA and discussed. Certification survey cards should not be viewed as representative of either command or personal failure. Rather, cards should be viewed as the subjective findings of personnel, who are conscientious and responsible for ensuring the safety of the operators and the protection of property.

2.6 System Certification Survey Cards. Deficiencies noted during the survey and recommended corrective action will be documented in the form of System Certification Survey Cards (SCSCs). Survey cards are classified by the SCA as follows:

a) Category 1A. Corrective action must be accomplished prior to use of the system. For an unmanned pressure test facility that has already been certified, the issuance of a Category 1A SCSC should result in either the termination or suspension of the existing certification. Prior to further use of the system, full re-certification or removal of the suspension by the SCA is required.

b) Category 1B. Corrective action must be accomplished prior to system certification. The issuance of a Category 1B SCSC should permit use of the system for the purpose of operational demonstration pursuant to certification only.

c) Category 1C. Corrective action must be accomplished prior to the date or event specified on the card to sustain certification. Certification, sustaining certification or continuation of certification may be granted in the interim. Unless advance justification is provided, failure to correct the deficiency and notify the SCA officially in writing by the specified date or event should cause termination or suspension of certification.

d) Category 1D. Corrective action must be accomplished on specified component and SCSC cleared prior to its use, while the over all system retains it’s certification.

e) Category 2. Corrective action is desirable, but not mandatory. Category 2 deficiencies may be corrected at the applicant's option, but should be addressed by the applicant even if no action is taken.

Each card has space for the survey team to record its findings and recommendations. Separate space is provided for a statement of corrective action. Figure 4 is a sample SCSC. At the conclusion of the survey, a critique will be held. The survey team leader will review and discuss all survey cards and their recommended corrective actions with the system applicant or his designated representative. The critique is open to all interested parties. Frank discussion and free exchange of information are encouraged. Any disagreement by the applicant with the findings or with the categorization of any of the SCSCs should be discussed during the critique. Further, if the applicant has completed some or all of the corrective action for one or more of the deficiencies found, he should make this information known at the critique.

The survey team leader may, as a courtesy, leave preliminary copies of the survey cards. These copies are for discussion purposes only. Expenditure of resources should not be undertaken based on these unofficial cards as they are subject to change prior to official issue.

Upon completion of the survey, the SCA will forward the results of the survey team's evaluation of the system to the applicant for action, via the appropriate chain of command. The SCA will provide copies of the survey cards to other activities, when requested by the applicant. If many Category 1A or 1B survey cards are issued during a survey, a follow-on survey may be required. If a follow-on survey is necessary, the SCA will inform the applicant in writing. The SCA may revise a card or downgrade an SCSC category after its initial issuance. Reasons for revising an SCSC include:

a) A partial clearing of the deficiency.

b) A change in the nature of the deficiency based on additional information.

c) Discovery of a new deficiency closely related to deficiency already documented on an SCSC.

d) Splitting a single SCSC into multiple SCSCs for ease of tracking status by subsystem.

A SCSC may be downgraded if it can be shown that the lower category is more appropriate than the originally assigned category. SCSCs that include more than one recommended corrective action would not normally be revised based solely on the completion of one of the recommended corrective actions. SCSCs may be revised or downgraded either unilaterally, by the

SCA, or based on a request from the applicant.

When action identified by a specific card has been completed, a brief summary should be written on the card and the card signed by a senior representative of the applicant. Cards must then be returned to the SCA, via the chain of command, for clearing. Should the clearing of the card involve supporting documentation (e.g., re-entry control forms, test memos, NDT records, calibration data, etc.,), the documentation should be referenced on the card and copies returned with it. When the submitted corrective action is satisfactory to the SCA, two representatives of the SCA should sign the card and return it to the applicant. Normally, one of the signing individuals will be the one who wrote the card. Double signature by the SCA will clear the card. If the action taken by the applicant does not satisfy the finding, but instead alters the system mission so that personnel safety will no longer be an issue, the SCA may cancel the card. The applicant may, with supporting justification, request that an SCSC be canceled. The request to cancel a card should be documented by the applicant on the card with the technical justification attached to the card. A senior representative of the applicant and two representatives of the SCA must also sign canceled cards. The SCA will normally provide copies of officially cleared or canceled cards to the applicant for record purposes.

All Category 1A and 1B deficiencies must be cleared or canceled prior to certification. Category 1C deficiencies must be cleared or canceled prior to the date or event specified by the SCA to sustain certification. Category 1D cards must be cleared prior to use of the specified component. Category 2 deficiencies may be corrected at the applicant's option, but should be addressed by the applicant even if no action is taken. Following the granting of either initial certification or re-certification of an unmanned pressure test facility, there are two additional times when survey cards may be issued. These are:

a) During a survey performed within the tenure of certification to ensure that certification is being adequately sustained.

b) During a survey requested by the applicant to continue certification beyond the original tenure of certification.

CARD NO.: _____
SER #: _____

SYSTEM CERTIFICATION SURVEY CARD

ORGANIZATION:

SYSTEM:

ITEM:

CATEGORY OF DEFICIENCY:

TEAM MEMBER: SURVEY DATE: _____

(A) FINDINGS:

(B) RECOMMENDATIONS:

(C) DATE CORRECTIVE ACTION MUST BE COMPLETED:

(D) CORRECTIVE ACTION:

(E) VERIFICATION OF CORRECTIVE ACTION: I have reviewed the Corrective Action and consider it to fully correct the Findings

_____ _____
SENIOR SYSTEM REP DATE POSITION

(F) CORRECTIVE ACTION IS SATISFACTORY:

_____ _____
SCA TEAM MEMBER DATE NAVFAC OOCE DATE

Figure 4
Sample System Certification Survey Card

2.7 Operational Demonstration. A satisfactory survey including correction of all Category 1A discrepancies may permit, with the concurrence of the SCA, the commencement of a certification operational demonstration to the depth or pressure limits stated in the certification application. The SCA or his appointed representative will participate in or observe the operational demonstration of the system. The SCA may elect not to observe an operational demonstration of an unmanned pressure test facility that has had a history of safe and satisfactory performance.

The SCA may certify or re-certify an unmanned pressure test facility for full certification depth based on operational demonstrations to a depth less than the full certification depth. This alternative can be exercised by the SCA for those systems that have a history of safe and satisfactory performance and pressurization to full depth is not possible or practical.

The certification operational demonstration may be conducted in conjunction with other DOD program requirements. Satisfactory completion of the certification operational demonstration and clearing of all open Category 1B SCSCs generally will justify the granting of system certification.

2.8 Issuance of Certificate. A certificate of Certification of System Adequacy may be issued by the SCA after the successful completion of the operational demonstration and the correction of deficiencies. The SCA should specifically state the operational limits, parameters and tenure for which the certification is granted. The SCA should also specify the terms and conditions of system certification and additional requirements as appropriate. The officer in charge of the facility is thereafter responsible for sustaining system certification and requesting continuation of system certification or re-certification.

2.9 Tenure of Certification. Tenure of certification is the length of time for which certification is granted. The tenure of certification for unmanned pressure test facilities should be determined by the guidelines provided in Table 3. The granting of system certification, by the SCA, does not automatically ensure that it will remain in effect for the full, stated period. System certification should not be granted for the entire design life of the system. The tenure of system certification may be negotiated to coincide with planned events such as overhaul or refurbishment.

Table 3
Unmanned Pressure Test Facility Certification Requirements

CLASS - A	CLASS – B	CLASS - C
3yr SCA Visit	6yr SCA Visit with 3yr documentation review	6yr Certification, No SCA Visit, submit documentation
-Initial Certification 1yr	-Initial Certification 1yr	-Initial Certification 1yr, no SCA visit
-Test Reliefs 1 time per Cert cycle (3yrs)	-Test Reliefs 1 time per Cert review (3yrs)	-Test Reliefs 2 times per Cert cycle (3yrs)
-Gauge Cal 24mos for critical gauges	-Gauge Cal 24mos for critical gauges	-Gauge Cal 24mos for critical gauges
-OQE/Documentation/ for new Cert, design modifications and maintenance	-OQE for new Cert and any design modifications	-OQE for new Cert and any design modifications
-Re-Entry Control Program, CWP, and Maintenance Manual	-Maintenance Log required	-Maintenance Log required
-OP/EP SCA Approval	-OP/EP Local Approval	OP/EP Local Approval

2.9.1 Termination or Suspension of System Certification

2.9.1.1 Termination of Certification. Termination of certification is a withdrawal of system certification. Once certification is terminated, the system cannot be re-certified without a complete SCA review of all work undertaken since the last certification survey.

2.9.1.2 Suspension of Certification. Suspension of certification is a temporary withdrawal of certification that remains in effect while one or more actual or potential violations of the terms of certification are investigated and corrected. Use of the system during the suspension is not authorized. Prior to reinstating system certification, an on-site review of the problem area(s) by the SCA may be required.

Once the deficiencies are corrected to the satisfaction of the SCA, the original system certification will be reinstated.

2.9.1.3 Conditions for Termination or Suspension. System certification may be terminated or suspended, at the discretion of the SCA, as a result of the following:

a) Violation of the limits or terms of the letter granting certification (e.g., pressure, time, temperature, etc.,).

b) Recognition of the existence of an unsafe condition.

c) Expiration of tenure of system certification.

d) Modifications to equipment or components within the SOC without the concurrence of the SCA.

e) Overhaul, repair, or alteration, as defined in Section 5.

f) Expiration of a lease contract.

g) Failure to correct Category 1C cards by specified date or event.

h) Issuance of a Category 1A or 1B survey card.

i) Casualty to the system pending the issuance of an investigative report dealing with the incident.

2.9.2 Sustaining System Certification. Sustaining system certification comprises those actions required of the applicant to ensure the SCA that the facility remains in the as-certified condition throughout the tenure of certification. As stated previously, granting system certification does not automatically ensure that system certification will remain in effect for the full certification period. The responsibility for sustaining system certification during the certification period rests with the officer-in-charge of the facility.

2.9.2.1 Design Changes and Alterations. SCA concurrence must be obtained for any design changes or proposed alterations to equipment within the SOC, or which could impact the SOC. Each proposed design change or alteration should contain an evaluation of the effects of the change to the safe operation, of the system, in accordance with the requirements of this document. Accomplishment of design changes and alterations within the SOC without SCA concurrence should result in termination or suspension of system certification.

2.9.2.2 Repairs and Maintenance. The facility should be

maintained so that all systems, subsystems, and components within the SOC are functioning properly, in an as-certified condition, prior to each operational use.

All work and testing accomplished during routine repairs and maintenance should be in accordance with the requirements in Section 5. Only qualified personnel should perform repairs, maintenance, inspections and testing. Documentation requirements for repairs, non-routine maintenance, and testing should be recorded in accordance with the requirements of Appendix C.

2.9.2.3 System Certification Survey. A system certification survey, as described in par. 2.5, may be performed when deemed necessary by the SCA as a condition of sustaining or continuing system certification. Unsatisfactory survey results may result in termination or suspension of system certification.

2.9.2.4 Operating Limits. The system should be operated only within its certified operational limits. Operation outside of the authorized limits without a valid waiver is not allowed and may result in termination or suspension of system certification. Any violation should be immediately reported to the SCA, stating the cause or justification.

2.9.2.5 Unusual Situations. The SCA should be advised of any situation, which may prevent the system from maintaining its intended operational capability. These may include, but are not limited to, exceeding certified pressure, physical damage, fires, emergency pressure excursions, and casualties resulting in injury or death. Further, a report should be submitted containing an evaluation of the extent of damage, proposed repair methods, and probable cause of the emergency (e.g., personnel error, nature of the operations, system or component failures, etc.,). It is not intended that these emergency situations include failures that only temporarily interrupt the operational capability of the system and are corrected by routine repairs.

2.9.3 Continuation of System Certification. Continuation of system certification is an extension by the SCA of the certification period beyond that initially granted. This is normally done to permit continued use of a system that has had no changes to the basic design, SOC, or general operating characteristics and where the material condition of the system will support the continuation. During this continuation of system certification, all requirements noted in par. 2.9.2 should be observed. The applicant should arrange with the SCA for a continuation of certification and should submit a request for an on-site survey no less than 90 days prior to the desired certification date.

2.9.4 Re-certification. Re-certification is a new certification of a system where the existing certification has expired or has been terminated. To re-certify a system, the SCA

should determine those requirements of this document that must be accomplished. Following a re-certification, all requirements noted in par. 2.9.2 should be observed.

2.9.5 Extension of Certification. The SCA may extend system certification for short duration in three cases:

a) When emergency operational commitments of the system prevent it from being available for an on-site survey at the time of the expiration of certification.

b) When the system is scheduled for overhaul within 90 days after expiration of the current certification.

c) When the SCA is unavailable due to prior commitments.

Extensions of certification will be granted only for systems that have required no more than routine maintenance and repairs during the original tenure of certification. Any non-routine work performed on the system should be reported to the SCA. The SCA requires equipment hydrostatic test dates, gage calibration dates and a statement that the system is operational prior to granting an extension of certification. If requested, the applicant should provide the SCA with a list of all work accomplished on the system during the tenure of certification and justification for the request for an extension.

2.10 Transfer of System Custody

2.10.1 Permanent Transfer. Unmanned pressure test facilities may be permanently transferred. The SCA should be kept apprised of all pending transfers. After authorization for a permanent transfer has been granted, the following action should be accomplished:

a) The custodial command should inform the recipient command of the operational condition of the system, including all operational and documentation deficiencies and outstanding SCSCs.

b) The custodial command should prepare a "turnover file" consisting of as-built system drawings, all re-entry control documentation, test records, technical manuals, operating and emergency procedures, a complete Preventive Maintenance System (PMS) package, and all certification survey documentation from previous surveys. The turnover file should accompany the system to the recipient command.

2.10.2 Recipient Command. After receipt of the system hardware and certification documentation, the recipient command should take the following action:

a) Establish a formal QA plan and re-entry control procedures.

b) Verify that system drawings, technical manuals, and operating and emergency procedures reflect the as-built condition of the system. All required drawings and operating and emergency procedure revisions should be submitted to the SCA for review and approval.

c) Initiate the preventive maintenance plan for the system.

d) Request an on-site survey of the system by the SCA.

Upon completion of a successful on-site survey, the SCA will grant the system a new certification. This procedure applies to all systems.

Section 3: INITIAL CERTIFICATION

3.1 Introduction. This chapter describes the criteria that must be met to obtain initial certification for an unmanned pressure test facility. Assembly of the necessary OQE and adherence to these criteria should coincide with the design and construction or fabrication of the new system. For a system designed, manufactured, and placed in service outside the purview of this document (i.e., a system built by and for private interests, placed in service, then purchased by DOD), the task of assembling the necessary documentation may be very difficult, if not impossible. In such cases, additional testing and analysis is generally required. The level of documentation complexity will vary according to the class of the facility. (See Tables 1 and 2.)

3.2 Design Review Information The applicant should submit the documentation and evidence described in the following paragraphs to the SCA for review and approval. During review of this evidence, the SCA may require the applicant to supply additional information. If, in the course of supplying information required by the SCA, it becomes necessary for the designer and or builder to disclose information he considers proprietary or classified, he should so identify it. The SCA should cooperate with the designer and builder in the protection of such information.

The design documentation submitted by the applicant for review and approval should include the following:

a) SOC

b) MES

c) Summary description of the system

d) Subsystem descriptions

e) Design parameters

f) Design analysis

(1) Design calculations

(2) Stress analysis

g) System drawings

h) Operability and maintainability criteria and procedures

i) Justification of materials

j) Flammable materials data

k) Hazard analysis

For new systems, the applicant should provide items (a) through (e) above to the SCA for review and/or approval prior to conducting formal design reviews.

Items (f) through (k) should be forwarded to the SCA by the applicant at least 60 days prior to convening each formal design review or as required by the MES. The number and scope of formal design reviews will be governed by the size and complexity of the system and can be negotiated between the applicant and the SCA.

3.2.1 System Scope of Certification and Milestone Event Schedule. The applicant should submit the SOC and MES (both described in Section 2) to the SCA for review and approval.

3.2.2 Summary Description of the System. To aid the SCA in performing a safety evaluation, the applicant should submit a summary description of the pressure vessel system including design and construction details. A written explanation of the features of the system, along with appropriate schematic drawings should be included. The content of the summary description should be commensurate with the complexity of the system. Simple systems need only brief summary descriptions; complex systems obviously require more detail.

3.2.3 Subsystem Descriptions. Each subsystem within the SOC should be described. These subsystems normally include fluid systems, electrical systems, compressed air and gas systems, and other significant mechanical, electrical, or structural features required for the complete operation of the facility.

Each subsystem design submitted must include both a written description and a function or flowchart diagram. The description should clearly delineate objectives of the design. Safety considerations should also be included. It should also include an analysis of the consequences of a failure or loss in the normal operating mode. The diagram should clearly show how the subsystem accomplishes its intended function. Sufficient information should be included to identify the specific components and their location, size, material, etc.

3.2.4 Design Parameters. Design parameters of the system must be identified. Design parameters provide the basis for evaluating system adequacy. Design parameters that the applicant must consider and which will be evaluated by the SCA include:

a) Design safety factors

b) Design life and service period (useful life, number

of cycles, etc.,)

c) Effect of ambient operating conditions and the effect of mechanical shock and vibrations on design life

d) Depth and pressure limitations

e) Design temperature limits

f) Identification of anticipated hazards

g) Corrosion allowance and resistance requirements

h) Soil and foundation considerations where applicable

i) Floor loads including hydrostatic test weight

3.2.5 Design Analysis. A complete and thorough design analysis should be submitted for SCA review and concurrence. The design analysis should consist of formal design calculations and a complete stress analysis as explained below.

3.2.5.1 Design Calculations. Design calculations should be submitted for SCA review and concurrence to demonstrate the adequacy of design. All assumptions should be clearly stated. Calculations should show the effect of building to worst-case dimensions and tolerances. Potential effects of corrosion should be considered. Appropriate reference should be made to applicable test data or operating experience when either is used to support a calculation technique. Design calculations should clearly show the adequacy of the item analyzed in terms of the system design parameters. Information must be submitted in sufficient detail to permit independent analysis of the design. Documentation submitted by the applicant should be tabulated to ensure that the information completely covers the design.

3.2.5.2 Stress Analysis. Applicant should verify the adequacy of the design by performing detailed stress analyses and, when appropriate, by conducting the tests described herein. Applicable sections and provisions of pressure vessel and piping design codes should be applied. Test programs in support of system certification should consider all ramifications of the stress analyses. Stress analyses and test reports submitted by the applicant should also consider the most critical loading case which includes the cumulative detrimental effects of design allowances, dimensional variations, and tolerances. Applicant may request that specific designs utilizing standard materials or components be exempted from stress analysis, based on technical justification. In cases where the pressure boundary is a unique and complex shape, destructive testing may be required if the validity of a stress analysis is in question. The SCA will then make a determination of those materials and systems that do not

require the stress analyses and will inform the applicant whether material may be exempted.

Examples of loads to be considered are:

a) Weight of water used for hydrostatic testing

b) Static loads imposed by the clamping or securing devices used to secure the system

c) Maximum operating pressure of the gas or fluid within the system

d) Thermal stresses due to the operating temperature range of the system

e) Reactions due to differential thermal expansion between the system and the structure to which it may be fixed or due to elastic expansion of the system caused by internal pressure

f) Shock, including accidental blows

g) Vertical and horizontal loads on foundations where applicable

h) Seismic requirements where applicable

i) Dynamic loads, such as those encountered from collapse of any non-pressure-compensated elements

j) Fatigue loads of the pressure resisting components and piping for a specified number of cycles

3.2.6 System Drawings. Certification of all unmanned pressure test facilities should require drawings meeting the requirements of MIL-DTL-31000, Technical Data Packages or acceptable commercial standards and which are adequate to support technical design reviews. The level of drawing detail should reflect the level of design maturity that has been attained at the time of each design review. The function and complexity of the subsystem being reviewed should determine the number and type of drawings required for an adequate technical design review. In addition to showing system and subsystem configuration, drawings normally required to support a technical design review must have adequate detail to show material, fabrication, cleaning, testing, and special assembly requirements. In most cases where mechanical or electrical systems are being reviewed, system schematic diagrams with the above information are acceptable. However, where critical equipment such as the pressure hull is being evaluated, actual assembly or fabrication drawings are required for the final design review. The applicant should submit up-to-date copies of drawings, signed by the appropriate

technical agent, for each subsystem to be evaluated during a design review.

Each component that provides a control, sensing, or similar essential function that impacts the operation of the system (valves, gauges, pressure regulators, etc.,) should have a unique identifier made up of a system designation and a number. A table should be provided identifying system designations. These unique identifiers should be shown on the drawings and should be used in the operating and emergency procedures.

When the final system design has been approved, a complete set of product drawings should be produced and distributed as determined by the Acquisition Manager. Where appropriate, the drawings should specify any special material control requirements. The Acquisition Manager should confer with the SCA to determine which drawings will be required to maintain system certification and should ensure that those drawings are distributed to the activity that will operate the system after initial system certification has been achieved. The system operators will then continuously keep those drawings current by ensuring that they reflect as-built system configuration. This may be accomplished by "red-line" marking of the drawings. Red line drawings must be officially revised after each system overhaul or major configuration change, whichever comes first. All drawing revisions should be formally documented and the reason and authority for each revision should be explicitly stated on the drawing. Each component or item on the as-built drawings should be identified by the manufacturer's model or type number, part number, vendor identification, applicable military specification, federal specification or standard as appropriate.

3.2.7 Operability and Maintainability. The criteria and procedures for which operation and maintenance are based should be explained and supported by technical manuals and other documentation. Include emergency procedures.

3.2.7.1 Operating and Emergency Procedures. The applicant should develop and submit operating and emergency procedures that cover all foreseeable normal and emergency evolutions the system may be required to undergo. Refer to par. 3.6 for detailed requirements concerning operating and emergency procedures.

3.2.7.2 Maintenance Procedures. The applicant should provide the SCA with formal maintenance procedures for all systems, subsystems and components within the scope of certification. This requirement can be met using DOD PMS and pre- and post-operational procedures. These procedures will be considered in the certification process as they relate to safe operation of the system.

3.2.8 Justification of Materials. All materials and their applications, used in the design of an unmanned pressure test facility, should be justified. It is not the intent of this document to limit materials and their applications. New materials, or time-tested materials in new applications, may be used if sufficient data exists to ensure the material adequacy of the system. Justifying data must include the requirements for care, preservation and maintenance of new materials for the projected life cycle of the material. The less information and experience available concerning a given material for a specific application, the greater the burden upon the applicant to justify the proposed material for the application. For the purpose of system certification, types of materials and components are grouped into three categories that are defined in Appendix A.

3.2.8.1 Design Practices. When required by the SCA, material selection, design, and fabrication techniques should be justified in accordance with military and recognized commercial engineering practices. Proper consideration should be given to complex configurations and intersections, cyclic fatigue, and low temperature requirements. Examples of recognized engineering design practices are:

a) American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section VIII, Divisions 1 and 2

b) ASME PVHO-1, Safety Standard for Pressure Vessels for Human Occupancy

c) NAVFAC Design Manual (DM)-39, Hyperbaric Facilities

d) ASME B31.1, Power Piping Code

3.2.8.2 Design Criteria. For typical design criteria of unmanned pressure test facilities, the applicant should refer to the following appendices of this document:

a) Appendix A: Categorization of Scope of Certification Materials and Components

b) Appendix B: Design Parameters for Unmanned Pressure Test Facilities

c) Appendix C: Required Documentation

3.2.9 Flammable Materials Data. The applicant should submit, for review and approval, a list of all potentially flammable materials to be used during construction, or to be installed or used in the unmanned pressure test facility. Flammable materials are those which will ignite or explode from an electric spark or when heated and will continue burning in the presence of air or in any oxygen-enriched atmosphere. Flammable materials should be evaluated under both normal and emergency atmospheric conditions. As applicable, all material data should be submitted in standard

Material Safety Data Sheet (MSDS) format.

3.2.10 Hazard Analysis. As part of the design process, a hazard analysis must be performed to evaluate the effects of all possible failures. The hazard analysis must be performed assuming that only one failure occurs at a time, not multiple failures occurring at the same time. The applicant should submit the hazard analysis of the system for review and approval by the SCA. The hazard analysis should describe the possible effects of a mechanical failure or an operator error for each component or subsystem. Those failures that could affect personnel safety should clearly show what features, warnings or procedures have been incorporated into the design, operation, and maintenance of the system to preclude or minimize the probability of failure. It is the responsibility of the applicant to ensure that conditions identified as significant safety hazards are eliminated or reduced to the lowest practical level.

Mishaps are not always the result of equipment failure. Human error, when responding to a routine command, a minor problem, or operation of a control function at the wrong time can result in a catastrophe. Operating and emergency procedures must be specific, clear and concise to avoid confusion. The hazard analysis should show that this type of failure has been considered in the design of the system and that safeguards have been taken to reduce the likelihood of such an occurrence. MIL-STD-882 provides an acceptable set of guidelines for the conduct of a hazard analysis. The application and tailoring guidelines given in MIL-STD-882 should be carefully followed to make the hazard analysis no more complicated than is necessary to prove the safety of the design. Hazard Categories, as they pertain to unmanned pressure test facilities, are defined in Section 2.

3.3 Fabrication And Assembly Documentation is required to verify that fabrication and assembly procedures meet engineering standards necessary to deliver a safe, reliable system. Copies of all documentation must be submitted with the certification package or otherwise made available for SCA review in a manner negotiated between the SCA and the applicant. All written fabrication and assembly processes that may affect the designed performance of the system must be identified. Documentation must include fabrication drawings and specifications, as well as supplementary information, not necessarily specified on the drawings, but which affects the process. Information of importance includes, but is not limited to the following:

a) Fabrication/assembly procedures

b) Process instructions

c) Welding procedures

d) Brazing procedures

e) NDT procedures

f) Cleaning procedures

g) Quality assurance procedures and inspections

h) Personnel qualifications

i) Fabrication and assembly documentation

j) Any other processes, procedures, or instructions required for construction of the unmanned pressure test facility

Adequacy of these processes must be substantiated by a history of satisfactory use or by documented qualifications and tests.

3.3.1 Fabrication/Assembly Procedures. Fabrication/assembly procedures must define the scope of work and provide production personnel with step-by-step instructions on how the work is to be accomplished. When fabrication/assembly procedures are written to accomplish repairs, maintenance or modifications, they should state the specific reason for performing the work. These instructions are required wherever fabrication, assembly, cleaning and/or testing of components or systems, within the SOC boundaries, is to be performed during initial certification. Fabrication/assembly procedures should also provide all inspection and retest requirements and any warnings or cautions that must be observed while performing the work. Fabrication/assembly procedures should be generated prior to commencing work. Where work procedures already exist (e.g., technical manuals, standard process instructions, approved drawings, PMS, etc.,), the specific paragraphs from those documents should be called out in the fabrication/assembly procedure. The person responsible for the work, inspections and retest of the system or component should sign each work procedure. Any change to the scope of work being performed should cause a revision to the fabrication/assembly procedure to be issued. All fabrication/assembly procedures should be made available to the SCA for review during on-site surveys.

3.3.2 Process Instructions. Process instructions are those standardized procedures that have been developed by a production activity for work that they commonly perform. To be used in a fabrication/assembly procedure, the process instruction must provide step-by-step instructions for accomplishing the work. All process instructions that the production activity intends to use during fabrication or repair of an unmanned pressure test facility should be provided to the SCA for review. In some cases, (e.g., welding, brazing, NDT and cleaning), the SCA or his designated representative must approve process instructions prior

to use.

3.3.3 Welding Procedures. All welding should be performed in accordance with written and approved welding procedures (see 3.3.2). Welding procedures must include requirements for documenting welder qualification and criteria for weld joint acceptance. The applicant must make available the written welding procedures and the welder qualification records, including any destructive/nondestructive test records required for proof-of-welder qualification on the specific material selected, for SCA review. Any repair involving heat or welding should be accomplished in accordance with approved written procedures and subjected to the tests and inspections specified for construction. All welded pipe joints must be documented and inspected in accordance with the P-1 requirements in NAVSEA S9074-AR-GIB-010/278 or ANSI/ASME B31.1, Power Piping, as supplemented by NAVFAC required inspections and documentation. The fabrication activity must provide traceability between the joint record and the actual welded joint for each welded pipe joint or structural weld joint.

The following procedures are typical of satisfactory welding practices:

NAVSEA S9074-AR-GIB-010/278, Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping and Pressure Vessels

NAVSEA T9074-AD-GIB-010/1688, Requirements for Fabrication, Welding, and Inspection of Submarine Structure

MIL-STD-1689, Fabrication, Welding and Inspection of Ships Structure

ANSI/ASME B31.1, Power Piping (with additional NAVFAC inspection/ documentation)

The following procedures are typical of satisfactory welder qualification practices:

NAVSEA S9074-AQ-GIB-010/248, Requirements for Welding and Brazing Procedure and Performance Qualification

ASME Boiler and Pressure Vessel Code, Section IX, Welding Qualifications

3.3.4 Brazing Procedures. In piping systems fabricated with brazed joints, all brazing should be performed in accordance with written and approved brazing procedures (see 3.3.2) which meet or exceed the requirements of Class P-3A, Special Category I, Table 3.1, described in NAVSEA 0900-LP-001-7000, Fabrication and Inspection of Brazed Piping Systems. Brazing procedures must

include requirements for documenting brazier/brazing operator qualification and criteria for brazed joint acceptance. The applicant must make available the written brazing procedures and the brazier/brazing operator qualification records, including any destructive test records required for proof of brazier/brazing operator qualification, for SCA review. Any repair to joints involving heat or brazing should be accomplished in accordance with approved written requirements and subjected to, as a minimum, the tests and inspections specified for construction.

For all brazed piping systems, ultrasonic testing is required only for those brazed joints located between the chamber hull and the first manually operated stop valve external to the chamber hull. When ultrasonic testing or other nondestructive tests are required on brazed joints within the SOC, the test records should be made available to the SCA for review. All records should clearly indicate that each joint has met the specification requirements and must be signed by a qualified inspector.

3.3.5 Non-Destructive Testing. All nondestructive test (NDT) records of welds performed within the SOC should be made available to the SCA for review. All NDT records should clearly indicate that each joint has satisfactorily met or exceeded the specification requirements and must be signed by a qualified inspector.

3.3.6 Assembly Procedures. Special procedures for assembly of components and systems (e.g., torque specifications, lubrication requirements, etc.,) should normally be called out in technical manuals and on approved drawings. Where used, assembly procedures should be issued prior to the start of production and should be followed by personnel performing the work. All assembly procedures to be used should be called out in the fabrication/assembly procedure. When assembly procedures are provided as drawing notes or technical manuals, the fabrication/assembly procedure should call out the specific paragraphs that apply. Assembly procedures should be verified as completed by the person responsible for the work and these records should be available for SCA review during the on-site survey.

3.3.7 Cleaning Procedures. Where applicable, cleaning of piping systems should be performed in accordance with approved written cleaning procedures. Cleaning may be accomplished during fabrication/assembly, upon final completion of assembly, or in a combination of both, in accordance with the overall contamination control process developed by the production activity or invoked by the applicant. Cleaning procedures should include methods for sampling and criteria for acceptance. Quantitative analysis to verify system cleanliness must be performed prior to use of the system. Hydrocarbon contamination is of particular concern because hydrocarbons may be flammable. For guidance in cleaning

and analysis, refer to Appendix B.

3.3.8 Quality Assurance Procedures and Inspections. Prior to any work on an unmanned pressure test facility, the applicant should prepare a formal Quality Assurance (QA) plan that lists the procedures to be followed and the inspections to be performed. In cases where costly or non-typical work is to be done, it is strongly recommended that the applicant submit the QA plan to the SCA for concurrence. Past experience has demonstrated that significant time, effort and cost savings can be realized when the SCA has reviewed and concurred with the proposed QA plan prior to commencing work.

3.3.9 Personnel Qualifications. Where required by specification or standard, personnel involved in critical fabrication and inspection procedures must be trained and qualified to perform such tasks. The qualification records of welders, braziers and NDT inspectors should be up to date and available for SCA review.

3.4 Quality Assurance Program. The QA program should be a planned and systematic pattern of all the actions necessary to provide adequate confidence that the facility conforms to established technical requirements. The applicant should ensure that QA provisions are maintained which demonstrate that a system meets these requirements. The quality assurance provisions should result in recorded data related to:

a) Configuration management and drawing control

b) Material control

c) Fabrication and manufacturing control

d) Cleanliness control

e) Testing and inspection control

f) Fabrication/assembly procedures

The vigorous enforcement of a comprehensive QA program for all parts of the system in which failure can result in a hazard to personnel will greatly decrease the chance that substandard workmanship practices or materials will degrade the safety of the system. QA provisions are more easily applied during construction of a system. However, it is the responsibility of the applicant to establish means by which the quality of an existing system may be evaluated. QA programs developed in accordance with ISO 9000, International Standards for Quality Management, or similar industry-developed standards are typical of satisfactory practices.

QA and personnel safety are inseparable. QA considerations are required in all areas that affect the safety of the system operators. These areas include, for example, initial forming, fabrication, assembly, cleaning, testing, inspection and preparation for delivery of all SOC items. The authority and responsibility of QA personnel in each of these areas should be clearly delineated. Manufacturing, fabrication, and assembly work conducted within the builder's plant, system maintenance facility or industrial activity should be carefully controlled. Such control should include a formal review and an engineering evaluation of all manufacturing processes, tolerances and deviations. An equally effective control over purchased materials and subcontracted work should be provided.

It is incumbent upon the applicant to conduct periodic internal QA audits during the course of production work. Internal audits often uncover deficiencies that, if left uncorrected, could cause extensive rework with associated cost and schedule overruns. The applicant should submit and retain copies of information relative to the quality provisions in sufficient depth, detail and organization to permit audit and evaluation by the SCA. QA documentation should be legible, accurate and complete. Each document should be dated and signed and should indicate, by the signature, that the work or procedure meets the requirements of the approved QA Plan. Such data is vital in the effort to sustain/continue certification. The applicant is responsible to make arrangements for the retention, storage and retrieval of all QA documents. The applicant should advise the SCA prior to disposing of such records.

3.4.1 Configuration Management and Drawing Control. The applicant is responsible for establishing configuration control of the unmanned pressure test facility design and documentation. The applicant must ensure that only current drawings are used and that obsolete drawings are removed from all points of issue and use. The applicant should maintain the technical data and drawings that reflect as-built conditions of the system.

3.4.2 Material Control. The applicant should show that the program for material control is effective for new construction and during overhaul or repair of existing systems. The program should ensure that materials used conform to the applicable technical requirements. A system of documenting the identity of tested and approved materials should be implemented. Controls should be established to prevent the inadvertent use of other than specified material. See Appendix C for material OQE requirements.

3.4.3 Fabrication and Manufacturing Control. The applicant should show how the QA program ensures that the system has been manufactured in accordance with the approved drawings, specifications and manufacturing processes. All production

records required by the fabrication specifications and drawings should be completed, signed, dated, and made available, as appropriate, for review by the SCA.

The hazards associated with the performance requirements of an unmanned pressure test facility dictate that only the highest quality workmanship be acceptable. Consequently, the evaluation of the workmanship evident in the finished system is a significant factor in determining the acceptability of the individual system. Acceptance standards to verify high quality workmanship are available from both military and commercial sources that establish acceptance/rejection criteria.

3.4.4 Cleanliness Control. The applicant should show that the program for achieving and maintaining cleanliness of all piping systems is under the close control of the builder during and after system assembly.

The applicant should use only SCA approved cleaning procedures during and after system fabrication. Failure to keep these systems clean may cause serious injury or death to the system operators. Appendix B provides additional guidance concerning cleanliness control of unmanned pressure test facilities. Once a system is verified clean within acceptable limits, no re-entry is allowed into that system without strict adherence to re-entry controls. Any uncontrolled opening of an unmanned pressure test facility to the surrounding atmosphere may require re-cleaning of the entire system to re-establish system cleanliness.

The final levels of cleanliness should meet the requirements that have been specified and justified by the applicant and that have been accepted by the SCA. Records of the date, method and results of sampling should be kept and made available to the SCA for review. Documentation of system cleanliness should include cleaning sheets and sketches and should indicate that each component, section or subsection of a system has been satisfactorily cleaned and that the entire system is free of contamination.

3.4.5 Testing and Inspection Control. The applicant should show that there is an effective test and inspection system in place. The system must establish the inspections and tests necessary to substantiate that items within the SOC are in conformance with the specified requirements. All inspection and test requirements should be identified in the fabrication/assembly procedures. The inspection system should incorporate clear, complete, and current instructions for inspection and should include criteria for acceptance and rejection. Records of all inspections and tests should be maintained and should indicate the nature and number of observations made the number and type of deficiencies found and the nature of the corrective action taken. Where no deficiencies are found, the satisfactory condition should be noted. All test and inspection documents should clearly show the following as a

minimum:

a) The testing activity.

b) The items, subsystems, and systems tested.

c) The procedure used, including minimum acceptance criteria (where applicable).

d) Test results that either meet or exceed requirements. Departures from test requirements must be justified, documented and approved by the cognizant technical authority.

e) The dated signatures of individuals responsible for testing and final evaluation of test data.

The inspection system should serve to verify that the latest applicable drawings, specifications and process controls, with all authorized changes incorporated, are used for fabrication, inspection and testing. The inspection system should describe the training and qualification of inspectors and should include demonstration of competency in techniques such as radiographic, ultrasonic, dye penetrant and magnetic particle inspection, as applicable. The inspection system should also provide for calibration of inspection equipment. In those areas where competence in technique must be demonstrated, it is imperative that the inspection be conducted by a qualified person other than the person performing the work to be inspected, unless specifically allowed by the inspection criteria; e.g. NAVSEA 0900-LP-001-7000, Fabrication and Inspection of Brazed Piping Systems. Test documents and data that fail to meet test criteria, are incomplete or are not technically evaluated and signed off as satisfactory by an authorized representative of the applicant will be rejected by the SCA. Additional guidance concerning test requirements is provided in Appendix C.

3.5 System Testing Program. The applicant should develop and implement a written test program. It should outline a comprehensive and integrated series of tests which fully demonstrates the adequacy of all systems and equipment within the SOC.

The test program should be approved by the SCA prior to execution and should be kept current by the applicant so that it can be utilized for future testing required to sustain certification. The test program should not be revised without prior approval by technical authority and the concurrence of the SCA.

The applicant must provide test results (data) to the SCA for review. Approval will be dependent upon satisfactory results and evaluation by an authorized representative of the applicant.

3.5.1 Test Categories. The test categories listed in items (a) through (d) below must verify that the candidate system

operates safely as designed. Upon satisfactory completion of these tests, the applicant should request an on-site certification survey.

a) Factory acceptance tests (FAT). This category covers testing performed by an equipment or component manufacturer to ensure that the material functions in accordance with specified limits. FATs should be required on all material where operation is of such a critical nature that failure to perform within the specified limits would jeopardize the safety of the operators. Testing of this material at the factory is usually required in cases where material/component testing is of such a specialized nature that the unmanned pressure test facility fabricator may not have the necessary test apparatus. Acrylic for view ports is an example of material that requires a FAT.

b) Prototype/first article testing (PFT). This category of test may be required to prove the design of critical components or entire systems that are developmental in nature. Performance of materials, components and systems that are unique or untried in a similar environment and are within the Scope of Certification (SOC) must be demonstrated by such tests. PFTs will often incorporate life cycle testing to verify that a component or system will operate within design limits and will not fail prematurely.

c) Pre-installation and Pre-operational tests. Pre-installation tests (PIT) are those tests that are performed on components prior to installation in a system (often referred to as bench tests). Hydrostatic and bench seat tightness testing of valves are examples of PIT level testing. Pre-operational tests (POT) are those tests performed at the system level, but prior to operating the system. Insulation resistance and continuity tests and mechanical system tightness tests are examples of POT level testing. These tests should normally be conducted on each system produced.

d) System operational and system integration tests. System operational tests (SOT) are required to verify that separately each subsystem operates satisfactorily within its design parameters. System integration tests (SIT) are performed to verify that all subsystems can be operated concurrently, as designed. SITs are also used to verify that the system operating procedures can be used to operate the system safely prior to conducting operational testing.

3.5.2 General Requirements for Test Procedures. The applicant should submit an index of all FATs, PFTs, PITs, POTs, SOTs and SITs test procedures to the SCA, indicating those within the Scope of Certification. The design agent should approve all SOTs and SITs test procedures. Once the test procedures have been approved, the test director is authorized to modify them to

suit conditions prevailing at the time of the test. For example, the test director may authorize the substitution of a piece of test equipment for one called out in the test procedure because of availability. However, only the design agent may authorize changes to a test parameter, such as a test pressure. Operational and system integration test procedures for systems within the SOC must be reviewed by the SCA. The format of the test procedures should provide both the test procedure and the data to be collected in a single document.

As each step in the test procedure that requires data to be recorded is satisfactorily completed, the witnessing representative of the builder's test or QA organization should so indicate by his dated signature. If the test requires that a particular parameter be within a specified range, both the range and the actual value must be recorded.

A test schedule should be provided to allow the SCA to schedule his presence at the test site for those tests he chooses to witness. The SCA reserves the right to require a rerun of any or all of the system operational and integration tests if results are not clear or are inconclusive. Upon completion of all system testing, an indexed documentation package containing all completed tests that were evaluated with satisfactory results should be provided to the SCA.

Specific component and system testing requirements are provided in applicable sections of Appendix B and C.

3.6 Operating And Emergency Procedures (OPs and EPs). The applicant should make normal and emergency operating procedures available for review by the SCA. For Class A Systems, all operating and emergency procedures should be approved in writing by the SCA. During the on-site survey, the SCA will verify the adequacy of and the operators' compliance with the OPs and EPs. Compliance with approved operating and emergency procedures is a requirement for sustaining system certification. Any changes to these procedures must have the approval of the SCA. For Class B and C Systems, OPs and EPs may be approved at the local level. Written operating and emergency procedures are required for the following purposes:

a. To ensure that the normal operation of the facility is within the range of conditions for which certification is granted

b) To ensure that there are adequate procedures to cope with emergencies

c) To ensure that there are checklists of prerequisites for various major evolutions (e.g., pre- and post-operational procedures)

d) To ensure that the duties of operating personnel are adequately defined

e) To ensure that up-to-date information is available for the training of operators and that it is consistent with safe operation of the facility

The procedures should be supplemented as necessary by diagrams, system alignment procedures, system shutdown procedures, pre- and post-operation procedures and other such procedures as they relate to normal and emergency operations. Component designation on all operating and emergency procedures must be consistent with the system drawings and as built conditions. Refer to Appendix C for a sample of an operating or emergency procedure form (Figure C.9).

Specific emergency procedures are dependent upon the type and complexity of the facility involved. Conditions typically covered by emergency procedures include rapid increase/decrease in pressure and fire in the building.

Additional emergency procedures may be required depending on the type and complexity of the system.

Operating and emergency procedures for systems within the SOC should be demonstrated during the on-site survey. This should include a demonstration of the accessibility to vital equipment or systems to ensure that personnel can safely operate the equipment and systems under normal and emergency conditions. Where an actual demonstration is not practical, the applicant may propose an alternate means of demonstrating acceptability of the procedures. In cases where it is found that a procedure cannot be performed in a satisfactory manner, the applicant must prepare an acceptable procedure for accomplishing the desired objective.

3.7 Maintenance Program. Sustaining system certification is predicated on maintaining the system in the "as certified" condition. The applicant must prepare a maintenance program that includes, as a minimum, the following elements:

a) Preventive maintenance procedures including calibration and alignment of instrumentation and servicing of other equipment in the facility

b) Corrective maintenance procedures that include repair and replacement of components and spare parts control

c) For Class A Systems, the applicant should ensure that a system of controlled work procedures (CWPs) and reentry control have been formally promulgated. For complex systems, the SCA may request that the CWP format be submitted for review. When a system has been cleaned and/or tested in accordance with certification requirements, no re-entry into that system should

be accomplished without strict adherence to the CWPs. For further information, see Appendix C

The applicant should provide instructions for conducting periodic inspections and tests to ensure continued safe operation of the system. The instructions should include the scope of the inspections and tests and should provide pass/fail criteria. Maintenance should be conducted on all items of equipment within the SOC. NAVFAC MO-406, Hyperbaric Facilities Maintenance Manual may be used as guidance. For other systems covered by this document, the applicant should submit a formal preventive and corrective maintenance program to the SCA for concurrence. In addition to the above elements, this program should include personnel responsibilities and provide both record keeping requirements and detailed, step-by-step procedures.

3.8 Operating And Maintenance Manual. Depending on the complexity of the facility, operating and maintenance manuals may be required. These manuals should describe all equipment and all phases of system operation. The following sections should be included, as applicable:

a) System Description. This section should identify and describe the purpose and functional operation of all systems and subsystems. System drawings should also be

b) Component Description. Sufficient design information should be included to identify and describe all major system components and their functions. Component drawings showing internal parts should be included.

c) Instrumentation and Controls. This section should discuss the control philosophy used in the system design and provide a detailed description of the controls and instrumentation used.

d) Operating Procedures. This section should identify all normal system operations and evolutions that involve personnel. The approved operating procedures may be provided as part of this document or separately if desired.

e) Emergency Procedures. This section should identify conditions requiring emergency action and provide procedures to be followed in the event of their occurrence. Emergency action is defined as operation under conditions of system malfunction or failure such as component failure, physical damage, or fire. The approved emergency procedures may be provided as part of this document or separately if desired (See 3.6.).

f) System Limitations, Precautions, and Set points. In this section, the applicant should clearly identify all system operational limitations. This section should also state all precautions to be taken during normal operation to preclude

potentially unsafe conditions. A list of system operation set points that represent the normal operation of the system should be included.

g) System Maintenance. This section should describe all required preventive maintenance and basic repair procedures for supporting the facility. All components that must be repaired by the manufacturer or depot level repair facility should be identified. While step-by-step detailed preventive maintenance procedures may be promulgated separately, the basic repair procedures should be included in this section.

h) System Storage and Start-up. This section should describe all disassembly and maintenance required to place the system in lay-up for an extended period of time. Additionally, instructions for system start-up, after extended storage, should be provided. These instructions should include all assembly, maintenance and testing required to bring the system out of storage and into an operationally ready condition.

i) System Troubleshooting. This section should provide guidance to be used to assess the symptoms, then locate and repair probable causes of a system malfunction. For the procedures used to repair failed components, this section may refer to the section on system maintenance.

3.9 Granting Initial Certification. The responsibility of the Acquisition Manager is defined in Section 4. It is the responsibility of the Acquisition Manager to ensure that the system is considered certifiable prior to its transfer to a user command. To be certifiable, the SCA must concur that all system design, fabrication and testing has been performed satisfactorily, in accordance with previously approved technical specifications. In addition, all system drawings, technical manuals, PMS and certification related documents should have been approved and issued. Custody of an unmanned pressure test facility will normally be transferred from the Acquisition Manager to the user command once the SCA deems the system certifiable but prior to granting initial system certification.

In addition, the Acquisition Manager should prepare a "turn-over file" consisting of as-built system drawings, fabrication records, test records, technical manuals, operating and emergency procedures and a complete Preventive Maintenance System (PMS) package. The turnover file should accompany the system to the user command.

After receipt of the system hardware and certification documentation, the user command should take the following action:

a) Establish a formal QA plan

b) Initiate the preventive maintenance plan for the system

c) Review and submit any necessary operating and emergency procedures to the SCA

d) Request an on-site survey of the system by the SCA

Upon completion of a successful on-site survey the SCA will grant the system "Initial Certification“.

Section 4: RESPONSIBILITIES OF THE ACQUISITION MANAGER

4.1 Introduction. This section defines the responsibility of the Acquisition Manager in relation to certification requirements for unmanned pressure test facilities built for use by DOD personnel. The Department of Defense acquisition program is set forth in the DOD Federal Acquisition Regulations Supplement (DFARS). The management of acquisition programs is guided by DOD Directive 5000.1 A Defense Acquisition, and DOD Instruction 5000.2 Defense Acquisition Management Policies and Procedures. In addition, system safety certification procedures must be clearly defined and strictly followed in every phase of the procurement process. This is due to the life critical nature of unmanned pressure test facilities, with particular attention being applied in regards to safety to outside operators and other personnel in the vicinity of the unmanned pressure test facility. Therefore, the Acquisition Manager should establish the certification effort in the earliest conceptual phase of the program.

The Acquisition Manager is designated as the applicant for initial certification of a new facility until the new facility is delivered to the designated user activity. Early and frequent communication between the applicant and the SCA is essential to the efficient prosecution of the system certification process. This point cannot be overemphasized.

In all aspects of the certification process, the line of communication is between the SCA and the applicant and not between the SCA and the contractor, manufacturer or procurement agency hired or contracted by the Acquisition Manager to provide the unmanned pressure test facility. While discussions and conferences with these organizations are useful, the line of action and responsibility is between the SCA and the applicant.

During a major overhaul or repairs involving configuration changes to the system, the individual parent command should assume the responsibilities of the Acquisition Manager.

4.2 System Certification Requirements In Contracts. The Acquisition Manager who contracts for or otherwise arranges for the design, construction, testing and delivery of a new unmanned pressure test facility must translate system certification criteria and documentation requirements, clearly and concisely, into contract specifications. The use of this document as a contract reference document, which allows the contractor to interpret certification requirements, should be avoided. If a contractor anticipates lease or purchase by DOD of an unmanned pressure test facility, he is building, he should become familiar with the documentation requirements necessary to support the system certification process.

However, lease or purchase agreements entered into by DOD must be specific enough in content to preclude any interpretation of the

requirements of this document by manufacturers or vendors. Areas of particular importance in the preparation of contract specifications are described in the following paragraphs.

4.2.1 Material Specifications. All materials used for the construction, fabrication and assembly of parts, components, subsystems and systems which are within the scope of certification must meet or exceed the specifications set forth in Appendix A. This material should also be provided with documented objective quality evidence (OQE) and test data verifying its acceptability, in accordance with Appendix C. The Acquisition Manager should ensure that contract specifications are complete and accurate in this respect and that deviations from these specifications are authorized only with the approval of the appropriate technical authority and the concurrence of the SCA.

4.2.2 Performance and Procedure Specifications. The Acquisition Manager should ensure that the performance and procedure specifications for the construction, fabrication and assembly of the facility are clearly and accurately described in contract documents.

4.2.3 Quality Assurance (QA). The Acquisition Manager should ensure that contract documents require the contractor to provide a Quality Assurance Program plan that specifically addresses the critical requirements of system certification. Contract documents should recommend the designation of a certification manager within the contractor's organization who will serve as a single point of contact between the contractor and the Acquisition Manager on matters concerning system certification.

4.3 Document Control. It is the responsibility of the Acquisition Manager to ensure that adequate document control procedures are developed and implemented in the earliest phase of the procurement process and that these procedures are strictly adhered to in every phase and at all levels of the procurement process. All documentation required by this document should be reviewed and evaluated by the Acquisition Manager, or his agent, prior to submission to the SCA. If an agent is used, the agent should not be affiliated with the fabricator.

4.4 Preparation Of Certification Application. The Acquisition Manager, as system applicant, should prepare and submit the application for system certification. The application for system certification should be prepared in accordance with the provisions of Section 2 of this document and should be submitted to the SCA with all required documentation attached.

4.5 Configuration Management Plan. The Acquisition Manager, as system applicant, should ensure that a configuration

management plan is developed and prepared during the appropriate phase of the procurement process. DODINST 5000.2 provides policy and guidance for the preparation of configuration management plans.

4.6 Technical Design Reviews. The Acquisition Manager is required to conduct design reviews. The SCA should conduct independent technical review to assess the adequacy and safety of all systems associated with the facility.

This applies to both new systems and those systems that are undergoing significant modifications.

It is strongly recommended that the Acquisition Manager invite the SCA to participate in the normal system technical design review process. An understanding between the Acquisition Manager and the SCA should be reached early in the system design regarding technical design reviews. The number, timing and level of detail of the technical design reviews should be dependent upon the uniqueness and complexity of the system. These points should be negotiated between the Acquisition Manager and the SCA and promulgated in the certification Milestone Event Schedule.

The design review process is best served when the Acquisition Manager assembles additional technical personnel, not affiliated with the system designer, to review the system design. Sufficient technical expertise should be used in the design review process to ensure that electrical, structural, mechanical and piping systems are thoroughly evaluated.

The SCA recognizes that the level of detail provided in each design review will depend on how far along the actual subsystem design has progressed. Therefore, it is imperative that the design review team review all design documentation prior to conducting each formal review.

For complex systems, the Acquisition Manager should issue a design review check-off list for each subsystem to be reviewed. This check-off list should include verification that all the required design review information is available for technical review. The Acquisition Manager, technical design review team and SCA should complete the check-off list during the design review.

At the completion of each technical design review the Acquisition Manager should issue findings and recommendations regarding all system design deficiencies. The methods of issue of previous review findings should be discussed between the SCA and Acquisition Manager prior to each design review. Those deficiencies that are determined by the Acquisition Manager and SCA to be within the Scope of Certification should be identified as such.

All identified safety related design deficiencies must be

resolved before the construction contract is awarded. Design deficiencies not resolved prior to the award of the construction contract will require a change order to the construction contract, which in most cases, causes additional costs and time delays to the Government.

The Acquisition Manager should avoid awarding the construction contract prior to resolution of all identified safety related design deficiencies.

4.7 Associated Documents. The Acquisition Manager, as system applicant, should ensure that all associated documents, such as technical manuals, preliminary design, final design, test memos, etc., are prepared and submitted in accordance with the Milestone Event Schedule during the acquisition process. The Acquisition Manager should ensure that all associated documents are submitted to the SCA in a timely manner and that there is adequate time allocated in the Milestone Event Schedule to allow the SCA to conduct a thorough review of the associated documents. The Acquisition Manager should review SCA comments and take appropriate action on safety related issues.

4.8 Construction Review Board. It is recommended that the Acquisition Manager conduct Construction Review Board (CRB) meetings during the period that the facility is being fabricated. The CRB should meet frequently at the construction facility, with frequency being dependent upon the complexity of the facility being built.

Section 5: REPAIR AND OVERHAUL

5.1 Introduction. Periodically, unmanned pressure test facilities require repair or overhaul wherein industrial work is performed within the certification boundary beyond that which is normally conducted during routine maintenance procedures. During such industrial periods, system certification should be terminated until the requirements for re-certification, specified in Section 2, have been satisfied.

During significant configuration changes, the responsibilities of the acquisition manager may shift from the user command to another command or program office. However, the user command to which the system is assigned should remain the applicant for system certification. Close coordination between the acquisition manager, the applicant and the SCA is crucial to ensure that the system certification process does not become disjointed and unmanageable.

In all instances, the number and extent of technical design reviews should be negotiated between the applicant and the SCA.

It is the responsibility of the system applicant to ensure that the requirements for re-certification are satisfied during repair or overhaul periods. As stated in Section 1, the line of communication concerning certification is between the SCA and the system applicant and not between the SCA and the activity responsible for the performance of the work. The applicant may designate an individual or organization to act as certification manager, who will be the single point of contact for liaison both with the overhaul organization and with the SCA on matters concerning certification.

5.2 Certification Status During Repair Or Overhaul. When the supporting building facilities undergo any major facility upgrade that would affect the performance or operational integrity of the unmanned pressure test facility, system certification is terminated.

Often, component or minor system repair is required between scheduled overhauls. Minor work on the facility that does not involve hot work (welding/brazing) and that does not modify the certified system configuration does not terminate system certification if the work and testing are documented under re-entry control. Though notification to the SCA is not required, all documentation of the minor work and testing will be reviewed at the next certification on-site survey. Examples of minor work that does not terminate or suspend system certification are:

a) Repairing leaking valves by replacing valve software

b) Replacing unmanned pressure test facility components (mechanical joints) with the same kind as specified by

the system drawing

c) Re-qualifying system hoses, volume tanks, high pressure gas flasks, high pressure fluid tanks, filter housings or moisture separators by hydrostatic testing required by PMS

d. Calibrating gages and relief valves

e) Re-certifying DOT 3AA flasks/bottles

f) System configuration changes in support of mission testing documented on controlled work procedures

Should the scope of work exceed minor work (as described above), termination or suspension of system certification may be required. This applies whether the work is accomplished during scheduled maintenance, as day-to-day work, or to correct a casualty. The applicant should immediately notify the SCA when this work is required so the SCA can make a determination with respect to termination or suspension. Examples of significant work that may terminate or suspend system certification are:

a) Welding or brazing on the pressure boundary

b) Overhauling the unmanned pressure test facility.

5.3 Pre-Overhaul Requirements. Prior to the commencement of overhaul or repair of an unmanned pressure test facility, the applicant should submit the following to the SCA for review:

a) A detailed definition of the scope of the overhaul, including a list of repairs, alterations, modifications and significant components to be replaced, etc.,

b) The overhaul or repair work package should include, as appropriate, drawings, description of work, quality assurance provisions, tests and inspections to be accomplished. All procedures or processes to be followed must also be included.

c) A schedule showing major overhaul milestones.

Pre-Overhaul information should be submitted as early as possible to allow sufficient time for review by the SCA. The SCA, as early as possible, in conjunction with appropriate technical authorities, should review all work and procedures/processes that involve system certification.

In cases where the work package includes alterations, the Naval Facilities Engineering Command Hyperbaric Facilities Maintenance Manual, NAVFAC MO-406, may be used to provide guidance for the control of the alteration process. The timing of formal technical design reviews should be negotiated between the applicant and the SCA and should be dependent upon the complexity and uniqueness of the alteration.

5.4 Overhaul. All unmanned pressure test facilities should be overhauled, as described below. The length of time between overhauls of a particular facility should be determined by the activity, sponsor and SCA, but should not exceed 10 years. Should a facility be taken out of service (mothballed) for more than two years, an overhaul should be conducted prior to placing the facility back in service.

The overhaul of unmanned pressure test facilities should be accomplished in three phases as follows:

a) A pre-overhaul test and inspection of existing systems and components must be performed to determine the condition of the facility.

b) All systems and components that do not perform to specifications must be repaired or replaced to bring the facility into conformance.

c) The facility should undergo final system functional testing to verify the acceptability of the work performed.

Functional testing includes those tests that are performed upon completion of an overhaul. Functional testing is to be witnessed by a SCA representative and should include all systems of the facility.

The level of overhaul accomplished should be based on the criticality of the respective system.

5.4.1 Hazard Categories. All systems, equipment, components and procedures should be evaluated and assigned a hazard category (HAZCAT) as defined in Section 2. The HAZCAT is based upon the potential hazard to operators or other personnel involved in the test evolution, as well as systems associated with the loss of pressure boundary integrity and/or loss of functional operation. It is emphasized that the facility operators and test support personnel are the individuals to whom this HAZCAT analysis program is directed.

5.4.1.1 HAZCAT I Systems. All components that are a part of a HAZCAT I system should be evaluated and refurbished to the "as new" condition. The "as new" condition of a component is that condition which was acceptable in the original design, and/or meets the quality control requirements of the Commercial or Military Specification for that component. The "as new" condition includes, but is not limited to, the following:

a) complete internal/external visual inspection

b) replacement of all software

c) operational test

d) cleaning

In the event the component cannot be restored to "as new" condition, an in-kind replacement for the required component should be installed. The in-kind replacement must pass all the tests for the design requirements of the original component. General maintenance of all HAZCAT I components should be performed and documented. NAVFAC MO-406 may be used as a guide. In-kind replacement of a component is defined as replacement with an identical component if that component is still manufactured. In the event an identical component is no longer manufactured, the replacement component must meet all of the original component's design criteria. Should there be any doubt as to whether a component is an in-kind replacement, contact the SCA.

5.4.1.2 HAZCAT II Systems. All HAZCAT II systems should be envelope functionally tested to their complete design parameters. Envelope functional testing is defined as testing each component of the respective HAZCAT II system to its system design parameters (i.e., ball valves, completely shut off and fully open; needle valve, fine tuned and flow as required for original design; pressure gauges, accurately record tested parameters). In addition, Functional Testing, as performed originally when the system was installed, should be conducted for all HAZCAT II systems. HAZCAT II system components should not be removed or refurbished, unless the component does not perform or if a noticeable flaw is found during functional testing of the system. General maintenance of all HAZCAT II system components should be performed and documented, NAVFAC MO-406 may be used as a guide.

5.4.1.3 HAZCAT III and IV Systems. All HAZCAT III and IV systems should be demonstration tested to system design requirements. Demonstration testing is the functional testing level performed originally when the system was installed. HAZCAT III and IV system components should not be removed or refurbished unless the component does not perform, or if a noticeable flaw is found during demonstration testing of the system. General maintenance of all HAZCAT III and IV system components should be performed and documented, NAVFAC MO-406 may be used as a guide

5.5 Routine Maintenance. As defined in Section 2, all HAZCAT I, II, III AND IV system components should receive routine maintenance as required by facilities PMS or as required by the manufacturer of the respective component. General maintenance should include, but is not limited to: replacement of belts, pulleys, lubrication, filters, calibration, o-rings, calibration of gauges, periodic testing of relief devices, replacement of filter elements, calibration of sensors and indicators, etc.,

5.6 Document Control. The requirement for adequate document control during overhaul and repair is as essential to re-certification as it is in the initial certification process.

The applicant should ensure that all documentation required to support design, material selection, work procedures, tests and inspections are prepared and maintained in accordance with the requirements of Section 2 and Appendix C.

For major modifications due to system alterations, the Acquisition Manager should ensure that applicable fabrication and test documentation (i.e., drawings, technical manuals, test memoranda, etc.,) are revised and then reviewed by the SCA. For repairs, the responsibility for updating this documentation lies with the applicant.

5.7 Procedures. Those procedures required to perform work, inspection and testing should meet the requirements set forth in Section 3.3 and be so specified in contract documents. These procedures should be available for review and concurrence by the SCA during on-site surveys.

5.8 Quality Assurance (QA). Quality assurance requirements during overhaul and repair should be the same as those specified in par. 3.3.8 of this document and should be specified in contract documents.

5.9 Re-Entry Control. Particular attention must be directed to the proper use of approved re-entry control procedures as described in Appendix C. Re-entry control forms must be accurately completed and must contain all required signatures prior to re-entry into a system that is within the scope of certification. Prior to use of the system, all re-entry control actions must be satisfactorily completed and signed or have an approval for a departure from specifications approved.

5.10 Retest Requirements. Repairs and modifications to systems require the same stringent testing requirements as newly designed systems. The following guidelines should be used to determine the level of testing required during systems overhaul periods:

a) Factory Acceptance Tests will not be required unless the replacement equipment is of such a specialized nature that the repair activity is unable to perform testing.

b) Pre-installation tests will be required only for replaced or repaired components.

c) Pre-operational tests will be required only when a subsystem is repaired or modified. These tests need to be performed to ensure that those sections of the system that were repaired or modified are properly reinstalled.

d) System operational tests should be conducted on all subsystems that have been repaired, modified or placed in lay-up when time permits and personnel are available. The extent of system operational testing may be negotiated with the SCA.

Additional information concerning test requirements is provided in Section 3.5 and in Appendix C.

5.11 Technical Requirements. The primary sources of technical requirements are the documents that the facility was designed to, such as:

a) ASME Section VIII Division 1 or Division 2, Boiler and Pressure Vessel Code

b) ANSI/ASME B31.1, Power Piping Code

c) NFPA 70 National Electric Code

Other documents that may be used for guidance are:

a) NAVFAC DM-39, Hyperbaric Facilities Design Manual

b) NAVFAC MO-406, Hyperbaric Facilities Maintenance Manual

c) NAVFAC MIL-HDBK-1152, Inspection and Certification of Boilers and Unfired Pressure Vessels

d) ANSI/NB-23, National Board Inspection Code

Section 6: NOTES

6.1 Subject Term (Key Word) Listing

American Society of Mechanical Engineers (ASME)
Boiler and Pressure Vessel Code (BPV)
Fatigue
Hatch
Hazard Category (HAZCAT)
High-pressure gas storage
Hyperbaric Facilities
Joint Tightness Test
Maximum System Pressure (MSP)
Milestone Event Schedule (MES)
Navy Occupational Safety and Health (NAVOSH)
Objective Quality Evidence (OQE)
Penetration
Pressure Media
Pressure Vessel
Re-certification
Re-entry control (REC)
Safety
Safety Standard for Pressure Vessels for Human Occupancy
Scope of Certification (SOC)
Seals
System Certification Authority (SCA)
System certification process
Unmanned Pressure Test Facility
View Port

APPENDIX A
CATEGORIZATION OF SCOPE OF CERTIFICATION MATERIALS AND COMPONENTS

A.1 INTRODUCTION

This appendix contains guidance for categorizing materials and components within the Scope of Certification (SOC). Categorization of a material or component is dependent upon its application and service experience. The proposed application, (configuration, joining techniques, etc.,) must be reviewed to determine the proper categorization for each material or component.

For the purpose of system certification, materials and components are grouped into three categories:

Category 1: Materials and components for which considerable operating experience in pressure vessel applications is available.

Category 2: Materials and components which are commonly used in a variety of military and commercial applications, but with little or no past experience for the proposed unmanned pressure test facility application. Generally, Category 2 material requires testing to verify that it will be acceptable for its intended use in the new application.

Category 3: Materials and components that may be developmental, or do not have a documented history of satisfactory use in pressure vessel applications.

These material and component categories are not to be confused with the hazard level categories of MIL-STD-882 and as defined in Section 2. Solely as an aid in assessing the reliability of materials and components in specific unmanned pressure test facility applications, the material and component categories described above were conceived. The applicant must justify the materials and their applications as used in the design of the pressure vessel system for the expected service environments. All materials considered to be within the SOC should be identified. Their relative location in the system should be described, and verification of material compatibility with the intended environment and with each other should be analyzed.

The applicant should justify the adequacy of the proposed material and its application. The less information and experience available regarding a proposed material or component for a particular application, the greater is the burden of proof for the acceptability of the material. This burden of proof is the responsibility of the applicant.

A.2 CATEGORY 1 - MATERIALS AND COMPONENTS

To be classified as a Category 1 material, the material must be manufactured to a commonly used commercial or federal specification. Additionally, extensive experience in fabrication of the specific component configuration (e.g., commercial off-the-shelf) and a history of operation in a specific environment must be presented to the SCA. For piping systems, compatibility with both the specific internal and external fluids/gases to which the piping will be exposed must be proven by previous usage.

Unusual configurations or applications of these materials and/or components with no documented history of use in the specific environment might, however, place them in Category 2.

All view ports made of acrylic plastic should comply with the requirements of ASME PVHO-1. View port materials other than acrylic plastic will be considered Category 3 materials

A.3 CATEGORY 2 - MATERIALS AND COMPONENTS

Materials manufactured to a recognized commercial or federal standard, but with no documented history of use in the specific pressure vessel environment, fall into this category. Materials used in standard commercial (or military) applications that are not commercial off-the-shelf are also in this category. The use of Category 2 materials and components requires justification by complete design analysis of material properties and operating stresses. Approval of a material or component for use in a specific application will be based on the supporting technical information provided by the applicant.

A.3.1 Structural Materials. For pressure vessels and hard structure, the applicant should submit information on material in accordance with Appendix B. For other structural components (i.e., foundations, weight handling strength members, etc.,) the applicant should submit the following information as justification for the use of each Category 2 material or component:

a) The commercial or federal specification and the chemical and physical properties of the base material in the condition it will be used. If the material is to be welded, brazed, cold worked, work hardened, etc., the acceptable material properties at the completion of fabrication should also be specified.

b) Proof of weldability and fabricability (if the fabrication process or possible future repairs include welding).

c) Fatigue data, preferably data in the high-stress, low-cycle range (below 10,000 cycles), which considers the effect of the environment (e.g., seawater, fresh water, oil, O_2, HeO_2 and hydrogen).

d) Data collected over a sufficient time period to justify the adequacy of the material with respect to general corrosion, susceptibility to stress-corrosion cracking, and compatibility with adjacent materials in its intended environment.

e) Nondestructive testing results on the material, the heat-affected zone (HAZ), and the weld joints, as appropriate.

A.3.2 Pressure Compensating and Hydraulic System Fluids. As a minimum, the applicant should submit the following:

a) A list of the applicable military, federal or commercial specifications

b) Information covering flammability, resistance to deterioration and compatibility with system component.

c) Information relating to possible toxicological hazards if used inside the unmanned pressure test facility

A.3.3 Electrical System Materials. All electrical system materials and components should, as a minimum, meet the requirements of Appendix B and the National Electric Code.

A.4 CATEGORY 3 - MATERIALS AND COMPONENTS

The basis for testing and the criteria for acceptance of new materials and components will not necessarily be the same as for those currently in use. The proof of the acceptability for the material or component and the justification of the acceptance criteria must be provided by the applicant. For example, the applicant should demonstrate the effect of defects and manufacturing variations on the reliability of the material or component by appropriate model and/or prototype testing in a simulated service environment. The applicant must establish that a design using the new material or component provides at least the same degree of safety as proven materials (Category 1) in a similar application. As such, this may result in a higher factor of safety being required for Category 3 materials.

Examples of Category 3 pressure vessel and other structural materials are those generally characterized by low ductility, such as ultra high-strength metals, glass, metallic composites, concrete and ceramic materials.

For pressure vessels and other structural materials, the applicant should submit the same information that is required for Category 2 material. In addition, as justification for the use of a Category 3 material, formal test data should be provided to the SCA covering, as a minimum, the following information:

a) Basic process to be used in producing the material. Sufficient information is required to demonstrate that the process results in reproducible material properties.

b) Effect of flaws, such as cracks, inclusions and porosity, on material performance.

c) Effects of temperature on material performance and on crack propagation rate.

d) Results of destructive tests of samples fabricated from the material and comparison of these results with the design basis predictions of the failure point.

e) Results of nondestructive test requirements applied to the base material and joints as appropriate.

f) Results of fatigue testing based on operating pressure differentials and external loading.

g) Hazards involved in fabrication or use of the material with respect to flammability.

h) Additional testing or information as required by the SCA.

Should the designer choose to use Category 3 materials for purposes other than as structural pressure vessel components, fully documented technical justification will be required. As a minimum, the applicant should submit the information required in paragraph A.3 plus additional information as may be required by the SCA to justify the use of Category 3 material or components.

APPENDIX B
DESIGN PARAMETERS FOR UNMANNED PRESSURE TEST FACILITIES

B.1 INTRODUCTION

This appendix provides guidance to the designer of an unmanned pressure test facility in the form of requirements, recommendations, information and preferred approaches pursuant to safety certification. It is not to be considered as all-inclusive. It is written to provide guidance in those areas of design where experience exists and design parameters have been established. The applicant must review the requirements for the specific facility for which he is seeking certification, then coordinate those requirements with the design guidance of this document. Established pressure vessel design guidance are provided in the following documents:

a) NAVFAC DM 39, Hyperbaric Facilities

b) ASME/ANSI PVHO-1, Safety Standards for Pressure Vessels for Human Occupancy

c) ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 and Division 2, Pressure Vessels

d) ASME B31.1, Power Piping

The final responsibility for all aspects of a safe design lies ultimately with the applicant and cannot be assigned to any document or textbook.

B.2 STRUCTURAL DESIGN CONSIDERATIONS

The information provided herein may not be applicable to every design attribute for unique systems or systems used in unique environments. All unusual circumstances that may affect the system design should be brought to the attention of the SCA during the initial design phase. The designer should consider conditions such as the effects of shock, vibration, creep, thermal transients, implosions, material deterioration due to environmental effects, or any other condition that may be applicable to a specific design.

Pressure vessels are complex structures that may contain penetrations for piping, electrical cables, hatches, view ports or other appurtenances. These structures may also contain geometrical discontinuities, such as hemisphere-to-cylinder intersections and saddles for foundations. The physical properties of the materials from which these structures are fabricated, such as modulus of elasticity, yield strength, ultimate strength, fatigue strength and fracture toughness interact in a complex fashion. Thus, a rational design procedure, which accounts for fatigue, yield, fracture, buckling and all pertinent material properties, should be applied to ensure a safe structure. The burden of proof is upon the applicant to design a pressure vessel and demonstrate by use of analytical and/or experimental means that the structure will function as intended for its expected life.

B.2.1 Fatigue. A fatigue analysis should be submitted for all pressure vessels that do not comply with the requirements of the ASME Boiler and Pressure Vessel Code. This fatigue analysis may be based on specimen and/or model tests. Suitable fatigue strength reduction factors should be applied to the specimen or model test results to account for variations in properties, scatter in the test results and the uncertainties involved in applying specimen and model fatigue data to fabricated full-scale structures. The fatigue analysis must consider at least the following design parameters:

a) Magnitude and nature of peak stresses, stress concentration factors used in the calculation of peak stresses, should be based on experimental data on similar structures;

b) Material properties and method of fabrication;

c) Maximum deviation in material thickness, assembly techniques and allowable flaws;

d) Geometry of the structure and details of penetrations and attachments;

e) Previous fabrication and operating history of the material;

f) Effects of residual stresses, thermal stresses and strain rate;

g) Type and method of loading and environmental effects such as corrosion/erosion;

h) Maximum anticipated number of load cycles.

When pressure vessels are constructed of Category 3 material (see Appendix A), sufficient destructive fatigue tests of full-scale prototypes or models should be performed to determine the fatigue

life of the design.

Pressure vessels designed to comply with the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, may not require a fatigue analysis if SCA concurrence is obtained. Pressure vessels designed to comply with the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 2, do not require a fatigue analysis if condition A or condition B of Article AD-160.2 are met.

B.2.2 Fracture Toughness. The applicant should ensure that the materials used to fabricate the pressure vessel, or any pressure boundary component exhibit adequate resistance to fracture. Specifically, the design analysis submitted to the SCA should demonstrate that brittle fracture is not a possible mode of failure by considering at least the following:

a) Magnitude, nature and rate of stresses (both applied and residual);

b) Temperature range to which the structure may be subjected in service;

c) Size, location and density of flaws initially present in the material and those that occur as a result of cyclic operations;

d) Environmental effects such as corrosion and/or erosion; Specifically, the environmental effects on crack initiation and propagation (e.g., stress-corrosion cracking) must be evaluated;

e) Effects of creep and strain rate on fracture toughness;

f) Localized effects due to penetrations, attachments and other vessel or component restraints (i.e., stress risers);

g) Effects of fabrication processes and heat treatments on the fracture characteristics of the material. In particular for welded construction, properties of the weld rod and base metal within the heat-affected zone and resultant induced internal stresses should be considered;

h) Material thickness

The material properties used in the fracture analysis should be based on appropriate tests such as tensile and compressive strength tests, K_{Ic} (fracture toughness) tests, K_{Iscc} (stress corrosion cracking) tests, Charpy V-notch impact tests, dynamic tear tests, drop-weight tests and explosion bulge tests as discussed in Appendix A. Where appropriate test data is not available, fracture mechanics type tests should be conducted. Further, the design analysis must consider possible variations in

material properties and, in particular, the effect of material thickness on fracture characteristics. The structural design basis used by the applicant for the analysis of brittle fracture should be verified by destructive testing of the pressure hull and component models and structures, or, where possible, by reference to existing information and service experience. All plates, parts and components must demonstrate adequate strength and toughness over the range of design operating temperature. Toughness characteristics of ferrous materials should be referenced to the Nil Ductility Transition Temperature (NDTT).

B.3 DESIGN STRENGTH PARAMETERS OF INTERNALLY-LOADED PRESSURE VESSELS

In general, the applicant should demonstrate the structural integrity of the pressure vessel under loading conditions to be representative of those expected in service. Therefore, the designer must take into consideration the effects of temperature, cyclical loading, creep, ductility, corrosion rates and anisotropy. Examples of pertinent fabrication variables include material reproducibility, fabrication flaws and defects, vessel openings, intersections of different shells of revolution and attendant reinforcement(s), residual fabrication stresses and deviations from the nominal geometry.

B.3.1 Inelastic Stability (Yield). For stable pressure vessel structures (i.e., stiffened or un-stiffened shells which permit the level of load-induced membrane stresses to approach the material yield point), the ratio of the pressure that would produce yield to the design operating pressure should be justified. In determining the pressure at which yield occurs, all fabrication and design-induced restraint and geometric variables should be considered and their effect(s) included. This is because the strength of moderately stable vessels can be detrimentally affected by such variables (i.e., yield can occur at levels of membrane stress below calculated levels of yield stress).

B.3.2 Stress Analysis. The applicant should perform a complete stress analysis of the pressure vessel and demonstrate that all stresses are within the design criteria and that the vessel's fatigue life is adequate for its expected service life. For Category 1 and 2 materials, the allowable stresses under internal pressure should be justified to the SCA. The stress levels defined in paragraph B.3.3 may be used as guidelines; however, the applicant must demonstrate compliance with only B.3.3.c., maximum peak stress. The design requirements for Category 3 materials must be comprehensive, provide at least the same degree of conservatism as the design requirements for Category 1 and 2 materials and should be approved by the SCA.

B.3.3 Verification of System Design Pressure. For Category 1 and 2 materials, model testing or use of existing model test data

must be used to verify the calculated system design pressure. There are three alternative methods of verification (SCA approval of the method chosen must be obtained prior to testing):

a) When comparable hull geometries and identical materials have been successfully tested to a pressure greater than the system design pressure of the vessel to be certified, the existing test data can be substituted for destructive model testing of the structure under review. Any geometric differences between the hull requiring verification and the comparable hull for which test data exists should be brought to the attention of the SCA.

b) For new designs that do not fall within the parameters described in paragraph (a) above, the calculated failure pressure may be verified by performing destructive model tests, either full or reduced scale. When such testing is performed, the structural model should be large enough to contain representative prototype geometries, material properties, and fabrication process restraints, tolerances and residual stresses.

c) Nondestructive pressure testing of the actual vessel to be put into service in accordance with applicable requirements of the ASME will be acceptable as verification of the calculations. All others will be non-destructively pressure tested to 1.5 times the maximum operating pressure. When this option is chosen, the calculated failure pressure must be greater than 1.5 times the maximum operating pressure by a factor of safety sufficient to preclude damaging the structure during the test. The SCA should approve the ratio of failure pressure to test pressure prior to testing. Clearly, use of this method requires that the decision be made very early in the design process because of the profound effect on the structural design.

For Category 3 materials, the above testing requirements may not be appropriate or adequate. The testing used must demonstrate the same degree of conservatism as the testing requirements for Category 1 and 2 materials. The factor of safety and all testing parameters should require SCA approval.

B.3.3.1 Testing Procedures/Test Instrumentation. For all vessels, a detailed test procedure should be developed and provided to the SCA for review and approval prior to testing. The test should be of sufficient duration to demonstrate that the combined stress/temperature/time loads do not produce permanent deformation or damage in the structure. If the tested structure is to be used in service, a complete set of instrumentation readings should be recorded at the maximum operating pressure (this may be accomplished during instrumented testing to 1.5 times the maximum operating pressure). The test procedure should include a detailed strain gage plan, which specifies the number,

type and location of all gages. Strain gages should be placed at points of:

a) General stress level

b) Fatigue

c) Low quality analysis

d) Uncertain dimensions

e) Geometrical discontinuities

f) High stress between openings

The test procedure should duplicate the loading conditions expected in service and, where applicable, should be such that the mode of failure is identifiable. Upon completion of testing, the recorded strain gage data should be used to verify the calculated performance of the structure. The complete test report should be provided to the SCA for review and approval.

B.4 DESIGN OF PRESSURE VESSELS TO COMMERCIAL CODES

Pressure vessels, within the scope of certification, should be designed and fabricated in accordance with the ASME Boiler and Pressure Vessel (BPV) Code, Section VIII, an equivalent published design code, a standard approved by the SCA, or the design should meet the applicable criteria of Sections B.2 and B.3 herein. When designing to ASME BPV Code, Section VIII or other commercial codes, the allowable stress values given in that specific code are to be used. These allowable stress values reflect a factor of safety empirically determined for the material and application for each specific code.

B.4.1 Documentation Requirements for Pressure Vessels Built to Commercial Codes. When using commercial codes in designing and fabricating pressure vessels, the SCA requires documentation, as outlined in the following subsections, in addition to that which is specified in the commercial code.

B.4.1.1 Vessel Drawings. Drawings must completely identify the vessel and all the appurtenances (foundations, penetrations, attachments, etc). All welds should be detailed and fully located. All components should be fully specified on the Bill of Material and notes should fully explain or define processes, specifications, procedures and/or special instructions. Vessel weight, internal (floodable) volume and cycle life (when required) should be stated on the Top Assembly Drawing for each vessel.

B.4.1.2 Design Calculations. Design calculations should be provided showing worst-case dimensions and tolerances, and clearly stating all design assumptions and load conditions. The

calculations should be in standard engineering data sheet format that clearly indicate that the design, as depicted in the drawings, is fully satisfactory and meets all design requirements of the ASME BPV Code, Section VIII Division 1 or 2 as appropriate. The design calculations should show that they meet the above requirements for the design life of the vessel, and be signed by the design engineer.

B.4.1.3 Manufacturer's Documentation. The Manufacturer's Data Report should be submitted for each vessel. Copies of the completed and signed ASME Manufacturer's Data Reports for Pressure Vessels (Form U-1/U-1A) should be submitted with applicable ASME Manufacturers Partial Data Reports (Form U-2).

A copy of the Certification of Authorization from the ASME Boiler and Pressure Vessel Committee, or the equivalent from other approved commercial code committees, authorizing the manufacturer to fabricate vessels of the designed class should be attached to the Manufacturer's Data Report.

B.4.2 Material Verification. All materials comprising the pressure vessel (pressure containing material) and all materials welded to the pressure vessel should be documented to verify compliance with the Bill of Materials and applicable specifications. This should also include welding rods used on the pressure boundary.

B.4.3 Welding Procedures. Copies of all welding procedures required for the fabrication of the pressure vessel and attachments should be provided to the SCA. In addition, documentation verifying approval of these procedures should also be provided.

B.4.3.1 Welder Qualifications. Documentation should be provided verifying that all welders that produce welds on the pressure vessel are qualified to the approved welding procedure for the type and position of each weld made. The document should clearly state that the welder is qualified to perform the procedure and his qualifications are current under applicable code requirements.

B.4.3.2 Weld Records and Maps. The weld records should consist of a chamber weldment joint identification drawing, or map, for each chamber pressure shell and piping system. All chamber joint weld locations should be shown and a joint identification number assigned to each weld. A chamber weldment record form for each welded joint, including non-pressure retaining joints and brackets, should be prepared. The weldment record form should contain the following information:

a) Joint Identification Number (JID) number

b) Joint design type

c) Base metal type with heat and lot number

d) Filler metal type with heat and lot number

e) Fit up and inspection results

f) Welding procedure number

g) Heat treatment if required

h) Welder or brazier number

i) Type of inspection and results

j) Disposition of joint (pass/fail)

k) Any repairs of joint

l) Inspection procedure number

m) NDT inspection number

n) Signature and date

B.4.3.3 NDT Records. Copies of all nondestructive testing (NDT) records should be provided. Qualification records of nondestructive test personnel should be maintained and provided to the SCA.

B.4.3.4 Dye Penetrant (PT) Inspection. Records of dye penetrant inspections should be maintained and should consist of:

a) Type(s) of dye penetrant tests

b) Identification of assembly, part, etc.,

c) Number of cracks

d) Type(s) of cracks

e) Signature and date of the assigned responsible individual verifying all specified PT inspection including PT of any required repairs has been accomplished and is satisfactory

B.4.3.5 Radiographic (RT) Inspection. Chambers are required to have full radiographic testing (RT) of all pressure retaining butt welds (joint efficiency of 1). Records of radiographic weld inspection should contain, as a minimum, the following:

a) Date of exposure of the radiograph

b) Positively identified location of weld radiographed

c) Type of material and material thickness

d) Type of weld joint

e) Approved procedure identification

f) Energy source (isotope type, intensity, kilo-voltage and focal spot size of x-ray machine)

g) Type of film, screens, source-to-film distance, and exposure time

h) Penetrameter designation

i) Image Quality Indicator (IQI) sensitivity reading

j) Applicable acceptance standards

k) Flaws (unacceptable slag, porosity, or other indications)

l) Acceptance or rejection

m) Date of interpretation and signature of film interpreter(s)

n) Interpreter's documented qualification level should be noted

o) Diagram (radiograph map) indicating the specific location of each radiograph coded to its unique number

Where required by contract, a copy of the actual radiographs should be provided to the government.

B.4.3.6 Ultrasonic (UT) Inspection. Records of ultrasonic inspection should contain, as a minimum, the following:

a) Date of the ultrasonic inspection

b) Description and unique item identification, weld location and joint identification

c) Type of material and material thickness

d) Type of weld joint and length of weld inspected

e) Approved procedure identification

f) Equipment used for inspection (instrument and search unit): manufacturer and model number, transducer size and type, search beam angle, test frequency, couplant

g) Calibration standard number

h) Applicable acceptance standard

i) Reference block identification

j) Discontinuities that exceed the DRL (Disregard Level)

k) Acceptance or rejection

l) Signature of inspection personnel and date

m) If supplemental ultrasonic inspection techniques are used that contribute to the final inspection results, they should be recorded

B.4.3.7 Heat Treatment Procedures and Records. Copies of the procedures and records of all heat treatments performed on the chamber should be attached to the Manufacturer's Data Report.

B.4.3.8 Charpy Impact Test Data. When Charpy Impact testing of materials is required by the applicable commercial code, a copy of the Charpy Impact Test data should be attached to the Manufacturer's Data Report.

B.4.3.9 Material Repair Report. A report on repairs of any defects in the materials used for the fabrication of chambers should be attached to the Manufacturer's Data Report.

B.4.3.10 Technical Manual. Each pressure vessel system should be supplied with all operating, maintenance, technical and parts manuals and instructions necessary for the safe operation of all devices or components supplied with or part of the pressure vessel system.

B.5 MATERIAL SELECTION

Selection of the proper materials to be used in the manufacture of pressure vessels is critical to ensuring system safety. The specific end use of each structural component must be evaluated on the basis of its operating environment, life expectancy and intended use. The use of inappropriate material in a pressure vessel may result in a catastrophic failure and cause fatal or critical injury to personnel and substantial damage to property.

B.5.1 Corrosion. Corrosion effects must be considered during the initial selection of the material and throughout the design process. The following list represents typical types of corrosion that must be considered:

a) Electrolytic corrosion - stray electrical currents that can accelerate corrosion.

b) Crevice corrosion - crevices in or between materials retard the formation of oxide film within these crevices.

The oxide film that forms on the surrounding surface will act as a cathode and the crevice will act as an anode that accelerates the corrosion within the crevice.

c) De-alloying corrosion - In some alloy compositions, corrosion will attack one or more of the components of the alloy, which will result in weakening of the material.

d) Galvanic corrosion - When two different metals are coupled in the marine environment, one will act as an anode and the other will act as a cathode depending on the relative positions of the metals within the galvanic series and the relative size of the exposed metal surfaces of each. This will accelerate corrosion. The applicant should consider this when choosing materials to use in the design of the system.

e) Stress corrosion - certain alloys are susceptible to stress corrosion cracking, which can only occur when the material is exposed to a corrosive environment while under tensile stress. In the case of some high strength steels and titanium alloys, this form of corrosion can be propagated at highly accelerated rates, depending on environmental conditions.

f) Pitting - pitting can be a serious problem in pressure vessels and components. Pitting is normally limited to alloys of steel and aluminum. Hatch and view port seating surfaces have been known to leak due to pitting.

Painting, anodizing and plating are all common and cost-effective methods of corrosion protection. These processes provide only a thin layer protection, however. When this surface protection is scratched, the exposed bare metal is subject to accelerated local corrosion.

B.5.2 Protective Finishes. Finishes applied to pressure containing and critical load bearing elements should not be of a type likely to permit the development of hidden pitting. The application of all protective finishes to surfaces in contact with breathing gases should be performed in accordance with written and approved procedures.

Metal applied as a surface finish, coating or cladding should be lower on the electrochemical scale than the metal to which it is applied. Clad welding is a process that deposits corrosion resistant metal over the area to be protected. This process can be used to protect critical hatch and view port seating surfaces and is effective in eliminating pitting and general corrosion. The applicant should justify that use of dissimilar metals in contact, where dissimilar metals are defined by MIL-STD-889, Dissimilar Metals, does not present an unacceptable corrosion potential.

B.5.3 Toxicity. As a precaution, the designer should consider the toxic effects of materials. Materials, such as paints, insulations, sealants, adhesives, plastics, fabrics, fittings, and other items and equipment containing material or components which may give off noxious fumes at any temperature below 200 degrees Fahrenheit or which could cause occupational illness, should not be installed or applied within the unmanned pressure test facility. For paints, sealants or adhesives, this requirement applies after drying or curing. The SCA may require Material Safety Data Sheets (MSDSs) for materials used inside pressure vessels and on other surfaces in contact with pressurization media.

Mercury, asbestos, cadmium, magnesium and beryllium are examples of materials that should not be used in an unmanned pressure test facility without adequate protection and justification.

B.5.4 Flammability. Every effort should be made to eliminate, or at least minimize, flammable material in the unmanned pressure test facility. It should be understood that materials that are nonflammable at atmospheric pressures might be highly flammable when subjected to increased oxygen concentrations and/or elevated pressure.

If aluminum paint is used inside an unmanned pressure test facility, precautions should be taken to ensure that it is not applied over rusted steel. A primer, not containing red lead or iron oxide, should be used under the aluminum paint.

Magnesium and alloys containing significant amounts of magnesium should not be used in the unmanned pressure test facility because of their high combustibility.

The applicant should provide sufficient information to permit an independent evaluation of the suitability and adequacy of the materials used.

B.6 DESIGN OF PENETRATIONS INTO AND THROUGH THE PRESSURE VESSEL

The applicant for the unmanned pressure test facility is responsible for the safe and adequate design of all openings or penetrations in the pressure envelope. When using the ASME pressure vessel code as a guide, the designer must carefully consider additional loads such as piping loads and make provision for them.

All possible modes of failure, including leakage, must be considered during the design phase of the system. Sufficient testing must be performed and documented to confirm the structural integrity and leak tightness of each penetration.

All vents, drains, exhausts, or other exits from the pressure envelope, should be equipped with a means of positively securing or locking against accidental opening or closing.

Penetrations with gasketed sealing areas should have corrosion protection provisions for these areas.

Alternative design methods may be approved by the SCA on a case-by-case basis.

B.6.1 Piping Penetrations. Pipe penetrations to the pressure envelope should be located and arranged so that, in the event of flooding, loss of atmosphere or similar emergency, a maximum amount of atmosphere will become entrapped in the unmanned pressure test facility. Emergency shutoff capability should be provided to protect the internal breathing atmosphere from exhaust, full flooding, or contamination.

B.6.2 Electrical Penetrations. The bodies of electrical penetrators and connectors that may be exposed to water or spray should be made of corrosion-resistant material. Electrical penetrations to the pressure envelope should be gas-/watertight, even when the connecting cables have been damaged. Pin-type connections or cable entrances into compensated enclosures are the preferred methods and should be used on all new design pressure vessels. Terminal tube entrances are acceptable on existing pressure vessels when evidence of compatibility of the cable jacket and insulation with the compensating medium is provided.

B.6.3 View Ports. The applicant should show that view port design is adequate for the system pressure and temperature range, environmental conditions and expected number of pressure cycles. The materials used must have adequate fatigue strength for the stress levels incurred over the expected life of the vessel. Resistance to the stresses applied continuously over long periods of time, as well as cyclic stresses, must be properly considered. Full specification must be made of the materials used; their composition; thermal, chemical, or physical treatment(s) required; dimensions and tolerances; and renewal or replacement criteria. Where necessary, view ports must be protected against accidental impact or other mechanical abuse. Although the use of various materials for view ports is not restricted, acrylic view ports have a demonstrated high level of success and are recommended above all other types when design parameters permit the use of acrylic. View port penetrators should be designed such that the view port seals against an integrally machined sealing surface when pressure is applied (i.e., the retaining ring should not be part of the primary sealing boundary when pressure is applied). Acrylic materials, view port designs and view port penetrators should conform to ASME/ANSI PVHO-1, Safety Standards for Pressure Vessels for Human Occupancy unless prior approval is obtained from the SCA.

In-service (i.e., used) view port defect criteria should be based on view port material, dimensions, and loading conditions, and must be determined separately for each view port design. SCA

approval is required for used view port defect criteria. Crazing and cracks are not allowed in new or used view ports. Chips and scratches may be allowed in used view ports and the acceptable sizes of each, if permitted, will depend upon the view port design. The service life of a view port also depends on the view port design. For designs that are in accordance with ASME/ANSI PVHO-1, view port service lives are either 10 or 20 years, depending upon the view port design.

B.6.4 Hatches/Closures. For Category 1 or 2 materials, all pressure retaining closures, including hatches, doors, covers, and caps or plugs for openings should have a demonstrated (by hydrostatic test using strain gages) factor of safety of at least 1.5 times the maximum operating pressure. The mating flanges of all hatches and doors should be integral to the pressure vessel shell.

For Category 3 materials, the criteria stated for Category 1 and 2 materials may not be appropriate or adequate. Therefore, the criteria used must demonstrate the same degree of conservatism as the criteria for Category 1 and 2 materials and require SCA approval.

The ease and speed with which a closure can be opened or closed, and whether tools are required to do so, should be a design consideration. In all cases when these factors are important, SCA approval of the closure design should be obtained.

B.6.5 Seals. Sealing materials and techniques must be shown to be adequate for the range of pressures, temperatures, pressurizing media, vibrations, lubricants, and atmospheric environments specified for the system. Seals should not be subject to failure due to the effects of a non-lethal extinguishable fire inside or outside the system, attack by the fire extinguishing agent(s) used by the system, or by thermal shock caused by the application of the extinguishing agent(s). The effects of ultraviolet light, pressure cycling, stress concentrations, differential thermal expansion, differences in moduli of elasticity, tolerances and aging should be considered when designing seals.

In systems that may contain elevated oxygen concentrations, only oxygen compatible materials should be used.

B.7 FABRICATION DESIGN CRITERIA

Prior to the start of fabrication, the applicant should demonstrate to the SCA that accepted commercial or military guidelines are being used during the system fabrication process. In cases where the applicant desires to use fabrication procedures developed to commercial specifications, recorded data, in addition to that required by the commercial specification, may be required to provide the SCA with assurance that those procedures have been followed.

B.7.1 Welding and Brazing. All welded and brazed pressure-retaining construction should be performed in accordance with written and approved procedures, as discussed in Section 3, Sections 3.3.3 and 3.3.4. Welding and brazing of structural members may require the use of approved procedures depending on the application. The applicant is responsible for the integrity of the joint design and the proper choice of filler material.

B.7.2 Threaded Fasteners. The design of all critical threaded fasteners, including bolts, studs and nuts, should meet the requirements of the Screw-Thread Standards for Federal Services, FED-STD-H28, Screw-Thread Standards for Federal Service. Studs and bolts should be of sufficient length so that, when nuts are tightened to their appropriate torque values, at least 1 thread is exposed. Where practicable, the number of threads exposed should not exceed 5; however, in no case should the thread exposure exceed 10 threads. Any fastener design not covered in FED-STD-H28 or ASTM A325, Standard Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength must be brought to the attention of the SCA for approval.

B.7.3 Locking Devices for Critical Mechanical Fasteners. The need for locking devices on mechanical fasteners should be evaluated by the applicant. In cases where the loss of a fastener would cause a critical failure, locking devices should be used. Generally, a locking device should provide a positive locking action, be simple to install and should lend itself to easy inspection without disturbing the locking feature.

If the locking device does not meet the above guidance, or is unique in design, the applicant should bring this device to the attention of the SCA, with sufficient information to justify the safety and integrity of the device. The justification should include recommended inspection procedures and acceptance standards.

If locking devices are not practical, critical fasteners should be marked with a "torque stripe" which identifies the relative locations of parts when properly torqued.

B.8 DESIGN OF PIPING SYSTEMS

When designing piping systems, the applicant should employ the design requirements of established military or commercial standards where a substantial body of service experience exists in similar applications.

Maximum System Pressure (MSP) is the highest pressure that can exist anywhere in a system or subsystem during any condition (i.e., uncontrolled pressure excursion). MSP is generally understood to be the relief valve set pressure and must include the effect of static head pressure. Pressure ratings for all piping and components should be equal to or greater than the MSP

of the system or line of which they form a part. Piping subject to external pressure should be designed for the maximum differential pressure that can exist in either direction during operating, shutdown or test conditions; otherwise suitable over pressure protection should be provided.

Maximum Operating Pressure (MOP) is the highest pressure that can exist in a system or subsystem under normal operating conditions. All piping components must undergo a hydrostatic strength test based on the MOP, with no external leakage or permanent distortion permitted. Additional information concerning testing requirements can be found in Appendix C.

B.8.1 Piping. Consideration should be given to material type, wall thickness, minimum bend radius, back-wall thinning allowance and inner radius wrinkling when specifying the method of piping system fabrication.

B.8.1.1 Structural Considerations. The applicant should consider the structural adequacy and fatigue life of the piping system for all anticipated in-service conditions. Some in-service conditions include the following:

a) Weight of pipe fittings, valves and other components including cleaning or testing fluids

b) Internal or external pressure, both static and cyclic

c) Restraint of hangers and supports

d) Thermal expansion and contraction

e) Shock, impact, vibration and water hammer

f) Mechanical loads caused by operation of the system

g) Effects of the corrosion

Piping which, if ruptured, would depressurize the unmanned pressure test facility should be protected against damage. Suitable routing, shielding, etc., may accomplish this. Piping connections should be designed and arranged so that it is physically impossible to inadvertently connect a system of one pressure or service to a system of a different pressure or service. If gas reservoirs, such as cylinders, are included in a system, a readily-accessible valve should be provided to stop gas flow from the reservoir.

B.8.1.2 Pipe Hangers. Arrangement and design of pipe hangers should be carefully considered as a basic element of the piping design. Piping support spacing should be IAW Table B.1 and ASME B31.1, Power Piping.

Piping and tubing should be supported as close to bends as

possible. Piping alone should not be used as the sole support for relatively heavy components (e.g., large valves, moisture separators or filter housings). Components should be supported so that the force required to operate them (or other normal operational loads) does not cause visible deflection, rotation or vibration. One line should not be used to support another, although clamp blocks may be used to support two or more adjacent lines as long as the blocks are attached to non-piping structural members.

B.8.1.3 Piping Flexibility. Piping should be designed to have sufficient flexibility to prevent failures resulting from the conditions listed in Section B.8.1.1.

In certain cases piping flexibility calculations are required by the SCA as a further measure of assurance prior to system fabrication. Detailed sketches of piping under examination may be required with the calculation report. Where required, calculations should show maximum stresses and their location in each section of piping under examination. Calculations should be submitted in a detailed form that will permit their review without difficulty and should include a statement delineating the following:

a) Theoretical basis of the calculations

b) Method of performing the calculations

c) Simplifying assumptions

d) Sign and symbol conventions

e) Assumed material and dimensional data

f) Other pertinent information such as hull deflections

The piping flexibility analysis should also consider the flexibility of piping components. The applicant's piping flexibility analysis should include calculations of the bending moments, twisting moments, and reaction forces imposed on each critical component in the piping system. Flexibility analysis is not required for pipe up to and including 3/8 inch IPS or for tubing up to and including 1/2 inch OD. Additional information on the flexibility analysis can be found in ASME B-31.1.

Table B.1
Pipe Support Spacing

PIPE SUPPORT SPACING		
Nominal Pipe Size (Inches)	Span (Inches)	
	Gas Service	Liquid Service
1/8	24-28	18-24

1/4	38-44	30-36
3/8	50-60	40-46
1/2	60-70	50-56
3/4	85-95	65-75
1	95-100	85-100
1-1/4	120-140	110-120
1-1/2	120-140	110-120
2	120-140	110-120
2-1/2	120-140	110-120
3	120-140	110-120

TUBING SUPPORT SPACING

Nominal Tubing Size O.D. (Inches)	Span (Inches)
	Gas and Liquid Service
1/8	18-24
1/4	24-30
5/16	30-40
3/8	40-50
1/2	50-60
3/4	60-70
1	70-80

B.8.1.4 Materials. In general, piping materials should be in accordance with MIL-STD-777, Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships. However, materials called out in ASME B-31.1 may be used with prior SCA approval. Consideration should be given to eliminate contact between dissimilar metals where galvanic effects of corrosion may occur. Specific approval must be obtained from the SCA for the use of non-metallic piping and piping components. Refer to Appendix A for additional information on material categories.

B.8.1.5 Pipe Joints. Only pipe joint designs that are fabricated, assembled and tested to accepted military or commercial standards may be used (typically; butt welds, socket welds, bolted flange connections and O-ring faced fittings). Other joint designs (typically; bite type, flared, compression fittings and threaded joints) must be justified to the SCA. Brazed joints, while considered standard practice in shipboard pipe systems, should be justified for portable and shore based systems.

The number of pipe joints should be kept to a minimum. Wherever possible, bending of the pipe should be considered. MIL-STD-1627, Bending of Pipe or Tube for Ship Piping Systems provides specific requirements and limitations for bending pipe or tube. All pipe and tube fittings should be used only at temperatures and pressures not exceeding ratings recommended by the manufacturer.

Lines, which must be connected and disconnected during system

operation, should be equipped with appropriate pressure venting capabilities. Lines which are required to be disconnected during set-up and take-down of the unmanned pressure test facility must be provided with suitable caps or plugs to maintain cleanliness and prevent damage to threads. Both male and female connections should be so protected. Caps, which introduce moisture, and tapes, that leave adhesive deposits, should not be used for this purpose. Closure devices, when not in use, should be stored in a way that prevents contamination.

B.8.1.5.1 Welded Pipe Joints. Welded pipe joints are the preferred method of joining pipe that will not require disassembly for system repair or maintenance. The welding process melts the base metal to form a joint that is often as strong as the surrounding piping and resists cracking due to piping flexure. Welded pipe joints must meet the requirements of ASME B31.1 and supplemental requirements of the SCA.

B.8.1.5.2 Brazed Pipe Joints. Brazed pipe joints are used to permanently join piping material that is not weldable (i.e., copper and copper-nickel). Brazed joints are not as strong as welded joints because the process only melts a soft filler metal, not the base metal. Brazing of austenitic stainless steels should not be performed without express permission of the SCA. All unmanned pressure test facility brazed pipe joints should meet the requirements of NAVSEA 0900-LP-001-7000, Category P-3a, Special Category (I) and should be performed in accordance with NAVSEA/NAVFAC-approved procedures.

B.8.1.5.3 O-Ring and Flanged Pipe Joints. Mechanical piping unions and flanges include a wide variety of designs that rely on a mechanical action (i.e., torquing of bolts or nuts) to compress a soft seal. Flange fittings are most often used in designs for large diameter shore-based liquid or steam system piping. The use of face seal o-ring unions are recommended over bolted flanges. MS boss fittings, with o-ring seals, are preferred over threaded pipe joints because galling of the threads is less likely and the threads are not relied upon to form the seal. Additional design requirements for bolted flanges and blanks and all alignment and assembly requirements for mechanical joints should be in accordance with Navy Ships Technical Manual (NSTM), Chapter 505 and ASME B-31.1.

B.8.1.5.4 Threaded Pipe Joints. Experience has shown that these connections are susceptible to corrosion, shock and vibration damage, and leakage. Consideration must be given to pressure limitations due to a reduction in wall thickness of the pipe at the tapered threads. Should a component only be procurable with threaded end fittings, a means must be provided upstream and downstream of the component to permit its removal without disturbing the threaded joints. Any compound (e.g., antiseize thread tape) or lubricant used in threaded joints should be suitable for the service conditions and should not react unfavorably with the service fluid or piping materials.

B.8.1.5.5 Flared Pipe Fittings. Flared pipe fittings and their joints should conform to the range of wall thicknesses and method of assembly recommended by the manufacturer. Care should be taken with cutting and flaring tools so as to not induce work hardening of the tube end, which can make the material more susceptible to brittle fracture. Flared fittings should not be used without specific NAVFAC approval.

B.8.1.5.6 Flareless Pipe Fittings. Flareless, mechanical friction or bite-type connections should not be used on piping components where failure could cause uncontrolled depressurization or flooding of pressure vessels, mission support systems, electrical assemblies or other mission components. The use of such fittings in control and monitoring systems may be permitted only if:

a) they can be quickly isolated from the rest of the system in case of failure and,

b) a redundant means of providing the control and monitoring functions is available

Flareless and non-standard fittings, including proprietary fittings, should not be used without specific NAVFAC approval. Approval for joint design should be based on past experience and/or tests that demonstrate that the joint is safe for the operating conditions.

B.8.1.6 Flexible Hoses/Flexible Pipe. In most applications and for permanent installations, flexible hose is a poor substitute for rigid pipe or tubing. The use of flexible hose should be limited to applications where excessive flexing or vibration of rigid piping dictates its use. When hose is to be subjected to considerable vibration or flexing, sufficient slack should be provided to avoid mechanical loading. Sharp bends or twisting should be avoided. Bend radii should not be less than the manufacturer's recommended minimum bend radius. All hoses should have a rated working pressure equal to or greater than the system design pressure for the system in which they are used. A pressure safety factor of four times the hose rated working pressure to burst pressure should be the minimum used for flexible hose. Flexible hose material should be compatible with the intended service. Cleaning solutions must be compatible with the hose materials and must be able to clean the hose to the same level as the system in which it is used.

When hoses and connectors are used in applications where they may be subjected to mechanical loading, they should be provided with strain relief devices. These devices should be designed to prevent damage to the hoses and connectors as well as to prevent accidental disconnection of the hoses if they are pulled. Provisions should be made to connect the strain relief device to a nearby structural member. The most common form of strain

relief is a small diameter wire cable with eyes at each end for shackles. The cable is attached to the hose by marlin at regular intervals. All high-pressure hoses are required to have this strain relief device except those that are permanently installed.

The safe useful life for each flexible hose in the unmanned pressure test facility should be specified and inspection requirements and criteria should be established. Periodic replacement of rubber hoses should be anticipated. Rubber hoses used in critical applications should be replaced every five and one-half years from date of manufacture. Rubber hoses used in non-critical applications should be replaced at least every 12 years. Metal, PTFE and thermoplastic hoses have no predetermined life but require annual inspection and testing. In all cases, hose inspection and replacement criteria should be in accordance with approved PMS.

All flexible hoses that are not permanently installed should be provided with suitable end caps that protect the hose end fittings from mechanical damage and prevent contamination when not connected for use.

The applicant should maintain a hose log for recording the inspection and test records and the life history of each flexible hose in the system.

Quick disconnect fittings used on flexible hoses should be readily accessible and capable of being disconnected under pressure in an emergency. Provision should be made to prevent accidental disconnection, i.e., a positive locking mechanism requiring more than one mechanical action to disconnect.

B.8.2 Piping Components. Care must be exercised when installing piping components in the system to ensure that gas or liquid flow is in the proper direction through the component. Most components have a designed direction for flow and this should be observed. Where components permit bi-directional flow, they should be installed to take best advantage of the design. For example, valves that serve as both inlet and outlet on high-pressure flasks should be installed so that when they are closed the flask pressure acts from below the seat and not on the valve stem packing. Piping components should always be installed in accordance with the manufacturers' recommendations, unless deviation is approved by NAVFAC.

All manually operated piping system components should be readily accessible and easily operable under normal and emergency conditions.

All piping system components should be selected for flow that is adequate for the most demanding mission conditions expected for the unmanned pressure test facility. These conditions should be specified when justifying the selection of a component.

Unmanned pressure vessels are of two types, those pressurized using a gas and those pressurized using fluid. Because of the differences in the pressurizing medium, selection of components of the different systems should be given different considerations.

B.8.2.1 Components of Gas Pressurized Systems. Only seamless piping or tubing is authorized in DOD unmanned pressure test facilities.

B.8.2.1.1 Compressors. Required features include pressure gages for each stage of compression, running hour meter, high-pressure shutdown, high temperature shutdown/alarm and low oil pressure shutdown/alarm. It is recommended that automatic condensate drains be installed on compressors. Consideration must be given to the location of the compressor inlet in regards to possible contamination from machinery exhaust fumes or other airborne contaminants. Proper inlet filtration should be provided. A dry type, non-shedding inlet filter is recommended.

B.8.2.1.1.1 Coolers. High temperatures associated with high-pressure air compressors may cause compressor lubricants to break down. Therefore, compressor inter-stage coolers and after coolers may be required to bring the discharge temperatures down to an acceptable level.

B.8.2.1.2 Moisture Separators. All high-pressure air compressors require moisture separators to remove liquid contaminants from the compressed air. The moisture separator capacity is selected according to compressor output flow rate and temperature and the anticipated environment that the compressor will be used in.

Separators should be located downstream of any after coolers to trap the condensation resulting from the air cooling process and compressor oil which may enter the outlet gas stream. All separators must be provided with drain valves to remove collected liquid. For maximum efficiency, moisture separators should be installed in a straight length of pipe at least 10 pipe diameters downstream of the nearest valve or fitting and should be drained regularly during operation. All moisture separators should be visually and hydrostatically tested. The periodicity for hydrostatically testing the moisture should be negotiated with the SCA.

B.8.2.1.3 Back Pressure Regulators. High-pressure air compressors should be equipped with a backpressure regulator located downstream of the moisture separator. Backpressure regulators should be designed to maintain a specified minimum operating pressure (normally 1000 psig or greater in accordance with the compressor manufacturer's requirements) at the compressor outlet. The backpressure regulator is used to seat the compressor piston rings and prevent excessive compressor lubricating oil from entering the system piping.

B.8.2.1.4 Filters. Compressor outlet filters are to be located downstream of the moisture separator and backpressure regulator and upstream of the rest of the system. All installed filter housings (except compressor inlet housings) should be hydrostatically tested. The periodicity for hydrostatic testing should be negotiated with the SCA. Depending on system design, additional particulate filters may be required to protect sensitive system components.

Components should have a working pressure that is greater than the maximum system pressure and the purification chambers should conform to ASME Code for unfired pressure vessels, Section VIII, Division 1.

B.8.2.1.5 Valves. For guidance on the selection of valves for a particular application refer to MIL-STD-777, NSTM Chapter 505, ASME B31.1 or NAVFAC DM-39.

Valves utilizing a soft seat design are preferable to those employing a metal-to-metal seat design.

Periodic inspection and maintenance should be performed in accordance with PMS. Pressure boundary hydrostatic and seat tightness testing of valves should be in accordance with NSTM Chapter 505.

B.8.2.1.6 Receivers and Volume Tanks. All air systems that are supplied air from a compressor should incorporate medium or low-pressure receivers or volume tanks. These components help to eliminate pulsations in the compressor discharge, and act as storage tanks, allowing the compressor to shut down during periods of light load. Receivers and volume tanks should be fabricated using approved specifications for pressure vessels described in Section B-5.1. In general, receivers and volume tanks are fabricated in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code. All receivers and volume tanks should be equipped with pressure gages, drain valves and relief valves. Receivers and volume tanks should be inspected in accordance with MIL-HDBK-1152, Inspection and Certification of Boilers and Unfired Pressure Vessels. More information on receivers and volume tanks can be found in NSTM Chapter 551.

B.8.2.1.7 Flasks. If high-pressure gas cylinders or flasks are installed, they should be designed and fabricated in accordance with DOD-approved specifications such as MIL-F-22606, Flask Compressed Gas and End Plugs for Air, Oxygen and Nitrogen or standards of DOT or ASME. Each gas flask should have a readily accessible isolation valve to stop gas flow to the system. The flask isolation valve must be able to withstand full flask pressure. Each air flask should incorporate a method for periodically draining moisture from its interior (i.e., drain valve, dip tube). MIL-F-22606 system air/gas flasks should be periodically inspected and undergo either nondestructive testing

or hydrostatic testing. DOT and ASME flasks should be inspected and hydrostatically tested in accordance with DOT or ASME requirements.

B.8.2.1.8 System Pressure Gages. The need for accurate, reliable, readable pressure gages in unmanned pressure test facilities cannot be overstated. Sufficient gages should be located throughout the system so that operators are able to monitor pressures at all times. Location of gages at the following points in a system is essential:

a) Gas manifolds

b) Volume tanks

c) H.P. bank manifold

d) Upstream and downstream of reducing valves

e) On each compressor stage and at outlet

The prudent designer will locate pressure gages at other locations throughout the system as operating needs, configuration or layout may require. Gage operating ranges should be selected so that system minimum and maximum operating pressure fall between one-fourth and three-fourths of full scale. Pressure gages in the system should be accurate to within "1% of full scale.

Unless specifically exempted by the SCA, each gage should be provided with a gage isolation valve that is readily accessible and may be closed to isolate a defective gage from the system. Valves that act as both isolation valve and calibration connection port are recommended.

All gages must be securely mounted in a location that permits easy reading of the dial and access for removal. Gages must be protected from mechanical vibration, shock and inadvertent mechanical damage. Care must be taken when mounting gages not to obstruct or block the operation of the "blow-out" plug.

When a gage is calibrated, a calibration data sheet should be prepared and retained as part of the certification documentation. A calibration sticker showing the date of calibration and the next calibration due date should be affixed to the gage dial or housing. Calibration should be accomplished only by a qualified calibration activity. The accuracy of helical-type Bourdon-tube gages may be verified by performing a comparison check with a gage that has been calibrated to a national standard. Gage comparison checks may be performed by qualified personnel within the command, however, those gages requiring adjustments must be forwarded to a qualified calibration activity. The dates and results of comparison checks should be documented and retained. All gage calibration and comparison should be performed in

accordance with approved system PMS.

B.8.2.1.9 Special Considerations for Oxygen Systems. The applicant should give special consideration and analysis to the use of oxygen in the specific unmanned pressure test facility design. Oxygen leaks are extreme fire hazards. Every attempt should be made to design oxygen-piping systems to eliminate the possibility of leaks. Use of seamless stainless steel piping/tubing is permitted in oxygen systems. Wherever possible, high-pressure portions of the oxygen system should be welded, vice using mechanical fittings. Quick-opening valves should not be used in high-pressure oxygen systems.

For further guidance on designing oxygen systems refer to ASTM G88, Standard Guide for Designing Systems for Oxygen Service; NFPA 53M, Manual on Fire Hazards in Oxygen Enriched Atmosphere and CGA G-4, Oxygen. Deviation from any of the above criteria requires technical justification and approval from the SCA.

B.8.2.1.10 Special Considerations for Hydrogen Systems. The applicant should give special consideration to the use of hydrogen in a UPTF. Dialog with the SCA early in the planning and design process is strongly recommended. The primary emphasis of the design is to prevent a flammable mixture of hydrogen and air or oxygen from forming. This can be broken down into two areas;

1. hydrogen gas leaking from the vessel, component or piping

2. flammable mixtures of hydrogen, oxygen or air within the piping system or vessel.

In the design of hydrogen piping systems special consideration should be given to the choice of piping joints, type of components and location of ancillary equipment. Special safety features and operating procedures should be considered to prevent the inadvertent forming of a flammable mix within piping or the pressure vessel.

Consideration should be given to monitoring equipment to alert operators of hydrogen gas leaks or hydrogen flames that may be undetectable to the naked eye.

The following additional references should be considered when designing a UPTF utilizing hydrogen as a pressurization media:

a) Flame Arresters in Piping Systems. API Publication 2028, Second Edition, American Petroleum Institute, December 1991.

b) Hydrogen as a Diving Gas. UHMS Publication number 69(WS-HYD), Undersea and Hyperbaric Medical Society, February 1987.

c) McCarty, R.D. Hydrogen: Its Technology and Implications. CRC Press, Inc., 1975.

d) NASA Hydrogen Safety Handbook.

e) Standard for Purged Enclosures for Electrical Equipment in Hazardous (Classified) Areas. NFPA 496, National Fire Protection Association, 1989.

f) Standard for Gaseous Hydrogen Systems at Consumer Sites. NFPA 50A, National Fire Protection Association, 1989.

B.8.2.2 Components of Fluids Pressurized Systems.

B.8.2.2.1 Pumps. Pump selection should be based upon the system fluid, the operating pressure and the flow capacity that is required. Once these operating parameters have been determined, pump selection is determined by an overlay of system and pump curves. Pumps should be located to maximize the net positive suction head and to minimize air entrainment into the system.

Pumps should be equipped with one pressure relief valve per each stage. Each stage of a pump should be provided with a temperature gauge for monitoring bearing temperature and with a pressure gauge. When pumping potentially contaminated fluids, a filter should be provided upstream of the pump to remove debris that could cause pump/system inefficiencies (e.g., cracked impeller, build-up in suction and discharge piping). The filter should be placed in an easily accessible location for ease of maintenance.

When installing pumps, consideration should be given to minimizing the effects of vibrations when choosing foundation mountings and piping connections. Consult with the manufacturer's recommendations for installation.

When high flow and low-pressure conditions are needed, centrifugal pumps should be considered for use. If these pumps are used in series, ensure that each pump is rated for the proper inlet pressure (i.e., the inlet pressure will increase for each consecutive pump).

When low flow and high-pressure conditions are needed, positive displacement pumps should be considered for use. This type of pump should also be considered when pumping high viscous fluids (i.e., if the viscosity is the same as or greater than SAE-30 motor oil (at room temperature)). Positive displacement pumps may also be used for metering flow. Some examples are external gear pumps and sliding vane pumps.

B.8.2.2.2 Valves. Valves should be selected based upon the system fluid, operating pressure and flow capacity that are required. Valves produced to a commercial or military standard are acceptable as long as the design pressure of the valve meets

or exceeds the system operating pressure. The soft goods (e.g. O-rings, gaskets) contained in the valves should be compatible with the system fluid.

Consult manufacturer's literature for recommendation on routine maintenance.

Ball Valves should be used in "on/off" applications and should not be used for throttling.

Globe/Plug Valves should be used in locations where throttling is necessary.

Needle Valves should be used in by-pass applications and where precise control is needed.

B.8.2.3 Piping Component Testing. All piping system components should be subjected to adequate strength and leak tests to ensure that the system is safe. The requirements for material OQE and component testing are given in Appendix C. All test results must be formally documented and available for SCA review during on-site surveys.

B.8.3 General Considerations for Piping Systems. It is essential that all seals, gaskets and o-rings in unmanned pressure test facilities be fabricated from the proper material. Gaskets containing asbestos material should not be used without approval of the SCA.

B.8.3.1 Identification and Labeling. All piping and components including fittings should be identified in sufficient detail on the system drawings (i.e., description, material, part number, pressure rating) to prevent replacement with an unsuitable part. Unless specifically exempted by the SCA, all hoses, valves, pressure vessels, gages, filters, etc., must be marked or labeled to indicate function and content.

Unless authorized by the SCA, all piping and piping system components used for the transmission or monitoring of liquid or gas within a system should be marked and color-coded to identify the specific gas or liquid contained and the direction of flow. Where piping is located behind a panel, an accurate schematic should appear on the panel. Color-coding of piping systems not identified in Table B.2 should be negotiated with the SCA. A labeling system should be used to identify each component by type of gas or liquid, by color and by word or letter symbol.

Table B.2.
Suggested Color Code And Component Designation
For Unmanned Pressure Test Facilities

Gas System	Designation	Color Code

Helium	HE	Buff
Oxygen	OX	Green
Helium-Oxygen mix	HE-OX	Buff & Green
Nitrogen	NIT	Light Gray
Exhaust	EXH	Silver
Air (low pressure)	ALP	Black
Air (high pressure)	AHP	Black
Chilled Water	CW	Blue & White
Hot Water	HW	Red & White
Potable Water	PW	Blue
Fire Fighting Material	FP	Red

Piping system components must have a standardized labeling scheme throughout, with unique component identifiers that match the system drawings and system operating and emergency procedures. Such standardization is important for approval of operating and emergency procedures, continuity of system manuals and personnel training.

B.8.3.2 Cleaning and Testing. All cleaning and testing of piping for unmanned pressure test facilities should be in accordance with NAVFAC approved procedures. Cleaning of oxygen, helium, HEOX and NITROX piping systems should meet the requirements of MIL-STD-1330, Precision Cleaning and Testing of Shipboard Oxygen, Helium, Helium-Oxygen, and Nitrogen Systems.

All pressure retaining components of the piping system must be hydrostatically tested for strength and porosity after completion of the installation and/or after welding or brazing. Individual components (e.g., valves, pressure regulators, volume tanks, etc.,) may be tested prior to installation in the system. In gas systems, pressure-measuring devices, such as gages and sensors, should not be hydrostatically tested due to the possibility of component damage.

Additional tests must also be performed to ensure system tightness and proper operation of components. General testing requirements are provided in Section 3. Appendix C provides specific component testing requirements for installation and repair of components.

Protection devices such as caps, plugs and plastic bags should be used to prevent entrance of foreign materials whenever the system integrity is broken and to protect the sealing surfaces of the components. Both male and female connections should be protected. Caps, plugs and plastic bags that introduce particulate contamination from shedding, moisture and tapes that leave adhesive deposits should not be used for this purpose. Caps and plugs should be cleaned to the acceptable level of system cleanliness before each use in accordance with approved cleaning procedures. When not in use, protection devices should

be stored in a way that prevents their contamination.

B.9 DESIGN OF ELECTRICAL SYSTEMS

Consideration must be given to the electrical requirements for all unmanned pressure test facilities and supporting equipment. This covers a wide range of equipment from heavy machinery such as pumps, compressors and handling equipment to precise instrumentation for monitoring, control, communications and data acquisition.

Although they cannot always be eliminated, electrical components exposed to high oxygen concentrations inside an unmanned pressure test facility pressure hull are potentially hazardous. The applicant should justify their use and should show their potential for creating a fire hazard in a hazard analysis. Electrical systems must be designed to the requirements of NFPA-70.

B.9.1 Power Requirements. The applicant should provide an estimate of he power requirements, both normal and emergency, to support the unmanned pressure test facility. The applicant should show how much power is required from the support facility and how much of the unmanned pressure test facility is self-supporting.

B.9.2 Electrical Connectors and Penetrators. The bodies of pressure vessel electrical penetrators and connectors exposed to water should be made of corrosion resistant material. Connector pins and sockets should be corrosion resistant or plated to prevent corrosion and electrical discontinuities. Provisions should be made to protect the pressure vessel from corrosion in the gasketed areas of the penetrators. Electrical connectors and individual hull penetrator designs should be technically justified for their intended applications.

B.9.3 Electrical Connectors. Connector design should permit the operator to readily disconnect the cable assembly and any other electrical conductor without receiving an electrical shock. System design or operating procedures should not allow disconnecting connectors when the circuit is energized.

Electrical connectors must be designed to prevent incorrect connection and accidental disconnection. This may be accomplished by size selection, key fitting, or other means. Color-coding or other visual identification alone is usually insufficient.

B.9.4 Electrical Penetrators. Pin-type connections for cable entrances into compensated enclosures are preferred; however, terminal tube entrances are acceptable provided evidence of compatibility of the cable jacket and insulation with the compensating medium is provided.

The electrical hull penetrator is part of the primary pressure boundary. Therefore, pressure test data should be provided to ensure that its hydraulic life is defined in relation to the design life of the hull and thermal shock to the connector.

B.9.5 Lighting Systems. If lighting is required, it is preferred that light sources be located external to the unmanned pressure test facility and provided internally through ports, light pipes, or other suitable means. In this case, infrared filters or other means may be required to dissipate heat from the port.

When lights are installed inside an unmanned pressure test facility chamber or capsule, the housings must be adequately designed so as not to explode or implode, and the wiring to the fixture must be sufficiently rugged to withstand inadvertent impact and mechanical loads without causing a fire or shock hazard.

B.9.6 Instrumentation. Instrumentation must be electrically isolated from the unmanned pressure test facility personnel, but not located in a manner that might subject it to erroneous readout. Electrical failure of one instrument must not impair the use of another. All instrumentation must be compatible with its intended environment and must not create a fire, electrical or toxic hazard.

B.10 ENVIRONMENTAL CONDITIONING COMPONENTS

Hyperbaric chamber heating/cooling systems may be required where environmental conditions dictate. The electrical components of heating/cooling systems should be located outside the pressure hull whenever possible. Heated/cooled gas or water may flow through the pressure hull, or the hull itself may be heated/cooled. If the hull is to be heated or cooled by an electrical device, the applicant should provide verification that no electrical current may pass through the hull.

B.11 OPERABILITY AND MAINTAINABILITY

The applicant should demonstrate the operability and maintainability of the facility. The facility must perform reliably under worst-case conditions. Mean time between failures must be longer than the longest mission duration. A comprehensive operation and maintenance technical manual, including troubleshooting instructions, should be developed and submitted for review.

B.12 REMOTE CONTROL SYSTEMS

The designer should furnish detailed design information for all remote control systems and components. Information provided to the SCA must clearly discuss the capability of the system to function in the intended environment (i.e., temperature,

pressure, humidity). Descriptions must be furnished for all remote control systems. The descriptions should include an analysis of the consequences of a failure or loss of normal mode, and describe automatic and manual backup control features available for emergency recovery or surfacing procedures. Test data in support of system and component reliability for the intended service must also be provided. Design information and test data must be in sufficient detail to permit an independent evaluation of the adequacy of the controls in their environment, under all normal and emergency operating conditions.

B.12.1 Remote Control Power Supply. Remote control power supplies may be manual, mechanical, pneumatic, hydraulic, or electrical. The choice should be based on reliability in the environment in which the power supply must function. The designer should furnish information that substantiates the reliability of the power supply in the intended environment. This information may be based either on previous use of the power supply or on tests.

All critical remote controls must have two independent sources of power. Failure of one of the power sources should not hinder the use of the other power source.

B.12.2 Remote Control Monitoring. Remote control systems should require devices that monitor system status and responses. Indication of malfunction or failure in a control actuator must be provided to the operator. The applicant should define the level of monitoring required based on the criticality of the system. The monitoring system design should be submitted to the SCA for concurrence.

B.12.3 Remote Control Actuators. A remote control actuator is any device or group of devices used to accomplish a desired control function. The design should be such that the control actuator is not subject to false alarms or extraneous signals that produce undesired responses. Switches and controls that are used to manually energize a control actuator must be located so that they are not inadvertently energized.

Remote control actuators should be designed to be fail-safe. Individual remote control actuators should be capable of being isolated from other remote control actuators that share a common power supply. For electrical remote control actuators, this requires either fuses or circuit breakers on all lines connecting each remote control actuator to the power supply. For hydraulic or pneumatic remote control actuators, this requires appropriate check valves or isolation valves on all lines connecting the power supply to the remote control actuator.

Where a remote control actuator normally operates automatically, provision should be made to allow the operator to manually override the automatic control. The manual control should bypass as much of the automatic control system as is practical.

APPENDIX C

REQUIRED DOCUMENTATION

C.1 MAINTENANCE AND REPAIRS

Work within the Scope of Certification (SOC) must be done in a controlled fashion to ensure certification is not voided. All work within the SOC on class-A chambers, should either be done in accordance with a controlled work procedure (CWP) or a re-entry control (REC) package. For Class-B and Class-C chambers, a maintenance log sheet should be filled out for all work within the Scope of Certification. An example of a Maintenance Log Outline Sheet is provided as Figure C.1.

C.1.1 Controlled Work Procedure (CWP). Work that is of a repetitive nature such as maintenance, equipment set-ups and alterations in support of testing may be accomplished using a CWP. All controlled work procedures should state:

a) Facility/Title

b) Safety Procedures
   tag out/isolation, depressurization, etc.,

c) Material required for installation
   penetrators by serial number
   soft goods
   test set-ups

d) Detailed work procedures
   list work steps in order
   list special work instructions

e) Testing required
   list test set-up requirements
   pressure, time, pass/fail criteria

f) Signature of person performing work and testing

CWPs may be pre-printed in a fill-in-the-blank format and used on an as needed basis. Controlled work procedures for each application should have individual numbers and be retained on file until the next certification audit. An example of an acceptable controlled Work Procedure is provided in Figure C.2.

Note: Deviation from the certified design within the Scope of Certification requires SCA Approval.

Facility _____ Date _____

_____ Maintenance _____ Repair _____ Design Change (requires Cert Board approval)

Caution: Verify system is NOT pressurized/powered prior to starting work and that the system CAN NOT be pressurized/electrified during work!

Short description of why work was performed:

List parts repaired/replaced:

State tests performed (type of test, item tested, pressures and result):

Craftsman performing work _____Sign/date: _____

Supervisor's approval of work _____Sign/date: _____

Figure C.1
Maintenance Log Outline

C.1.2 Re-Entry Control (REC). REC is a system for maintaining positive control of work performed within the certification boundaries of the unmanned pressure test facility. The system provides for monitoring and documenting the following:

a) What system worked on

b) Why work was required

c) What work was accomplished, including safety precautions, materials and components used, re-test requirements, test data and supporting documentation

d) Who did what work (Craftsman)

e) Who authorized and accepted the work (Facility Manager or his designated representative.

f) Who maintains documentation (REC Supervisor)

When any maintenance or work is performed which breaches the certification boundaries of the UPTF the REC supervisor must first initiate a REC. This is accomplished by filling out the REC log, completing a REC sheet obtaining authorization from the facility manager (or designated representative). The necessary work or maintenance can now be performed on the facility. Upon successful test completion, the REC sheet is completed and all applicable maintenance check-off sheets, inspection records, testing records, and fabrication records are attached to the REC sheet. Once the closure complete signature is obtained from the Facility Manager, the REC can then be closed out by the REC supervisor by placing the REC package on file and completing the REC log entry.

Under Normal circumstances the unmanned pressure test facility should not be operated with an open REC. However, if the system or Sub-system affected by the REC can be isolated to ensure the safety of operators, craftsmen, and property, the Facility Manager may authorize operation of the Unmanned Pressure Test Facility.

C.1.2.1 Exceptions to Re-Entry Control. Certain UPTF require frequent entry into the certified boundary for routine operations or maintenance actions to enable mission accomplishment. Any operational controls believed to be adequate in lieu of re-entry control or controlled work procedures should be submitted to the SCA for approval. Examples of actions not requiring a REC are:

a) Normal operation of access hatches, pressure boundary doors or similar operations covered by an operating procedure (OP).

b) Removal of portable gas flasks for charging.

c) Gauge calibration, reference or sampling line changes where the ID of the line is 0.25 inches or smaller and the pressurization medium is considered non-flammable.

Note: No exceptions from re-entry control other than those listed above are authorized. Recommendations for exception from re-entry control will be considered on a case-by-case basis by the SCA. When entering systems under a REC exemption normal caution must be observed in protecting the system integrity and cleanliness.

C.1.2.2 Energy Control (Lockout/Tag-Out). Lockout/Tag-out procedures are used to identify equipment and components which are (1) in need of maintenance or repair, or (2) define REC boundaries and are not to be operated while the REC is open (i.e., work in progress). Commands must develop suitable lockout/tag-out procedures to control energy during maintenance or servicing of equipment that meet the following requirements (Navy plans must be in accordance with OPNAVINST 5100.23, Navy Occupational Safety and Health (NAVOSH) Program Manual or USACE EM-385-1-1, Safety and Health Requirements Manual for contractor personnel):

a) Command instruction that clearly defines Lockout/Tag-out procedures to be used for the unmanned pressure test facility

b) Both Lockout/Tag-Out devices shall indicate the identity of the employee applying the device, cognizant shop of code, telephone number where the employee can be reached during working hours, his/her supervisor, date applied, and the machine, equipment or system component that is deenergized.

C.1.2.3 Supporting Documentation/Objective Quality Evidence. Objective quality evidence (OQE) is supporting documentation that enables verification of installed components and raises confidence in the installation. For UPTFs the major area of concern is the primary pressure boundary. Pressure vessels, hull penetrators, fittings and piping up to and including the hull isolation valve, soft goods and repair kits, are examples of components requiring OQE. OQE ranges from ASME code documentation, level of cleanliness documentation, soft goods packaging, and certificates of conformance (COC) from manufacturers verifying part or kit numbers.

C.1.2.4 Re-Entry Control Log Instructions (FIG C.2).

Block (1) Enter name or designation of the subject Unmanned Pressure Test Facility.

Block (2) Enter REC number (example 6003; 6 is the year group 1996, 003 is the third REC of that year).

Block (3) Enter the revision, for the initial issue REC and alphabetical letters for each revision thereafter.

Block (4) Enter the name of the system Re-Entered.

Block (5) Enter the name of the REC supervisor.

Block (6) Enter dates for when REC number is issued, when work is started and when the REC is completed.

Block (7) Enter any remarks or associated REC numbers.

(1) FACILITY

(2) REC NO.	(3) REV	(4) SYSTEM RE-ENTERED	(5) REC SUP (Print Name)	(6) DATES			(7) REMARKS (Include associated RECs)
				ISSUE	START	COMPLETE	

Figure C.2
Re-Entry Manned Pressure Test Facility Control Log

C.1.2.5 Re-Entry Control Form Instructions for Figure C.3.

Block (1) The assigned technician should identify the system or components being re-entered. Only one system can be entered on one REC. Where more than one system is involved, separate associated RECs must be written.

Block (2) Obtain the appropriate sequential serial number from the REC log and enter it on the Re-entry Control form (an example of a REC Log can be found in figure C.2. Revision should be entered on the initial version of all RECs. If a revision is made, prepare a new REC form with the original number, plus the next revision letter, obtained from the REC log. Attach the revised REC to the front of the original and make the required entries in the log.

Block (3) Enter the applicable reason for the REC. When other is checked, state the reason in the space provided.

Block (4) Enter the number of pages in the REC.

Block (5) Enter the applicable drawing and revision or reference numbers for the systems identified in Block 1. Where specific plans/drawings do not exist, system drawings may be referenced or sketches can be prepared and approved by the appropriate technical authority.

Block (6) Enter the valve, circuit breaker or device numbers that have been tagged out.

Block (7) List by name all other systems affected by this REC, included non-certified systems.

Block (8) Describe in brief detail the work to be accomplished. List steps to be performed, including special actions required to retain certification of the balance of the system. Provide enough detail for craftsman to complete the removal, repair, testing and reinstallation. The boundaries of the re-entry should be detailed in specific terms, a simple sketch may be attached to the REC for clarity. The identity of all joints to be affected by this work must be clearly indicated and any new material to be installed must be listed Other supporting OQE should be attached to the REC Form. The craftsman’s signature indicates that the work was performed as documented.

Block (9) List steps to prevent contamination of the system being re-entered.

Block (10) Mark the recertification requirements that will be supported with documentation in the REC package. The SCA may be contacted when questions about recertification requirements arise.

Block (11) Facility Manager should review the REC for completeness and clarity, signature authorizes work to commence.

Block (12) Facility Manager, or representative, should review the completed REC package for its compliance with documentation requirements. Upon satisfactory review the supervisor or his representative should sign the REC and file the package for future SCA review.

C.1.2.5.1 Test Line-Up. A test line-up (TLU) or approved operating procedure (OP) should be initiated by the REC supervisor and will be included as part of all Re-Entry control packages as Objective Quality Evidence (OQE) of the valve line up used for testing. The TLU will include a simple line drawing, or photocopy of an existing drawing, of the portion of or entire system being tested. The drawing should be marked to indicate valve positions (open/closed) during the test. A key should be included to define any symbols or colors used. This drawing may also be used to show the valves that were tagged out during the work procedure. The Test Director may, if preferred, list the valves in the system on the TLU and indicate the open or closed position and any special instructions to describe the sequence of the test procedure.

C.1.2.5.2 Test Line-Up Instructions (FIG C.4).

Block (1) Enter the system or component being tested and enter the REC number the test supports.

Block (2) Enter the gas or fluid used for the test (He, O_2, N_2, air, water, etc.).

Block (3) Enter the intended test pressure in psig.

Block (4) A sketch, copy of an existing drawing, or valve list should be included for the system undergoing testing and indicating the valve positions used for the test.

Block (5) The test director should sign stating the test line-up was completed per documented instructions. Note: Any variation from documented test method will be annotated and signed.

Block (6) A witness should sign stating the line-up was completed as documented.

(1) SYSTEM RE-ENTERED:	(2) REC # REV:
(3) REASON FOR REC: Alteration ☐ Repair ☐ Maintenance ☐ Trouble Shooting ☐ Retest ☐ Other (state)☐ ----------	(4) PAGE _____ OF _____ (5) DRAWING OR REF. NO.
(6) SYSTEM ISOLATION (List Vlv #'s):	(7) OTHER SYSTEMS AFFECTED BY THIS REC:
(8) WORK DESCRIPTION (USE REVERSE SIDE OR OTHER SHEET IF REQUIRED): _____ _____ CRAFTSMAN DATE	
(9) STEPS TO BE TAKEN TO PRECLUDE CONTAMINATION OF ANY PORTION OF THE SYSTEM BEING ENTERED:	
(10) TESTING/RECERTIFICATION SUPPORTING DOCUMENTATION: NDT DOCUMENTATION ☐ SKETCHES OR DRAWINGS ☐ CLEANING DOCUMENTATION☐ TEST LINE UP ☐ STRENGTH TEST ☐ SEAT TIGHTNESS TEST ☐ JOINT TIGHTNESS TEST ☐ DROP TEST ☐	
(11) WORK AUTHORITY APPROVAL: _____ _____ Signature Date	(12) CLOSURE COMPLETE _____ _____ Signature Date

NOTE: Local Re-entry formats may be generated, but require SCA approval.

Figure C.3
Unmanned Pressure Test Facility Re-Entry Control Form

(1)SYSTEM/REC: _____	(2) TEST MEDIA _____	(3) TEST PRESSURE (psig) _____
(4) SIMPLE DIAGRAMMATIC DRAWING OF SYSTEM TEST LINE-UP		
(5) TEST DIRECTOR DATE	(6) WITNESSED: DATE	

Figure C.4
Unmanned Pressure Test Facility Test Line-Up Sheet

C.1.2.6 Joint Tightness Test. A joint tightness test subjects mechanically joined pressure containing boundaries of pipe and piping components to an internal pressure equal to 100% of maximum operating pressure. It is used after joint assembly to help identify leakage in mechanically joined pipe and piping components. Unless otherwise specified, test pressure tolerance should be maintained within + or - 3% (but no greater than 100 psig) of the specified test pressure. The duration for the joint tightness test is to be not less than 15 minutes (not less than 5 minutes if the test is conducted in a shop or a bench test) soak time plus sufficient time for inspection. All joints, when possible, should be checked for leakage using a leak detection solution. A sonic leak detector may be used in conjunction with the leak detection solution to help find leaks. System fluid is the preferred test medium for joint tightness testing, however, for O_2 systems, nitrogen may be used due to safety concerns. Requests for other fluid substitutions should be directed to the SCA.

C.1.2.6.1 Acceptance Criteria. Acceptance criteria for joint tightness testing of all systems, except those tested with helium or hydrogen, should be zero leakage. For systems using helium or hydrogen as the test medium, the acceptance criteria should be zero leakage except at valve stem seals where a leakage rate of 0.6cc/min for each stem seal is permitted. This is identified by only small bubbles forming in the solution like foam but no bubbles large enough to be identified as an individual bubble with the naked eye.

C.1.2.6.2 Joint Tightness Test Instructions (FIG C.5).

Block (1) Enter the name of the command at which the work is being performed.

Block (2) Enter the REC number that this test is associated with.

Block (3) Enter the system or component that is being tested.

Block (4) Enter a short description of the item being tested.

Block (5) Enter the required test pressure (100% of operational pressure).

Block (6) Enter the time the test was started and the time the test was completed.

Block (7) The facility Manager (or designated representative) should review the REC including the proposed test. Signature in this block allows testing to begin.

Block (8) Enter the joint numbers tested. Joint numbers may be assigned at the time of the test by including a sketch identifying the location and orientation of each joint.

Block (9) Enter the results of each joint test (sat or unsat). If a joint is unsatisfactory it must be repaired and

retested with the appropriate documentation being added to the REC package.

Block (10)If required, make a sketch to show the joint configuration clearly marking the joint numbers.

Block (11)The test technician should sign stating the test was completed as documented.

C.1.2.7 System Tightness Test. A system tightness test is performed when the scope of work exceeds the complexity at which a joint tightness test can be performed. When a system is applying for initial certification or has undergone an extensive overhaul a system tightness test should be run. This test is used to identify long-term leakage of an entire system. The system is gradually pressurized to 100% of maximum operating pressure. Data is then taken to measure the change in pressure, corrected for temperature, over an extended period of time. System tightness tests, unless otherwise specified by the SCA, should be at least 6 hours in duration. The test pressure tolerance used to perform this test should be within + or - 3% (but not greater than 100 psig) of the specified test pressure.

Step 1 Pressurize the entire system to its maximum operational pressure with the appropriate pressurization medium.

Step 2 Ensure accurate temperature monitoring throughout the system being tested.

Step 3 Allow approximately two (2) hours for the temperature to stabilize and repressurize if necessary.

Step 4 Log the test pressure and temperature hourly. Monitor the tightness of the installed using A and B below.

a) For gas filled systems, apply leak detecting soap solution to all joints (mechanical, welded, brazed, etc.,) within the test boundaries. Solution should be applied at least hourly. For liquid filled systems, look for physical evidence of leaks.

b) Verify installation of a calibrated pressure gage for monitoring pressure within the system undergoing test. Observation of the test pressure is required to ensure that the test pressure is maintained throughout the test duration and that no piping leakage goes undetected due to piping porosity that may not be detected by the leak detecting solution. For systems with small volumes, acceptable tightness of the system based on the pressure drop method may be indeterminate. Therefore, step A should be an integral part of all tightness tests.

C.1.2.7.1 Acceptance Criteria.

a) Leak detecting solution method: For systems tested with Helium or Hydrogen, mechanical joints (such as union connections) shall have no detectable leakage. Only leakage allowed is 0.6 cc/min for each valve system seal. This rate is identified by the formation of only foam like bubbles, no large bubbles. Systems pressurized with other media should exhibit no leakage.

b) Pressure drop method: Calculate the corrected pressure as specified below. The pressure drop is considered acceptable if it is less than 1% of the test pressure (test pressure divided by 100). If the leakage exceeds 1% the source must be found, leak repaired and test repeated until acceptable.

The system corrected pressure (Pc) is found by the following formula:

$$Pc = [(Pf+14.7\ psig) \times [(Ti+460°F)/(Tf+460°F)]] - 14.7\ psig$$

$$\Delta P = Pi-Pc$$

Where:
Pi = pressure as read at start of test (psig)
Ti = temperature as read at start of test(°F)
Tf = temperature taken hourly for pressure correction (°F)
Pf = pressure taken hourly, to be corrected (psig)
Pc = corrected pressure (psig)
ΔP = pressure drop (psi)

1. COMMAND/UNIT		2. REC NO.
3. SYSTEM/COMPONENT		4. DESCRIPTION OF ITEM
5. REQUIRED TEST PRESSURE		6. DURATION OF TEST
7. TEST AUTHORIZATION		DATE
8. JOINT NUMBER	9. SAT / UNSAT	10. SKETCH (If Required)
11. TECHNICIAN		DATE

Figure C.5
Unmanned Pressure Test Facility Joint Tightness Test

C.1.2.7.2 System Tightness Test Instructions (FIG C.6).

Block (1) Enter the system or component that is being tested.

Block (2) Enter the test media used (air, O_2.He, water, etc,).

Block (3) Enter the required test pressure.

Block (4) Enter the date the test started.

Block (5) Enter the time the test was started.

Block (6) Enter the time the test completed.

Block (7) Enter the REC number with which this test is associated.

Block (8) Enter the pressure (Pi) and temperature (Ti) readings at the start of the test.

Block (9) The facility Manager (or designated representative) should review the REC including the proposed test. Signature in this block authorizes testing to begin.

Block (10)Each hour enter, the time the readings were recorded, system pressure (Pf), system temperature (Tf), corrected pressure (Pc) using above formula, and pressure drop.

Block (11)Enter any comments, observations, or changes made during the test

Block (12)The test director should sign stating that the test was performed as documented.

(1) SYSTEM:	(2) TEST MEDIA (gas)	(3) TEST PRESSURE (psig)	
(4) TEST DATE	(5) TEST START TIME	6)TEST COMP TIME	(7)REC

(8)INITIAL READINGS AT START OF TEST

INITIAL PRESSURE P_i _____ Psig INITIAL TEMPERATURE T_i _____ ^{o}F

(9) TEST AUTHORIZATION DATE

(10) TIME	(P_f) SYSTEM PRESSURE	(T_f) SYSTEM TEMPERATURE	(P_c)CORRECTED PRESSURE	$\Delta P=P_I$ - P2
1	Psig	^{o}F	psig	psig
2	Psig	^{o}F	psig	psig
3	Psig	^{o}F	psig	psig
4	Psig	^{o}F	psig	psig
5	Psig	^{o}F	psig	psig
6	Psig	^{o}F	psig	psig

(11) COMMENTS:

(12) TEST DIRECTOR DATE

Figure C.6
Unmanned Pressure Test Facility System Tightness Test

C.1.2.7.3 Hydrostatic/Pneumatic Test Instructions (FIG C.7).

Block (1) Enter the command or unit where the facility is located.

Block (2) Enter the REC number with which the test is associated or the Job Control Number (JCN).

Block (3) Enter the system or component this test supports.

Block (4) Enter a description of the item being tested.

Block (5) Enter any references for the test (drawings, manuals, etc,.).

Block (6) Enter any required test and inspection points.

Block (7) Make a diagram of the test area.

Block (8) Enter the required test pressure.

Block (9) The facility supervisor (or designated representative) should review the proposed test, signature in this block authorizes testing to begin.

Block (10) Enter the actual test pressure obtained during the test.

Block (11) Mark the test result (SAT or UNSAT).

Block (12) Record any remarks or observations.

Block (13) The test technician should sign stating the test was completed as documented.

C.1.2.8 Hose Log (FIG C.8). A hose log must be maintained for all flexible hoses. Hose logs may be divided into facilities that the hoses support but must be maintained in an auditable fashion. Locally generated forms may be used with the SCA’s concurrence.

C.1.2.9 Operation Log. The operation log is the official chronological record of procedures and events that occur during each pressurization of the test facility. The operation log must be retained by the command and available for SCA review. The minimum data items in the operation log include:

a) Date of test facility pressurization

b) Purpose of test

c) Maximum test pressure

d) Identification of operator(s)

e) Note(s) on unusual events during operation or with

equipment

f) Signature of operator(s)

1. COMMAND/UNIT	2. REC NO./JCN
3. SYSTEM/COMPONENT	4. DESCRIPTION OF ITEM
5. TEST REFERENCE	6. REQUIRED TEST & INSPECTION POINTS
7. DIAGRAM OF TEST AREA INCLUDING GAGS, BLANKS INSTALLED AND VALVE POSITIONS	
8. REQUIRED TEST PRESSURE (psig)	9. TEST AUTHORIZATION DATE
10. ACTUAL TEST PRESSURE (psig)	11. TEST RESULTS ( ) SAT ( ) UNSAT
12. REMARKS:	
13. TECHNICIAN DATE	

Figure C.7
Unmanned Pressure Test Facility hydrostatic/Pneumatic Test

HOSE NO. _____

LOCATION _____

_____

WORKING PRESSURE

_____

MANUFACTURE

_____

SIZE / TYPE

_____

PART NUMBER

_____

END FITTINGS

_____

_____

RECEIVED DATE

_____

* * * * * * * RECORD OF HYDROSTATIC TEST * * * * * * *

HYDRO DATE	DATE DUE
_____	_____
_____	_____
_____	_____
_____	_____

Figure C.8
Unmanned Pressure Test Facility Hose Log

DATE: _____

NOTE

TO LINE UP XXXXX FOR PRESSURIZATION:

PROCEDURE	INIT	NOTE

COMPONENT	DESCRIPTION	LOCATION	PROCEDURE	INIT	NOTES

Figure C.9
Unmanned Pressure Test Facility Sample Operating Procedure
Form XXXXX LINE UP

BIBLIOGRAPHY

The publications listed below are representative of those that may be useful to the sponsor in preparing for certification of an unmanned pressure test facility. The most recent issue or revision of each should be used.

ANSI/ASME B57.1, Compressed Gas Cylinder Valve Outlet and Inlet Connections

API Publication 2028, Flame Arrestors in Piping Systems

ASME Boiler and Pressure Vessel Code, Section V, Nondestructive Examinations

ASTM E1742, Standard Practice for Radiographic Examination

Compressed Gas Association Pamphlet C-5, Cylinder Service Life

Compressed Gas Association Pamphlet C-6.1, Standards for Visual Inspection of Compressed Gas Cylinders

Compressed Gas Association Pamphlet G-4, Oxygen

Compressed Gas Association Pamphlet G-4.2, Standard for Bulk Oxygen Systems at Consumer Sites

Compressed Gas Association Pamphlet G-4.4, Industrial Practices for Oxygen Transmission Systems and Distribution Piping

Compressed Gas Association Pamphlet P-1, Safe Handling of Compressed Gas

Compressed Gas Association Pamphlet P-9, Inert Gases Argon, Nitrogen, Helium

EM 385-1-1, Safety and Health Requirements Manual

IEST-STD-CC1246, Production Cleanliness Levels and Contamination Control Program

ISO 9000, International Standards for Quality Management

MIL-STD-101, Color Code for Pipelines and for Compressed-Gas Cylinders

MIL-STD-777, Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships

MIL-STD-889, Dissimilar Metals

MIL-STD-1411, Inspection and Maintenance of Compressed Gas Cylinders

MIL-STD-1689, Fabrication, Welding and Inspection of Ships Structure

NASA Hydrogen Safety Handbook

National Fire Protection Association, 50A, Standard for Gaseous Hydrogen Systems at Consumer Sites

National Fire Protection Association, 53M, Manual on Fire Hazards in Oxygen Enriched Atmosphere

National Fire Protection Association, 70, National Electric Code

National Fire Protection Association, 99, Health Care Facilities

National Fire Protection Association, 496, Standard for Purged Enclosures for Electrical Equipment in Hazardous (Classified) Areas

NAVFAC DM 3.5, Compressed Air and Vacuum Systems

NAVFAC MIL-HDBK-1002/2A, Structural Engineering – Loads

NAVFAC MIL-HDBK-1004/2A, Power Distribution Systems

NAVFAC MIL-HDBK-1004/3, Switchgear and Relaying

NAVFAC MIL-HDBK-1004/4, Electrical Distribution Systems

NAVFAC MO 406, Hyperbaric Facilities Maintenance Manual

NAVFACINST 11012.128,Design and Fabrication of High Pressure Gaseous Oxygen and Nitrogen Piping Systems

NAVSEAINST 6260.1, Occupational Noise Control and Hearing Conservation

NAVSEA 0900-LP-001-7000, Fabrication and Inspection of Brazed Piping Systems

NAVSEA S9074-AQ-GIB-010/248, Requirements for Welding and Brazing Procedure and Performance Qualification

NAVSEA S9074-AR-GIB-010/278, Requirements for Fabrication Welding and Inspection, and Casting Inspection, and Repair for Machinery, Piping, and Pressure Vessels

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NAVSEA T9074-AS-GIB-010/271, Non-Destructive Testing Methods

OPNAVINST 5100.23, Navy Occupational Safety and Health (NAVOSH) Program Manual

OPNAVINST 6260.2, Occupational Noise Control and Hearing Conservation

UFC 3-310-01, Design: Load Assumptions for Buildings

UFC 3-600-01, Design: Fire Protection Engineering For Facilities

UHMS Pub. No. 69(WS-HYD), Hydrogen as a Diving Gas

REFERENCES

NOTE: THE FOLLOWING REFERENCED DOCUMENTS FORM A PART OF THIS DOCUMENT TO THE EXTENT SPECIFIED HEREIN. USERS OF THIS DOCUMENT SHOULD REFER TO THE LATEST REVISIONS OF CITED DOCUMENTS UNLESS OTHERWISE DIRECTED.

FEDERAL/MILITARY SPECIFICATIONS, STANDARDS AND HANDBOOKS:

Unless otherwise indicated, copies are available from the Naval Publishing and Printing Services Office (NPPSO), Standardization Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

STANDARDS

FED-STD-H28	Screw-Thread Standards for Federal Services
MIL-STD-882	System Safety Program Requirements
MIL-STD-1330	Precision Cleaning and Testing of Shipboard Oxygen, Helium, Helium-Oxygen, and Nitrogen Systems
MIL-STD-1627	Bending of Pipe or Tube for Ship Piping Systems

HANDBOOKS

MIL-HDBK-1152	Inspection And Certification Of Boilers and Unfired Pressure Vessels

SPECIFICATIONS

MIL-DTL-31000	Technical Data Packages
MIL-F-22606	Flask Compressed Gas and End Plugs for Air, Oxygen and Nitrogen

OTHER GOVERNMENT DOCUMENTS AND PUBLICATIONS:

DODD 5000.1A	Defense Acquisition
DODI 5000.2	Defense Acquisition Management Policies and Procedures
NAVFAC DM 39	Hyperbaric Facilities
NAVSEA NSTM	Naval Ships Technical Manual

(Unless otherwise indicated, copies are available from Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia PA 19120.)

NON-GOVERNMENT PUBLICATIONS:

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI NB-23	National Board Inspection Code
ANSI/ASME B31.1	Power Piping
ANSI/ASME PVHO-1	Safety Standards for Pressure Vessels for Human Occupancy

(Unless otherwise indicated, copies are available from American National Standards Institute (ANSI), 11 W 42nd St., 13th Floor, New York, NY 10036.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASME Boiler and Pressure Vessel Code	Section VIII, Division 1, Unfired Pressure Vessels, and Division 2, Alternative Rules for Pressure Vessels ASME Boiler and Pressure Vessel Code, Section IX, Welding Qualifications

(Unless otherwise indicated, copies are available from American Society of Mechanical Engineers (ASME), 3 Park Ave, New York, NY 10017.)

ASTM INTERNATIONAL

ASTM G88	Standard Guide for Designing Systems for Oxygen Service
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength

(Unless otherwise indicated, copies are available from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.)

GLOSSARY

For purposes of this document, the following words or phrases are as defined.

Accessibility to vital equipment The ability to reach, read, and/or operate vital equipment and devices.

Accident A happening that is not expected, foreseen, or intended under normal circumstances.

Alteration A change from the as-certified design, material, configuration, or performance.

Appurtenance An accessory added to a major component (e.g., view ports hatches, support rails, connectors, piping, etc.,).

Builder Contractor or agency that constructs the unmanned pressure test facility.

Casualty An incident which causes damage or interruption of the normal operation of the unmanned pressure test facility and which may result in physical injury to personnel.

Catastrophe Any extreme or sudden disastrous malfunction which jeopardizes the safety of the facility operators or causes major damage to the facility.

Certifiable See System certification.

Certificate The document attesting to the system certification granted by the SCA.

Certification See System certification.

Certification Scope See Scope of certification.

Emergency A sudden, unexpected malfunction or other set of circumstances in the System operation which requires immediate attention.

Explodable items Any item containing a non-compensated volume that has the potential for failure under internal

	pressure.
Fail Safe	Material or equipment designed or arranged so that failure or malfunction renders it harmless or inert.
Fire resistant	A material that will immediately self extinguish when the source of ignition is removed, when tested in an atmosphere representative of its intended use environment.
Foundation	The permanently installed part of a pressure vessel system which serves exclusively to support the Pressure vessel system.
Hard structure	Pressure resistant structures, including reinforced openings and penetrations, but other than the pressure vessels, which may experience high differential pressure and that are designed to the same criteria as the pressure vessel.
Heat resistant	A material that does not give off noxious fumes at its operating temperature or at any temperature below 200° F and which is not degraded in respect to performing its intended function when exposed to a temperature of 400°F for 5 minutes.
Implodable item	Any item containing a non-compensated compressible volume that has the potential for failure under external pressure.
Material adequacy	Designed and constructed of proper materials and (materially adequate) performance tested in accordance with accepted engineering principles to provide for safety of the pressure vessel system personnel.
Maximum operating pressure	The highest pressure that can exist in a system or subsystem during any condition.
Maximum System Pressure	The maximum pressure that the system can experience.
Milestone event	A list of sequential events in the certification schedule process with estimated completion dates.

Operator(s)	1. The organization, agency, or firm having responsibility for the operation, repair, and maintenance of the pressure vessel system. 2. The personnel who physically control the operating parameters of the pressure vessel system.
Penetration	The assembly, component shaft packing gland, seal, or other device which penetrates the pressure resistant structure (e.g., pressure vessel or hard structure).
Pressure vessel	See definition of Unmanned Pressure Test Facility.
Procedural adequacy	The procedures used in the operation and maintenance of the pressure vessel system, suitable and sufficient to provide for the safety of the occupants and operators of the system, before, during, or after any credible operational or emergency evolution.
Procedures	Instructions, checklists, and maintenance guides, prepared in a manner that provides the occupants and operators a detailed, safe sequence of operations of the pressure vessel system in all of its various normal and emergency operating modes.
Re-certification	A new certification for system adequacy of a pressure vessel system fabricated, assembled, and performance tested in accordance with acceptable engineering principles.
Repair	A restoration to the original condition or replacement that does not change the original material, configuration, or performance, using procedures previously approved.
Replacement-in-kind	Replacement with parts or components meeting original specification requirements.
Scope of Certification (SOC)	A list defining those systems, subsystems, components, portions of the pressure vessel system,

	maintenance, and operational procedures which are needed to preserve the physical well being of the pressure vessel system personnel.
Sponsor	The agency/organization that is making application for system certification or re-certification of a pressure vessel system. For the pressure vessel System being developed, the sponsor will normally be that agency or organization tasked with development of the capability provided by the pressure vessel system. For existing pressure vessel systems, the sponsor will normally be that element within the organizational chain responsible for operational readiness and deployment of the specific pressure vessel system.
Survey	To examine, inspect, and review in detail all items falling within the scope of certification to determine their material and procedural adequacy.
Survey team	The personnel representing the System Certification Authority to perform the on site verification of the pressure vessel system survey.
Suspension of certification	The temporary revocation of certification that does not require full re-certification. Manned use of the system during suspension is not authorized.
Sustaining system certification	Actions required of the sponsor to ensure the SCA that the pressure vessel system remains in the as-certified condition for the tenure of certification.
System certification	The procedure including application, independent technical review, survey, and approval to ensure the adequacy of the pressure vessel system to safely perform over its operational/emergency spectrum. System certification is a combination of two major areas of review: material adequacy and procedural adequacy. This replaces the old term "material certification".

System Certification Authority (SCA)	The code within NAVFAC that has been delegated, through the Navy chain of command, the responsibility to conduct the Certification process.
System design pressure	The pressure used in the calculation of piping and piping components minimum section thicknesses.
Tenure	Tenure of Certification is the length of time for which certification is granted.
Termination of certification	The cancellation of system certification, requiring full system review to re-certify.

ACRONYMS

ANSI. American National Standards Institute

ASME. American Society of Mechanical Engineers

DOD. Department of Defense

DOT. Department of Transportation

EP. Emergency procedure

HAZCAT. Hazardous Category

MES. Milestone Event Schedule

MSDS. Material Safety Data Sheet

NAVFACENGCOM. Naval Facilities Engineering Command

NDT. Non-destructive Testing

OP. Operating procedure

OQE. Objective Quality Evidence

PMS. Preventive Maintenance System

PSOB. Pre-Survey Outline Booklet

QA. Quality Assurance

SCA. System Certification Authority

SCSC. System Certification Survey Card

SOC. Scope of Certification

UFC 4-420-01
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This UFC supersedes UFC 4-420-01, dated 1 May 2015.

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FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States, its territories, and possessions is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Military Department's responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Technical content of UFC is the responsibility of the cognizant DoD working group. Defense Agencies should contact the respective DoD Working Group for document interpretation and improvements. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

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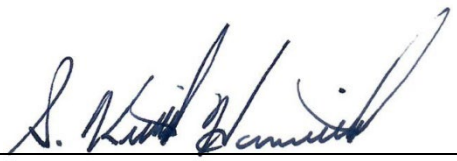
- Whole Building Design Guide website https://www.wbdg.org/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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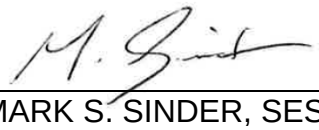
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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

The DDESB has established minimum AE safety standards for personnel and property that have the potential of being exposed to the effects of an accidental explosion.

These standards govern the design, construction, and use of all AE storage facilities within the DoD.

Magazines are used to store AE materials. Magazines are classified as Aboveground Magazines (AGM) or Earth-Covered Magazines (ECM). ECMs are further divided (7-Bar, 3-Bar, or Undefined). Magazines are not designed to resist the damaging effects of its own exploding contents; it is accepted that the exploding magazine will be heavily damaged or even destroyed if an internal explosion occurs. The intended function of a magazine is to mitigate a sympathetic detonation of either AE or an adjacent magazine. The structure is designed to resist an external detonation, thereby interrupting the propagation chain.

DoD explosives safety standards are contained in Defense Explosives Safety Regulation (DESR) 6055.09. DDESB Technical Paper 15 (TP 15) provides a ready resource for DDESB-approved protective construction as well as the explosives safety criteria associated with them. Service-specific explosives safety standards that implement the DoD standards are contained in the following documents:

- **DoD Contractors**: DoD 4145.26-M.
- **Air Force**: DESR 6055.09 AFMAN 91-201 Explosives Safety Standards.
- **Army:** AR 385-10, *U.S. Army Safety Program* and DA PAM 385-64, *Ammunition and Explosives Safety Standards*.
- **Navy**: NAVSEA OP 5, Ammunition and Explosives Safety Ashore.

1-2 REISSUES AND CANCELS.

This UFC supersedes UFC 4-420-01 dated 05-01-2015 with Change 1 dated 10-12-2022.

1-3 PURPOSE AND SCOPE.

This UFC serves as a reference tool to assist in the planning and design of Ammunition and Explosives (AE) storage magazines for the Department of Defense (DoD), by providing definitions and information related to the design, selection, and siting of these unique facilities. This UFC is intended to assist in the selection of a magazine design by providing available options and information related to the use of designs that have been used in the past and have been approved by the Department of Defense Explosives Safety Board (DDESB). The individual DoD Services can also provide additional guidance on the selection of magazine designs.

A web site designed to be a companion resource to this UFC is located on the Whole Buildings Design Guide and can be accessed at: https://www.wbdg.org/design/ammo_magazines.php . This web site provides the following additional information and resources:

- Available electronic copies of referenced military regulations, manuals and standards.
- Available design drawings, approval letters, and specifications for 7-Bar and 3-Bar Earth-Covered Magazines (ECM) that have been approved for new construction.
- Available drawings and related information for the designs of 7-Bar and 3-Bar ECM that are no longer approved for new construction but still in use.
- Available drawings and related information for the designs of ECM and Aboveground magazines (AGM) and containers that have been approved for restricted use.
- A listing of the existing magazine designs that are classified as undefined.
- Available drawings for barricade design utilizing various construction materials.
- Links to additional related resources and publications.

This UFC, when used with the companion web site, provides planners and designers of AE storage facilities access to up-to-date information and resources needed in the selection and design of new storage magazines and in the evaluation of existing facilities.

1-4 APPLICABILITY.

This UFC follows the same applicability as UFC 1-200-01, APPLICABILITY for the planning, design, and construction of DoD AE storage facilities worldwide.

1-5 EXCEPTIONS

Specialized magazines, such as containers and magazines with reduced net explosive weights (NEWs) and/or reduced quantity-distances (QD) are not covered by this document. DDESB TP 15 provides a listing of specialized magazines (both Earth-Covered and Aboveground) and shipping containers that have been approved with a reduced NEW and/or a reduce QD, along with requirements, restrictions, and conditions for use in Table AP1-4.

1-6 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance

and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-7 CYBERSECURITY.

All facility-related control systems (including systems separate from a utility monitoring and control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service Implementation Policy.

1-8 GLOSSARY.

APPENDIX C contains acronyms, abbreviations, and terms.

1-9 REFERENCES.

APPENDIX D contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

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CHAPTER 2 TECHNICAL REQUIREMENTS

2-1 MAGAZINE TYPES.

AE storage magazines are classified as either Earth-Covered Magazines (ECM) or Aboveground Magazines (AGM). Magazines are considered uninhabited structures and are used for storage only. The use of a preapproved standard design for new magazine construction is strongly recommended. A non-preapproved design may be used where a standard preapproved design is not suitable due to special circumstances, and the design meets all applicable requirements of DESR 6055.09.

For identification of various magazine types, the *Magazine Identification and Codex Development Guide* developed by the Ammunition & Explosives Facilities Working Group (AEFAC-WG) can be referenced. https://flankspeed.sharepoint-mil.us/sites/NAVFACLANTAMMagazineCriteria.

2-1.1 Earth-Covered Magazines (ECM).

In general, an ECM allows for lesser separation distances than an Aboveground Magazine (AGM) based on the same net explosive weight (NEW). ECM design criteria are specified in DESR 6055.9, Volume 2, Enclosure 5. DESR 6055.09 defines three basic ECM designations: "7-Bar," "3-Bar," and “Undefined,” based primarily on the relative strength of the magazine headwall and doors and the relative strength of the roof for non-arch or “flat roof” magazines. This designation is based on the structural strength and ability of the magazine to withstand blast loadings resulting from an accidental explosion of an adjacent magazine as a Potential Explosion Site (PES). Siting criteria, based on ECM designation, ensure a consistent level of protection across the AE storage area. Designations for previously designed ECM’s are contained in DDESB publication TP-15, *Approved Protective Construction*. In addition, the earth cover for ECMs must meet specific requirements, including minimum top cover thickness and slope, per DESR 6055.09 V2.E5 and DDESB TP-15. If the magazine design or earth cover requirements are not met, the ECM must be sited as an AGM and the storage capacity of adjacent PESs is significantly reduced. Storage capacity of magazine will also be downgraded.

2-1.1.1 7-Bar ECM.

A 7-Bar ECM provides the highest resistance to blast loading. Magazines designated as 7-Bar were referred to as “Standard” magazines prior to 1997.

2-1.1.2 3-Bar ECM.

A 3-Bar ECM provides a lower level of resistance to blast loading than a 7-Bar ECM, but more than an Undefined ECM. In 1997, this designation was established as an intermediate designation between “Standard” and “Non-standard.”

2-1.1.3 Undefined ECM.

An Undefined ECM has not been shown by analysis or testing to be capable of providing a level of resistance equivalent to either a 7-Bar or 3-Bar ECM. Magazines designated as Undefined were referred to as “Non-standard” magazines prior to 1997.

2-1.1.4 Aboveground Magazines (AGM).

All above grade magazines that are not Earth-Covered, or an ECM with less than the minimum 2 feet (0.61 m) of cover, are considered AGM. This also includes storage pads for AE stored in the open.

2-2 SITING CRITERIA.

To ensure the prevention of unacceptable damage or injuries in the event of an accidental explosion, siting criteria have been established to define minimum required separation distances between a PES and surrounding Exposed Sites (ESs). The minimum separation distances, commonly referred to as explosives safety Quantity-Distances (QDs), are based upon several factors including, but not limited to:

- The level of protection mandated by the applicable explosives safety standard.
- The ES type and classification.
- The net explosive weight (NEW).
- The hazard classification of the AE at a PES.
- The physical orientation between the PES and the ES.
- The presence of effective barricading.

Minimum explosives safety QDs are defined in the applicable DoD and Service-specific explosives safety standards for various applications. These QDs are based on maximum levels of risk considered acceptable for various types of ES. Separation distances are not absolute safe distances but are relative protective or safe distances. Whenever practicable, use of greater distances than those shown in the explosives safety standards should be considered.

Generally, explosives safety site plans are required for construction projects involving new PESs, new facilities (explosive or non-explosive) within the QD arcs of existing PESs, as well as for the upgrading or renovation of existing facilities (explosive or non-explosive) that might impact the explosives safety criteria applied to these facilities (e.g., removal of a protective feature that previously allowed the facility to be sited at a lesser distance or a change of mission that requires the facility to now be at a greater distance). These site plans are reviewed at various authority levels to ensure explosives safety criteria are being met by the proposed work. DoD requires most explosives safety site plans to be forwarded to the DDESB for review and approval (see the section in Chapter 2, entitled “Design Approvals”). See DoD and Service explosives

safety criteria for more detail on when a site plan is required and what level of site plan review and approval must be accomplished prior to commencing projects.

2-2.1 Magazines as Potential Explosion Sites (PES).

Magazines are not designed for, nor do they provide containment of, effects from an internal explosion. Thus, magazines pose a hazard to surrounding ESs due to the potential for accidental explosions, which may result in blast overpressures, primary fragmentation, secondary debris, cratering and thermal effects. DESR 6055.09 defines minimum explosives safety QDs between a magazine as a PES and surrounding ESs including other magazines, operating buildings, inhabited buildings, and public traffic routes to ensure uniform minimum explosives safety standards for DoD facilities. In general, the required separation distances are greater from an AGM than an ECM based on the same quantity of NEW.

2-2.2 Magazines as Exposed Sites (ES).

Minimum explosives safety QDs have been established between a PES and a magazine as an ES to provide appropriate protection. Tables specifying minimum QD requirements can be found in the DoD and Service explosives safety documents. In general, required separation distances are greater for an AGM than for an ECM. For ECM, required separation distances are generally greater for a 3-Bar ECM than a 7-Bar ECM and greater still for an Undefined ECM.

The minimum explosives safety QDs between magazines is commonly referred to as the inter-magazine distance (IMD). The required IMD is dependent on several factors including but not limited to:

- The physical orientation of the magazines.
- The structural classification of each magazine as an ES.
- The NEW and type of AE within each magazine as a PES.
- The presence of an effective barricade.

2-2.3 Approved ECM NEW Limits.

With respect to an ECM's structural strength designation, approved ECM NEW limits are based on their ability to withstand blast loads generated from an adjacent PES and **NOT** on their capacity for storage. Certain 7-Bar ECM have approved NEW limits that are less than the 500,000 lbs (226,800 kg) typically assigned to a 7-Bar ECM based on the limitations of their design as an ES and not on capacity as a PES.

Many military installations have ECMs that have not been evaluated against 7-Bar and 3-Bar strength requirements, and by default must be treated as Undefined (for arch-type ECMs) or AGM (for box-type ECMs). If, using the available structural drawings, an ECM (as an ES) cannot be shown by structural analysis to meet the loading requirements for a 7-Bar or 3-Bar ECM from an adjacent PES ECM containing 500,000 lbs (226,800 kg)

NEW, then it may be possible to demonstrate that the ES ECM could meet 7-Bar or 3-Bar loading requirements if the surrounding PES NEWs were reduced. In other words, the ES ECM design could be site approved as a 7-Bar or 3-Bar ECM for a quantity less than 500,000 lbs (226,800 kg) in an adjacent PES ECM. An advantage in doing this is that placing this information in automated explosives site planning software, such as Explosives Safety Siting (ESS) or Assessment Systems for Hazard Surveys (ASHS), allows the installation to determine more efficient separation distances for future storage construction. Selection of an appropriate magazine type to meet a specific siting requirement should be done in consultation with an experienced explosives safety site planning professional to ensure efficient use of existing real- estate and facilities while meeting mission requirements.

2-2.4 Barricades.

Barricades are used to decrease the required minimum separation distances between magazines and between magazines and other PESs. Specific requirements on the design and siting of front barricades as well as the reduction in the minimum separation distance resulting from a properly sited and constructed barricade are provided in the DoD and Service-specific explosives safety standards. Army Definitive Drawing 149-30-01 illustrates several conceptual barricade designs utilizing various construction materials. ECM front barricades should be located as close as possible to the front of the ES (protected) ECM. The side of the barricade facing the protected ECM front should be a vertical, or near vertical earth retaining structure with the opposite side meeting ECM side slope requirements of the section in Chapter 3, entitled, “Earth Cover”. The front barricade must also meet the barricaded IMD geometry requirements of DESR 6055.09. When properly sited and constructed, barricades offer protection against high-velocity, low angle fragments.

2-2.5 Floodplain.

The finished floor level of the magazine must be at or above the minimum Design Flood Elevation per UFC 3-201-01.

Verify the required elevation of the finished floor level with local, regional, and other required governing jurisdictions. The highest required elevation must govern.

2-3 DESIGN APPROVALS.

Site and construction plans for AE storage facilities must be approved by the sponsoring Service safety organization and the DDESB to ensure that the minimum DoD and Service-specific explosives safety standards have been addressed. See DoD and Service explosives safety criteria for more detail on when a site plan is required and what level of site plan review and approval must be accomplished prior to commencing projects.

2-3.1 Magazine Design Approval.

The design for all new ECMs must be reviewed and approved by the sponsoring Service's explosives safety organization and subsequently by the DDESB to ensure compliance with minimum explosives safety design and construction criteria, including earth cover depth and slope, grounding, electrical equipment and installation, and lightning protection. DDESB approval does not address conventional load or physical security requirements. In addition, the approval of all 7-Bar and 3-Bar ECMs, and all flat-roofed Undefined ECMs, requires the submission of test results and/or detailed structural calculations in accordance with UFC 3-340-02, *Structures to Resist the Effects Accidental Explosions*, to validate compliance with the blast design requirements of DESR 6055.09.

New designs or designs that involve modifications to blast resisting elements of a magazine's design must meet the requirements specified in DDESB-PD Policy Memorandum available on the WBDG website.

2-3.1.1 Quality Control Review

Per the DDESB-PD Policy Memorandum, a quality control review is required by a competent DoD blast design agency, such as the Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC) or the U.S. Army Engineering and Support Center Huntsville (CEHNC). These organizations operate on a cost reimbursable basis and early coordination for funding and schedule is advised. It is important to note that new ECM designs require a substantial review process; consequently, adequate time and resources must be allocated to allow for appropriate Service and DoD review prior to approval for construction.

2-3.1.2 Lightning Protection

The lightning protection system design for all new AGM designs must be reviewed and approved by the DDESB. New AGM designs involving protective construction to either reduce the NEW for which the facility is to be sited, or to reduce the required QD, must be reviewed and approved by the DDESB; this approval requires the submission of test results and/or detailed structural calculations to validate the proposed protective construction characteristics.

2-3.1.3 Use of Foreign Materials at OCONUS Locations.

Approved standard designs must be checked for adequacy when adapted for construction with foreign materials at OCONUS locations. Specifically, steel strengths, bar diameters, plate thicknesses, structural steel member dimensions, and concrete compressive strengths may vary for OCONUS locations. In addition to ensuring such modifications do not impact the conventional load capacity of a magazine design, the dynamic response of blast resisting elements of the design needs to be checked by a qualified structural engineer to ensure UFC 3-340-02 response criteria are met.

Modifications that alter the blast response of the magazine are to be treated as new ECM designs as detailed in the preceding paragraph.

2-3.1.4 Coordination with Service Organizations.

The Service explosives safety office may require other explosives-safety related design information (e.g., ordnance ground system design) for review and approval. The Service design authority may require other non-explosives safety related design information (e.g., ability to withstand soil loads) for review and approval.

Prior to the start of a design, it is essential to closely coordinate the requirements with the sponsoring Service's explosives safety organization to avoid excessive problems and delays in completing the design and obtaining the necessary approvals. The Service explosives safety organization will coordinate as necessary with the DDESB.

2-3.2 Approved ECM Designs.

2-3.2.1 7-Bar and 3-Bar ECM Designs Approved for New Construction.

To facilitate the design and approval process for AE storage magazines, several approved designs have been developed for 7-Bar and 3-Bar ECMs. DDESB TP-15, Table AP1-1, includes a listing and basic description of 7-Bar and 3-Bar ECMs approved for new construction.

The most current construction drawings, approval letters, and additional information and notes related to the approved designs can be accessed at the Whole Building Design Guide website: http://www.wbdg.org/design/ammo_magazines.php. Table AP1-1 of DDESB TP-15 identifies additional limitations, restrictions, and conditions associated with the use of approved designs.

2-3.2.2 Site Adaptation of Approved Designs.

Once a standard ECM or AGM design has been approved by the DDESB and listed in TP 15, the design does not have to be reapproved for subsequent uses unless changes affecting the explosives safety aspects of the design have been made. Approved designs can be site-adapted or tailored to the requirements of a specific site. Allowed, site specific adaptation primarily involves minor modifications to the foundation, subgrade preparation, and the drainage systems to suit local soil and site characteristics along with design of supporting facilities (utilities, physical security and pavement). Any changes to the approved designs, other than minimal site adaptation, that may affect the explosives safety aspects of a magazine design must be approved by the sponsoring Service's explosives safety organization and subsequently by the DDESB prior to construction. (Note: Even if using an approved design, a site plan is still necessary to validate that required QD is met to surrounding ESs and from surrounding PESs. With regard to the ECM design, the site plan need only identify the approved drawing numbers if using a previously approved design that has not been changed other than for minimal site adaptation.) When adapting approved designs, reference the drawings numbers of the Standard on the project plans.

2-3.2.2.1 Risk Category

The risk category for the standard ECM and AGM designs is III, as outlined in UFC 3-301-01, Table 2-2. If the government directs the DOR to change to a higher risk category, this could potentially change the structural components of the magazine which could adversely affect the 7-bar and 3-bar structural designation. These changes must be approved by the sponsoring service's explosives safety organization and subsequently by the DDESB prior to construction.

2-3.2.2.2 Project Start

When beginning a project, the DOR must go to the Whole Building Design Guide website and download the standard magazine design drawing. The DOR must not use previously site adapted drawings from another installation. After downloading the drawings, the DOR must begin the site adaption process.

2-3.2.2.3 Modifications

Throughout design and construction, the DOR must ensure that modifications made during the site adaption process do not impact the blast-resisting elements of the approved design. This typically includes the required soil cover geometry, magazine headwall, blast door(s) and frame, pilasters and header beams that support the doors against blast loads, and the roof elements. For blast doors that include a bottom support, foundation/slab modifications must ensure that the door support conditions of the standard design are not altered. Any modifications or changes to the above must be referenced back to the service-specific explosive safety office. See Figures 2-1 and 2-2 for a graphic showing the typical elements of an ECM and typical blast-resisting elements of an ECM.

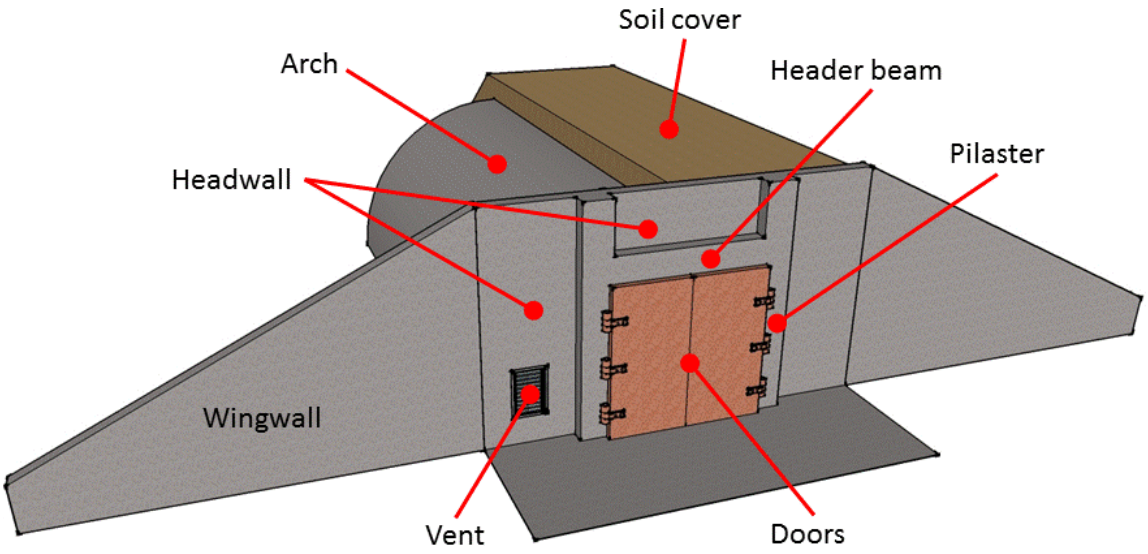
2-3.2.2.4 Navy standard magazines approved for new construction:

If Navy standard drawings are used, the Designer of Record (DOR) must adhere to all standard drawing "NOTES TO DESIGNER" and "DEPARTMENT OF DEFENSE EXPLOSIVE SAFETY BOARD (DDESB) APPROVAL NOTES". A CAD version of the standard drawings is available upon request. When using Navy standard drawings for NAVFAC projects, a new set of drawings, with unique NAVFAC Drawing Numbers must be created using the Navy standard border, customized for the project. The drawing numbers associated with the original unedited standard magazine drawings must also be listed on the title sheet of the set with a note clearly identifying the source, name and date of the standard design.

The DOR is responsible for the site-adapt design and must provide a Designer of Record Note on a General Notes sheet indicating that they have reviewed the standard drawings and that the DOR's site adapted design satisfies all design requirements. The DOR must edit the notes (on the notes sheet) as appropriate to include the pertinent site adapt information. Such information includes but is not limited to foundation design, wind, seismic, and any other transient and static load data used in the site-adapted

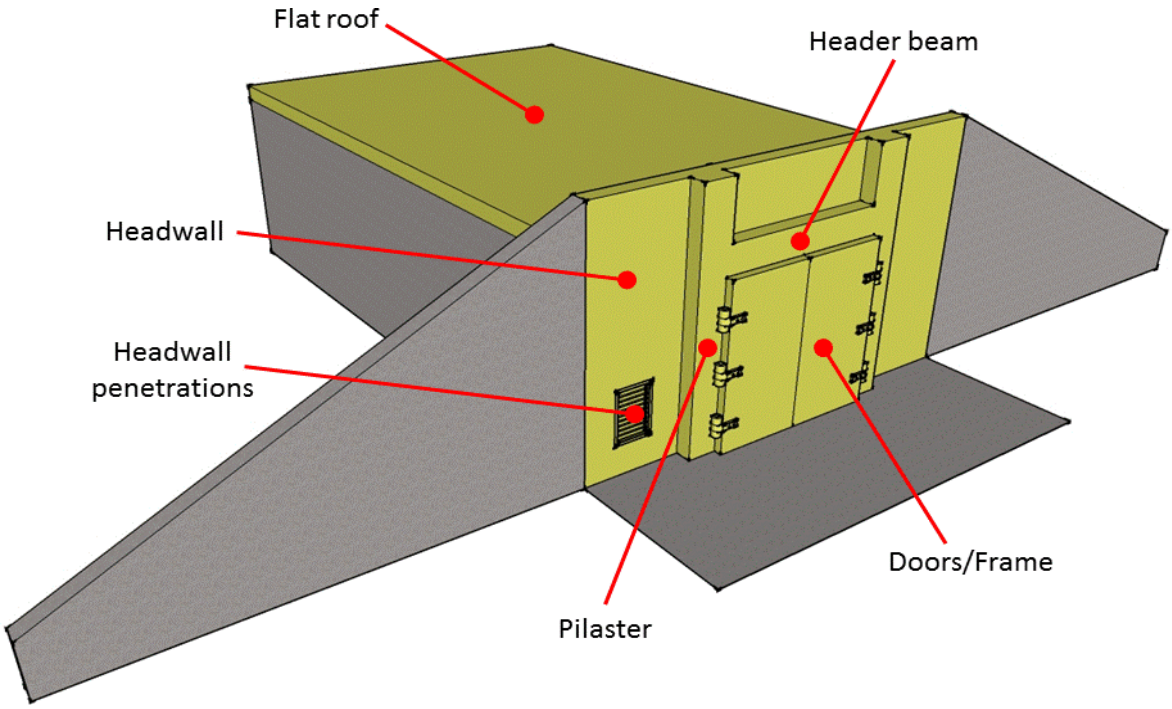
design. Portions of the new drawing set, which have been edited to include the required site adapted design, must be clearly identified in the drawing package.

Figure 2-1 Typical ECM Components



Note: Second vent location may vary with design and not shown for clarity.

Figure 2-2 Typical ECM Components Resisting Direct Blast Loads



Note: Second vent location may vary with design and not shown for clarity.

2-3.2.3 7-Bar and 3-Bar ECM Designs No Longer Approved for New Construction.

The Whole Building Design Guide web site and DDESB TP-15, Table AP1-2 contain lists of ECM designs that have been previously approved for 7-Bar or 3-Bar siting but are no longer approved for new construction. In most cases, these designs have not been updated to satisfy criteria changes. The intent of this list is to assist activities in sitings involving existing magazines. NEW limitations and/or restrictions associated with their DDESB approval must be observed. These designs can be used as the basis for new ECM designs, but they must be updated to comply with current explosives safety requirements, current construction methods and criteria, and are reviewed and approved by the DDESB. Any updated design drawings must clearly identify all changes and revisions made to the original design prior to approval.

Available electronic drawings, approval letters, and additional information and notes related to current approved designs can be accessed at the following web site: http://www.wbdg.org/design/ammo_magazines.php.

2-3.2.4 Undefined ECM Designs.

DDESB TP-15, Table AP1-3 contains a listing of ECM designs that are classified as undefined. These designs have not been shown by analysis or testing to have the structural capacity of either a 7-Bar or 3-Bar ECM. This table and the accompanying notes identify additional limitations, restrictions, or conditions associated with the use of these designs.

An undefined ECM can be structurally analyzed in accordance with UFC 3-340-02, *Structures to Resist the Effects of Accidental Explosions,* to determine its structural capabilities and potentially justify an upgrade to its classification. HNC-EDC-S-13-10, *Guide for Evaluating Blast Resistance of Existing Undefined Arch-Type Earth-Covered Magazines*, illustrates procedures that can be used for a preliminary determination of the adequacy of the headwall and doors of an existing arch-type ECM to provide an acceptable level of protection from a given quantity of explosives at a known distance. A complete analysis is required to ensure the design complies with current explosives safety requirements as well as current construction methods and criteria, prior to reclassifying the ECM design. The sponsoring Service's explosives safety organization and the DDESB must review and approve the upgraded classification.

2-3.3 Magazine Construction and Explosives Safety Site Approval.

Prior to construction, an explosives safety site plan for all new AE storage magazines must be reviewed and approved by the sponsoring Service explosives safety organization and the DDESB to ensure that the magazine has been sited in accordance with the minimum explosives safety QD appropriate to the magazine type and classification. An exception to this allows approval by a Service explosives safety organization for security and limited amounts of ammunition without DDESB approval; refer to DESR 6055.09 for exceptions.

2-4 MAGAZINE SELECTION CONSIDERATIONS.

Selection of the most suitable magazine design to use at a given site will depend on a number of factors including, but not limited to:

- The specific configuration (pallet or container size and stacking requirements).
- Physical security.
- The hazard classification and quantity of AE that is anticipated to be stored in the magazine.
- The cost of construction and maintenance.
- Siting limitations or restrictions.
- Ordnance storage and delivery operations.
- Flexibility for future revisions to operations or mission.
- AE non-compatibility.
- Trench or no-trench at base of magazine door.

Some of these factors are discussed below. Facility planners / designers should involve both end user and installation explosives safety personnel in the earliest stages of the planning and design process to ensure the selection will both meet the users end requirements and be in compliance with explosives safety requirements.

The use of an approved standard design for new magazine construction is strongly recommended within the DoD except where a preapproved design is not suitable due to special circumstances.

2-4.2 Net Explosive Weight (NEW) Limits.

Each of the approved magazine standard designs is rated for a maximum quantity of HD 1.1 AE that can be stored in adjacent PESs, expressed as maximum NEW, for the structure to be considered an ECM as an ES. Most ECMs approved for new construction are rated up to 500,000 lbs HD 1.1 NEW, but that should be verified in the selection of the ECM type. However, it is likely that existing legacy ECMs at the site may have NEW rating restrictions which may provide a constraint that prevents the new ECMs from being sited for the full 500,000 lbs HD 1.1. See Section 2.3 for additional details.

2-4.2.1 QD Relationships.

A magazine is sited using explosives safety QD relationships corresponding to the maximum amount of NEW that will be stored within the magazine, the NEW rating of adjacent magazines, and applicable criteria to surrounding exposures. The quantity of AE stored must never exceed the maximum sited NEW value.

2-4.2.2 Installation-Level Control of Stored Quantities.

Lastly, a magazine may have a licensed NEW that is less than the sited NEW. The licensed NEW represents an installation-level control of stored quantities based on mission requirements. Often a magazine will be sited to store the maximum capacity based on available space to maximize mission flexibility. Licensing is sometimes used to restrict quantities located within a magazine to match the needs of the mission. This allows the installation additional control of the quantity of explosives within facilities while maintaining mission flexibility.

2-4.3 Magazine Characteristics.

2-4.3.1 Shapes and Sizes.

ECM types that have been used in the past are shown in DDESB TP-15 and on the WBDG website. The physical dimensions and configurations of 7-Bar and 3-Bar ECM designs approved for new construction are provided in Table AP1-1 of TP-15.

Some approved ECM designs allow variable lengths to provide greater flexibility in sizing a magazine to its specific intended use.

2-4.3.2 Door Openings.

The approved 7-Bar and 3-Bar magazine designs have various door opening sizes. The door opening size must be selected based on current and anticipated future usage requirements and in consideration of the usage requirements for material handling equipment (MHE).

2-4.3.3 Door Types.

Magazine doors are vertical swinging or sliding type, single or double leaf. Doors are either manually or electrically operated. Electrically operated doors must have an option for manual operation. Doors and door hardware must not use dissimilar metals or must be dielectrically insulated from each other.

- Refer to UFGS 08 39 55.00 20 for Navy’s ECM door specification.
- Refer to UFGS 08 39 53, Blast Resistant Doors (Earth-Covered Magazines) specification.

Note: Doors are designed for specific bearing conditions under external blast loading and site adaption may not include altering the design bearing surface of the doors (top, side, and bottom).

2-4.3.4 Storage Options.

AE is usually stored within a magazine utilizing forklifts. An overhead bridge crane storage option has been developed for some magazine designs (e.g., the CLWS magazine). A self-supporting built-in crane can be installed after construction; however,

the planner must consult with the service-specific explosive safety office to ensure the crane does not affect the explosive safety classification of the magazine.

2-4.4 Storage and Loading Plans.

AE packaging information and suggested storage loading plans have been developed for many of the approved magazine designs. These plans are to assist in the effective use of magazines and may be used to estimate the potential storage capacity of various types of ordnance within a given magazine.

- The U.S. Army Materiel Command (AMC) provides Storage and out loading drawings for various AE within certain ECMs. These drawings, indexed in AMC 19-48-75-5, may be obtained at the Defense Acquisition University web site: https://www.dau.edu/cop/ammo/page/AMC-Drawings
- For Navy applications, additional standard layout plans for palletized ammunition, missiles, and torpedoes within ECMs are provided in FC 2-000-05N, Series 420. https://www.wbdg.org/dod/ufc/fc-2-000-05n

2-5 ELECTRICAL PLANNING.

Perform an electrical hazards survey to determine the structure's hazardous location classification per NFPA 70 Article 500. This classification is based on the possibility of an explosive atmosphere existing within the magazine rather than the material stored inside the magazine. Ordnance storage magazines that store only "DoD-titled ammunition and explosives" (AE) in its original packaging will typically only need to meet industrial standards for electrical service.

Perform a survey of the surrounding area to determine the grounding and lightning protection requirements for the facility. This survey might confirm that unique installation requirements apply to minimize the total resistance to ground. Ground connection locations must be established while ensuring that future maintenance can be accomplished. Verify that the exterior distribution requirements in DESR 6055.09 can be achieved.

2-6 MAGAZINE RETROFIT CONSIDERATIONS

Structural elements of existing magazines may need to be retrofitted or replaced due to deterioration of structural properties or performance, or due to changes in the site plan, siting criteria, or other changes that result in an increase of the current demands. Planners and designers must follow project-specific design requirements and criteria to be developed by the controlling DoD Service for the project. DDESB site approval is required for the retrofit design before commencing work. General considerations for retrofit of the blast elements of existing magazines are provided below.

2-6.1 Replacement of ECM Doors.

When doors of existing ECMs are replaced, except for undefined magazines, the ECM will lose its rating and subsequently requires reapproval. When doors of existing ECMs are replaced the doors and locking system must be upgraded to meet current Physical Security requirements.

Attention must be given to the blast load capacity of the new door and the associated loads transferred by the new door to the supporting structural elements of the magazine (e.g., header beam, headwall, pilasters). In general, when the new replacement door has a higher blast load capacity than the existing door, the associated loads that are transferred to the supporting structural elements are higher than those of the existing door. All the structural elements in the load path of the loads transferred by the new door must be verified to be able to withstand the associated loads within the applicable response limits as defined by the project-specific design requirements.

2-6.2 Strengthening of Blast-Resisting Structural Elements.

When required, strengthening of existing ECM's structural blast elements (e.g., header beam, headwall, pilasters, roof) must be designed to meet the project-specific design requirements as determined by the controlling DoD Service for the project. When increasing the flexural capacity of a structural blast element, other limit states where the design load is based on the flexural capacity of the element (such as diagonal tension and direct shear) must be verified for the new loads based on the increased flexural capacity of the element. Similarly, other structural elements that must withstand loads that are transferred by the strengthened element must be verified. For example, if a header beam's flexural capacity is increased, in addition to verifying the diagonal tension and direct shear capacity of the header beam, the pilasters must be verified for the loads transferred by the strengthened header beam. Similarly, if the roof slab's flexural capacity is increased, in addition to verifying the diagonal tension and direct shear capacity of the slab, the columns and walls may need to be verified for the loads transferred by the strengthened roof slab. If needed, shear, torsional, or axial load capacity of structural blast elements must be also increased through retrofits to resist the increased demands resulting from the increased flexural capacity of a strengthened structural element.

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CHAPTER 3 DESIGN

3-1 EARTH COVER.

The earth cover over the top of an earth-covered magazine must be a minimum of 2 feet (0.61 m). The steepest incline must be maintained at 2 horizontals to 1 vertical. The earth-cover above, to the sides, and to the rear of an ECM is the critical element of its design. The earth slope to the sides and rear of the magazine should continue to grade level and should not be terminated with a retaining wall or otherwise interrupted. Standard ECM designs are validated through detonation tests in which the earth cover to the sides and rear of the magazines continue to grade level. Elimination of a portion of this earth cover may invalidate this testing, and the magazine may not be considered an ECM as an ES and/or a PES for siting purposes without an accompanying engineering analysis providing justification approved by DoD review authorities. Additionally, while use of common earth cover between ECMs (e.g., earth cover between two ECMs intersecting above ground level) is allowed per DoD criteria, it is not recommended. DoD IMD criteria is based on ECM tests without common earth cover (e.g., two horizontals to one vertical slope), limited scaled tests suggest that an acceptor ECM which shares common earth cover with an adjacent donor ECM may sustain greater damage in an accidental detonation. Other explosives safety criteria (e.g., NATO) require increased separation distances when common earth cover is used between ECMs. If the earth cover between two adjacent ECMs intersects at a height greater than one-half the exterior magazine height (not including the earth cover), the planner must coordinate with their service-specific explosive safety office to assess siting impacts.

3-1.1 Material.

The material for the earth cover must be free from deleterious organic matter (large tree roots and similar materials), trash, debris, and stones heavier than 10 pounds (4.54 kg) or larger than 6 inches (15.24 cm) in any dimension. The presence of large stones (cobbles) will be limited to the lower, central portions of the earth cover, and such stones will not be used as surface cover over the magazine soil cover where they may contribute to hazardous debris (refer to Figure 3-1). Clay soils must not be used due to excessive cohesion and the potential to contribute to hazardous debris. Gravel or crushed stone must not be used as it does not comply with DESR 6055.09 requirements for reasonable cohesiveness. Compact the material and prepare as necessary to maintain structural integrity and provide erosion control. In locations where it is impossible to use a suitable material to maintain side slope or where rainfall is insufficient to maintain a grass cover, use other suitable materials and stabilization methods to ensure the structural integrity of the cover.

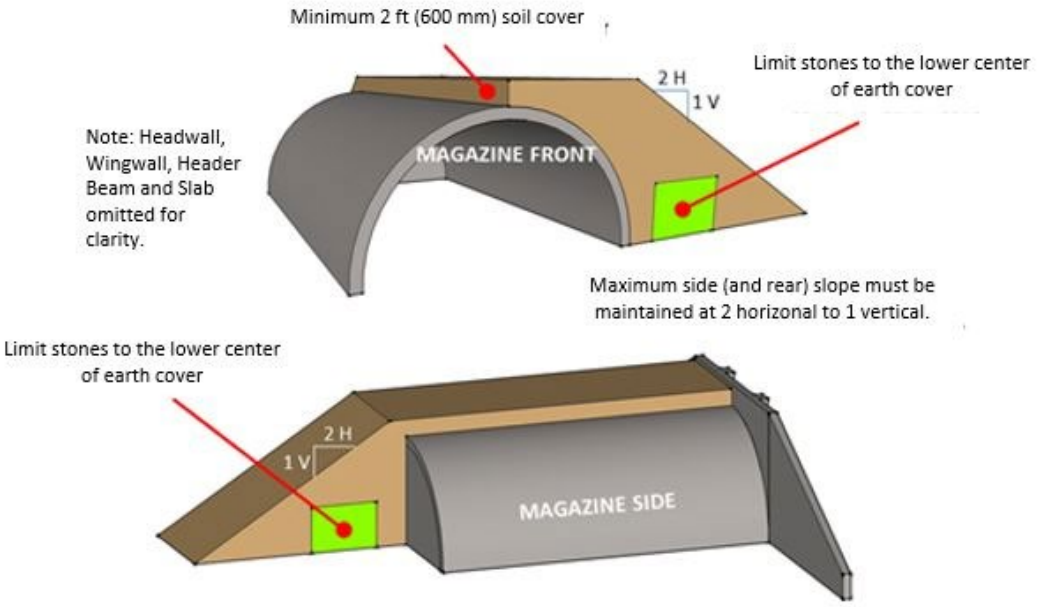
3-1.2 Additional Guidance

For additional guidance, refer to Engineering Research & Development Center (ERDC) study *Erosion Control of Earth-Covered Magazines to Maintain Minimum Cover Requirements* conducted in 2019.

3-1.3 Roof Live Load

The roof of the ECM must be designed for a minimum of 100 psf live load. This live load must not be reduced.

Figure 3-1 ECM Earth Cover



3-2 FLOOR DESIGN.

The design floor live load must be the maximum anticipated loading of stored material within the magazine during its useful life. Considerations must also be given to wheel loading from weight handling equipment (especially large or side loading vehicles).

Floor live loading as shown on the Standard Approved Magazine Drawings is based upon the anticipated maximum loading for that particular magazine type. Where soil conditions are poor, the design floor live loading may be reduced if it can be demonstrated that a reduced floor loading will be acceptable at a given location based on the actual anticipated usage. In such case, the maximum design floor live loading must be prominently posted at the entrance and within the magazine structure. Under all cases, the minimum floor live loading for any magazine type must be 500 PSF (2441 kg/sm).

3-3 FOUNDATIONS/SLABS.

3-3.1 Magazines based on Standard Approved Magazine Drawings

When considering a magazine based on Standard Approved Magazine Drawings:

- Unless a more detailed analysis is warranted, it is required that foundations redesigned for poor soil conditions must have a safe working static load capacity equal to or greater than the safe working load capacity of the foundations of the Standard Approved Magazine Drawings
- Foundations for earth retention walls must be designed using conventional design methods.
- Foundations that support elements of the magazine that are required to resist dynamic incident pressures from an external explosion from a PES must have an ultimate dynamic load capacity equivalent or greater to the ultimate dynamic load capacity of the foundations shown on the Standard Approved Magazine Drawings. Elements of the magazine that are required to resist the loading from a PES typically include structural walls and columns supporting roof elements.

3-3.2 Floor Flatness and Levelness

Provide the following minimum flatness and levelness: F-numbers: Ff=35, Fl=25.

3-4 WATERPROOFING, DRAINAGE, AND CORROSION PROTECTION.

The soil cover of ECMs can lead to moisture issues within the structure, deterioration of structural components, and degradation of stored AE. Ensure that the magazine is watertight and offers adequate protection to the stored AE from water intrusion. An elastomeric membrane is appropriate for concrete magazines and a bituminous waterproofing is more suitable for steel magazines. Protect the waterproofing membrane from backfilling and compaction operations during construction.

- Provide a subsurface drainage system around the ECM to adequately channel the water away from the structure. Subsurface drainage systems must consist of perforated drain piping surrounded by gravel and protected with landscaping fabric. Extend subsurface drainage systems between magazine and mechanical room walls where necessary to ensure proper drainage is provided.
- Provide an interior perimeter trench drain system within the magazine to accept incidental leaks and condensation. Mechanical rooms must be provided with floor drains or floor sinks to accept condensate produced by mechanical equipment.
- Where blast door trenches are included in the design, provide means of drainage at low points. Ensure that blast door trench drains are accessible for cleaning and maintenance. All floor drains must be provided with a

strainer. Drain openings within the mechanical room or magazine must be protected from rodent entry with holes no larger than 1/4-inch (0.635 cm).

- Consult with the installation public works department regarding the termination of drain piping. Comply with applicable federal, state, and local codes when connecting to storm or sanitary drain systems. Indicated drainage systems are not intended to be the only permitted systems. Designer must develop systems that meet the specific project drainage requirements.

3-4.2 Ordnance Handling, Loading and Offloading Area.

For new construction of magazines, a concrete area may be required by the service or activity in front of the magazine for handling, staging, inspection, loading and offloading ordnance. This paved area, if required, will ensure adequate space is available to handle ordnance in accordance with required safety. The area provides critical space and clearances for ordnance staging, set down, and maneuvering containerized weapons and/or pallets to/from flat bed and enclosed commercial conveyances. The paved area must not be part of an adjacent road but must connect with the adjacent road with an adequate turning radius or short access road. The paved area must be measured from the face of either, the magazine headwall where there is no loading dock or from the face of the magazine loading dock.

3-4.2.1 Paved Area Slope

The paved area must drain away from the magazine in a single continuous plane and the grade must be 0.5% minimum with a 2.0% maximum slope away from the magazine.

3-4.2.2 Navy Only Paved Area Requirements

For the Navy only, where the above required paved area is not available in front of the magazine, the planner must coordinate with the Local Ordnance Handling Activity and the respective Echelon III command must review and assess the impacts to ordnance handling safety. If the appropriate area is not provided, the Echelon III command must provide written (via email) concurrence of the proposed alternative to ensure all risk management concerns have been addressed or mitigated.

3-4.3 Corrosion Protection

Reference UFC 3-301-01 and other UFC documents for corrosion protection requirements. For structural concrete: provide 2-1/2" (6.35 cm) concrete cover to primary reinforcement at exposed concrete or a waterproof coating in Environmental Severity Classification (ESC) C4 through C5 project locations.

When constructing a magazine in accordance with standard drawings: If the concrete cover changes or the design exceeds the concrete cover required by the approved

standard drawings, changes must be approved by the sponsoring service's explosives safety organization and subsequently by the DDESB prior to construction.

3-5 VENTILATION, TEMPERATURE AND HUMIDITY CONTROL.

Typically, ECMs contain some form of ventilation. This is usually accomplished by louvered openings in the headwall and ventilator stacks that exit through the rear wall and penetrate through the earth cover. Due to the broad range of possible storage products and weather conditions, the criteria for a specific project should be provided by the using activity. Coordinate with the user to confirm specific project requirements.

3-5.1 Ventilation Only.

Where the using activity identifies natural or mechanical ventilation only as sufficient space environmental control, verify the following and confirm potential consequences are acceptable to the user.

- If occasional interior magazine surface condensation is not acceptable to the user, prepare an analysis to determine the potential for that condensation. The large thermal mass of concrete and earth berm changes temperature more slowly than ambient air. Under certain circumstances, the ambient air can quickly become warmer and moister (a suddenly warm spring day) than it was a short time earlier. If the interior surface temperature remains cool (below the air dew point) for an extended period of time due to thermal mass, the result could be interior surface condensation.
- If condensation is likely and unacceptable to the user, determine a method to keep surfaces above dew point (i.e. heat space, insulate walls) or lower ventilation air dew point by mechanical cooling with reheat or desiccant system.
- All potential options must also be judged based on the considerations listed in "Temperature and Humidity Control."

3-5.1.1 Natural Ventilation Systems.

Provide natural ventilation systems in accordance with *ASHRAE Handbook, Fundamentals*. Intake and relief opening free areas should be approximately equal wherever practical. Vertically separate intake and relief opening elevations as much as possible to promote airflow induced by temperature differentials. Intake louvers must be hinged with a locking hasp for access and inspection.

Natural ventilation openings may consist of louvers, stacks, or both. Provide the size and quantity of openings required to meet the natural ventilation systems criteria:

- The smallest opening in the path of flow must have a free area to floor area ratio not less than 0.05%.

- The smallest opening in the path of flow must have a free area to space volume ratio of not less than 0.0025%.

Natural ventilation openings must be designed to resist forced entry in accordance with UFC 4-026-01. Consult with the using activity regarding additional special security requirements and the inclusion of fire dampers at the natural ventilation openings.

3-5.2 Temperature and Humidity Control.

In some cases, due to specific criteria or determination that ventilation alone is inadequate, the AE product being stored may require more than just ventilation control. Specific criteria for special storage requirements should be provided by the using activity. For this application, some form of heating and cooling will be required. For cooling, heating, and humidity control systems, the following must be considered:

- Consider potential mechanical systems based on ability to achieve environmental control, availability of thermal utilities such as (installation chilled water or steam utilities), remoteness of installation, maintenance requirements, the availability of service and parts, and familiarity of proposed systems with facility management staff.
- Mechanical systems employing the use of natural gas are not permitted.
- Determine location of mechanical equipment. Indoor mechanical equipment must be located in a dedicated mechanical room wherever possible. To mitigate debris hazards, do not locate outdoor mechanical equipment in or on the earth cover.
- Avoid mechanical utility/piping penetrations into the roof structure of the magazine or mechanical room.
- Determine acceptable paths of connection from mechanical equipment to interior of magazine. Penetrations through the walls of the magazine and mechanical room must be waterproofed. Provide modular compression seals or cast-in-place sleeves or other elements that must be securely embedded in walls.
- Underground ductwork materials and joining methods must be carefully selected to ensure longevity of installation in the project environment. Give special consideration to corrosion from soils and moisture. Installation must be constructable and must withstand the pressure of compacted soil.
- Coordinate lightning protection with mechanical equipment and establish bonding requirements to ensure continuity of duct and piping.
- Mechanical humidity control using mechanical cooling requires some form of reheat. Reheat must be in accordance with ASHRAE 90.1.
- Mechanical humidity control using a desiccant drying system requires some form of desiccant regeneration (either integral to a package unit or

by desiccant replacement). Base final determination on a Life Cycle Cost Analysis.

- Determine the hazardous location classification of the atmosphere within the magazine and select equipment and materials compatible with that classification (e.g. Class 1, Division 2). Provide equipment with spark-proof construction and explosion proof motors where required.
- Consider the use of air curtains at the blast door to mitigate air exchange with the outdoor air where indoor environmental control requirements justify their inclusion.
- Evaluate the need for pneumatic door sealing systems and consult with the using activity regarding their inclusion. Coordinate installation and operational requirements with related disciplines including architecture, electrical, and structural.
- Mechanical openings into the magazine must be designed to resist forced entry in accordance with UFC 4-026-01.
- Coordinate with the user on the criticality of maintaining the space environmental conditions and determine if sensors and status points should be provided and connected to the base Energy Monitoring and Control System for remote monitoring or to another central monitoring site.
- Control panels for HVAC controls must be located in the mechanical room such that they may be accessed without entering the magazine. Sensors located within the magazine, if any, must be intrinsically safe.

3-5.2.1 System Design Calculations

Refer to UFC 3-410-01 for requirements regarding mechanical system design calculations. Confirm and document the indoor and outdoor design conditions with the using activity. Heat loads must reflect the installation conditions including the thermal mass effect of earth fill and cover. Assembly U-value calculations must be provided. Blast door U-value calculations must account for thermal bridging that may be inherent to the door’s design.

3-5.2.2 Engineering Weather Data

Refer to UFC 3-400-02 Design – Engineering Weather Data for information on access to and use of weather data in the required heat load analyses.

3-5.3 Structural Coordination.

Any mechanical work must maintain the structural integrity of the magazine design.

- If required, consider implementation of blast valves (explosion dampers) and/or blast attenuation chambers.

- Coordinate location of any mechanical penetration with structural requirements, including possible designed blow out walls or roofs.
- Consult with the Service explosive safety organization.
- If required by the using activity, coordinate installation requirements of snow/ice melt systems with structural slab/foundation design and electrical grounding.
- Note that any mechanical penetration into the blast-resistant elements of an ECM (aside from those specifically noted in the Standard drawings) must be reviewed by a competent DoD blast design agency to ensure they do not compromise the protective construction of the structure.

3-6 FIRE PROTECTION AND LIFE SAFETY.

Fire Protection and Life Safety must comply with the requirements outlined in the paragraph entitled "*Ammunition and Explosives Storage Facilities*" within UFC 3-600-01, *Fire Protection Engineering For Facilities*. AE storage facilities may be ECMs or AGMs as defined by DESR 6055.09. An AE storage facility can be used for AE storage only. An AE storage facility may not be used for handling; processing; testing; servicing; and inspection of ammunition, explosives, propellants, and oxidizers.

For Navy Projects, contact Government Project Manager or Contracting Officer for NAVSEA OP5 information.

3-7 PHYSICAL SECURITY.

Design AE facilities in accordance with DoDM 5100.76 and DESR 6055.09. Additional Service-specific guidance implementing DoDM 5100.76 are contained in OPNAV Instruction 5530.13D Department of the Navy *Physical Security Instruction for Conventional Arms, Ammunition and Explosives (AA&E)*, 26 September 2003, Army Regulation 190-11, *Physical Security of Arms, Ammunition and Explosives, 15 November 2006 (For Official Use Only)*, MCO 5530.14A Marine Corps Physical Security Program Manual, and AFI 31-101 Department of the Air Force Integrated Defense.

Approved magazine standard designs identify minimum physical security features, including high security hasps on doors, steel bars at openings and conduit for electronic security systems. The goal is to provide a forced entry delay time that exceeds the response force response time. Coordinate the security requirements for a specific magazine with the Service and installation security personnel. The below information is provided to assist the end user in determining requirements for magazine door locking devices:

- MIL-DTL-43607J, Padlock, Key Operated, High Security, Shrouded Shackle states: *“The padlock shall withstand a concentrated forced entry* attack using battery powered tools for an accumulated work time of at least one minute.” To improve forced entry resistance of structures with High Security Padlocks and Hasps, an Anti-Intrusion Barrier (AIB) can be

added to protect the locking system and increase the forced entry delay times against hand and battery powered tools.

- The Internal Locking Device (ILD) is a government developed and patented High Security Locking System that mitigates the “exposure to attack” that external locking systems are prone to. This system has been tested to withstand 10 minutes of forced entry resistance against hand and battery powered tools. The ILD is an approved alternative to the current high security padlock and hasp requirement. The ILD is best suited to high security applications and in locations where extreme climate makes opening and securing externally mounted padlocks impractical.
- ILD Locks and associated Boltworks as a locking system are required for all new ECM doors or planned upgrades to ECM doors for Security Risk Category I and II.

3-7.1 Assistance with Physical Security Components and Requirements.

For help with information on security hardware selection, requirements, specifications, national stock numbers, purchasing, and troubleshooting of equipment failures, call the Department of Defense Lock Program Technical Support Hotline (800) 290-7607, (805) 982-1212, DSN 551-1212, or send e-mail to: W_NAVFAC_DoD_Lock_Program_Support@navy.mil

Additional information can be found at https://exwc.navfac.navy.mil/DoD-Lock-Program/

3-8 ELECTRICAL DESIGN.

Provide site electrical utilities, lightning protection systems, grounding and bonding system, interior distribution systems, communications and security according to UFC 3-501-01, *Electrical Engineering*, and the latest installation design requirements.

- Site Electrical Utilities may include distribution service entrance equipment, overhead power distribution, underground electrical systems, service entrance grounding electrode, metering, and exterior site lighting.
- Lightning protection system, grounding and bonding system may include catenary system, faraday cage system, exterior buried grounding ring electrode, air terminals, lightning conductor, mast system, guardrails on headwall as air terminal components, down conductors, ground rods, test wells, static and ordnance grounding.
- Interior distribution systems may include distribution equipment, surge protective devices (SPDs), wiring devices, raceways, conductors, interior lighting and power systems, bridge crane system, and hazardous locations.
- Communications and electronic security includes telecommunications systems and electronic security systems (ESS). Telecommunications rooms (TR) are not required within each magazine. Individual/remote

magazines may utilize a telecommunications enclosure (TE) within the structure, however, either space conditioning must be provided or the equipment must be rated for the environment, and the TE must be NEMA 3RX rated. Sites with multiple magazines must provide one centralized TR located in one of the adjacent site buildings where all telecommunications equipment is to be located. The telecommunications equipment at this location must be in a conditioned space. The telecommunications equipment must be located such that the maximum cable length from the patch panel through the structured cabling system to the furthest outlet of the magazines being served does not exceed 295 feet (90 m). No distance restriction when using fiber optic cable. If telecommunications needs are minor, a TE may be substituted in lieu of a TR.

In addition to the criteria identified above, comply with DESR 6055.09 and the following Magazine-specific requirements.

3-8.1 Hazardous (Classified) Location.

Coordinate with local tenant to determine if the magazine is classified as a hazardous location established as outlined in Chapter 2, paragraph titled “Electrical Planning”. For Navy projects only, NCC/NAVFAC must contact local tenants to complete the NCC form (identifying hazardous classified location).

Explosion-proof fixtures and equipment are not required unless the magazine is classified as a hazardous location.

3-8.2 Power.

Electric lines serving the magazine must be installed underground from a point not less than 50 feet (15 m) from the facility. The electric lines must be installed in metal conduit, as required by DESR 6055.09, V2.E3.6.2.

The service entrance equipment can be installed inside of the magazine or on the exterior magazine headwall. Any electrical service entrance equipment or external disconnecting means, which serves as power disconnection to the magazine, must be readily accessible. Ensure to provide working clearances in front of electrical equipment as defined per NFPA 70 as continuous and unobstructed to egress pathway. Ensure to provide dedicated space above the equipment in accordance with NFPA 70 for conduits routing if located on wall surfaces. Coordinate the location of the equipment with the user. All interior conduits must be galvanized steel rigid metal conduit. If required on site, locate ground fault circuit interrupted (GFCI) duplex receptacles and electrical control equipment 48 inches (121.92 cm) above the floor.

3-8.3 Lighting.

Provide two separate exterior lighting systems:

- Photocell-controlled for security lighting (0.2 foot-candles (fc), 2 lux).

- Switched lighting for loading activities (5 fc, 50 lux).

Provide interior lighting system:

- Switched lighting per bay or area for warehousing activities. Incorporate manual on/off lighting controls. However, DORs must coordinate with users for the Activity within the magazines as identified within the provisions of ASHRAE 90.1.
- Lighting design must follow UFC 3-530-01. Provide footcandles or lux requirements as shown on illumination performance table.

Note: For Army projects, coordinate with the user and Activity to determine if there is a requirement for interior and exterior lighting, including lighting required to support electronic security systems. Otherwise, do not include in the project.

3-8.4 Earth Electrode System (Grounding).

Provide an earth electrode system (EES) for each facility including the following components:

a. A ground ring electrode around the entire circumference of the magazine in accordance with NFPA 780. The ground ring electrode must be installed at a depth of 30 inches (76.2 mm cm) instead of 18 inches (45.72 cm). Use a minimum of 2/0 AWG (133 kcmil) bare copper wire for the ground ring electrode and for all connections to the ground ring. For the Navy, the ground ring electrode is termed a “secondary ground ring”.

b. For the Navy, as a minimum, provide grounding electrodes at each change in direction of the ground ring.

c. Single point ground bus bar, static ground bus bar and ordnance ground bus bar (if required to be provided) must be bonded to the ground ring electrode outside of the magazine.

d. Provide at least two ground test wells at opposite corners of the magazine. Additional test wells must be provided for the single point ground bus bar and ordnance ground bus bar. When possible, locate all test wells in front of the magazine and install the rear test well outside the earth-covered mound with extension of grounding conductors for accessibility. Determine the precise test well locations during the project design to consider periodic access to the test wells given the installation location. Assemble test wells with bolted connections to facilitate future testing. Ensure that the cables are not bonded to or touching the ground rod as they course up from the buried location to the bonding/connection point.

e. Connect all inaccessible connection points in the earth electrode grounding system using an exothermic weld connection or with a high compression connection using a hydraulic or electric compression tool to provide the correct circumferential pressure.

f. If an additional demising wall is added, obtain an approval from the service authority for any additional static & ordnance ground bus bars as required.

3-8.5 Bonding.

Provide bonding as follows:

- Bond together all reinforcing steel bars within the structure, forming an electrically continuous Faraday-like shield.
- Bond between individual reinforcing bars using metallic wire ties at a maximum of 5 feet (1.22 m) in each direction. Note that welding is not permitted for reinforcing bars used in ECMs or other magazines that rely on protective construction for reduced NEW/ESQDs.
- Bond between structural elements (roof to wall, wall or arch to floor slab, wall panel to wall panel) or other areas where reinforcing steel is discontinuous.
- For Navy magazines, welding or brazing to the reinforcement in structural reinforced concrete members, (including walls, beams, slabs and columns, etc.) is not permitted.
- Bond between the floor slab to the ground ring electrode at or near each corner of the structure. For magazines with perimeters greater than 400 feet (122 m), provide one additional connection for each 100 feet (30.48 m) or fraction thereof; equally space the connections around the magazine's perimeter.
- Bond other points (test wells, ground rods, lighting protection system down conductor, electrical panel, ordnance and static inserts, doors' metallic parts, metallic equipment enclosures, and single point ground bar) to the ground ring electrode. The ground ring electrode must be permitted to service as the single-point ground required by the NEC.
- The bonded connections between structural elements, and to the ground electrode ring, must be made with 2/0 AWG (133 kcmil) bare copper wire with exothermic or approved compression connections. For the ordnance ground, use minimum 2/0 AWG (133 kcmil) insulated conductor in PVC conduit to isolate from metallic objects. If a cathodic protection system is used, it must be a galvanic system and comply with requirements in UFC 3-570-01 *Cathodic Protection*.

3-8.6 Lightning Protection.

Provide lightning protection per UFC 3-575-01, *Lightning and Static Electricity Protection Systems,* and the grounding requirements defined herein to protect the exposed portions of the facility. However, if justification can be provided per DESR 6055.09, then lightning protection is not mandatory.

- Lightning protection will incorporate the metallic (Faraday-like) cage type system by bonding together the rebar as mentioned in 3-8.5 and bonding together the structural components of the magazine as required by NFPA 780, or other services applicable requirements. Additionally, 3/16-inch (0.476 cm) thick minimum and 42-inch-high (106.68 cm) maximum metal guardrails may be utilized as strike termination devices on the magazine headwalls, which will be bonded to the ground ring electrode at both ends. This will provide a two-way path to ground ring electrode and will be bonded via ground rods (one is minimum) at each end of headwall.
- The lightning protection system must be bonded to the ground ring electrode. An air terminal with two down conductors for each ventilator will be provided and bonded to the ground ring electrode.
- For these magazine facilities, ensure compliance with the 100-feet (30.5 m) radius striking distance requirement in NFPA 780.
- Third party inspections must be required based on service requirements. Refer to paragraph 3-10 for additional special inspection requirements.

3-8.7 Bonding of Horizontal Sliding Doors.

Provide bonding from door's grounding reel and door's railing to the structure (steel/re-enforcing steel).

- Bonding path should continue with/through the structure steel to grounding ring electrode. Bond door's rail at three locations: one at each end and one at middle of the door's rail.
- Provide bonding with 1 ohm resistance maximum for lightning protection.
- For Air Force and Army projects: If the door can be proven to be inherently bonded by their weight, then flexible bonding is not required. However, the resistance must be measured at initial construction and recorded in the base-line records for the facility.

3-8.8 Snow Melting System.

Snow melting systems are optional. When snow and ice are a concern, and Activity requires a "snow melting system," use the appropriate heat intensity for the applicable geographic area per ASHRAE Handbook, *HVAC Applications*, Chapter "Snow Melting," Class III.

3-8.9 Communications.

Communications outside plant pathways and cabling for phone lines or electronic security at the magazine is optional based on munition category and branch of the military.

- At a minimum each magazine will include one 4” (10.16 cm) conduit extended 10 feet (3.048 meters) outside the foundation for potential future use when the requirement arises.
- Any communication lines must be buried underground in metal conduit for a minimum of 50 feet (15.24 meters) before entering the facility, as required by DESR 6055.09, V2.E3.6.2.
- Phone services at the magazine are optional. When phone is required a POTS, phone will be mounted on the exterior headwall of the magazine. Locate to not be obscured when the magazine door is open.
- Communications infrastructure and cabling will be designed and installed in accordance with UFC 3-580-01, Telecommunications Interior Infrastructure Planning and Design.

3-8.10 Electronic Security.

Electronic security systems (ESS) are optional based on the type and classification of munitions to be stored.

- When electronic security systems are required, they will be designed and installed in accordance with UFC 4-021-02, Electronic Security Systems. When ESS is included the following magazine specific criteria will be incorporated into the design.
- When Internal Locking Devices (ILD) are deployed the internal contact of the ILD must be integrated with the Intrusion Detection System (IDS), if equipped with an IDS.
- Keypads for arming and disarming of the magazine must be mounted exterior on the magazine head wall. Locate to not be obscured when the magazine door is open.

3-8.11 Additional Electrical Requirements (Navy Only).

Incorporate details addressing specific electrical requirements for Navy occupied magazines that are available on the Whole Building Design Guide at https://www.wbdg.org/navy/cad/electrical-details-magazine. Details are available in *.pdf and *.dwg formats.

3-9 ADDITIONAL ELECTRICAL CONSTRUCTION QUALITY CONTROL.

Incorporate the following inspection, testing and photographic documentation during construction of the Earth Electrode System and bonds into the project specifications. Include a plan view sketch identifying locations of photographs and tests.

a. Inspect all concrete reinforcing steel bonding connections for positive contact between individual bars. Document with photographs at 10-feet (3.048 m) intervals.

b. Inspect bonding connections (2/0 AWG (133 kcmil) conductor) between structural elements at each location. Provide photographic verification and continuity testing of a random sample (10% minimum) of the connections. If any of the results are greater than 1 ohm, correct the deficiencies and sample additional 10% random sample. If any of the additional results are deficient, test 100% of the connections.

c. Test continuity and provide photographic documentation at all bonding connections to the ground ring electrode. Include:

- Each end of the floor slab connection.
- Each ground rod location and test well.
- Each lightning protection system down conductor.
- The electrical panel (service entrance grounding electrode conductor).
- All ordnance and static inserts / ground bus bars.
- Single point ground bus bar.
- Ground cross connection cables and other connections as identified in Service standard designs.

3-9.1 Lightning Protection System, Bonding and Grounding Quality Control Submittal Requirements to be included in the project specifications.

The Lightning Protection System, Bonding and Grounding Quality Control Plan must:

- Indicate the contractor's understanding and explanation of the QC process.
- Include Special Inspector (SI) qualifications and responsibilities.
- Include shop QC Manager (or in-house inspector) qualifications and responsibilities.
- A list of challenging issues (available material challenges, shipping challenges, schedule challenges, etc.)
- Special procedures and processes.
- Include a discussion of SI record keeping and required bi-weekly submittals and any other submittals to the contractor’s QC Manager, etc.
- Show coordination between Special Inspector, In-House Inspector, Shop QC manager, Contractor QC manager.

3-9.2 Lightning Protection System, Grounding and Bonding Quality Control Pre-Construction Meeting to be included in the project specifications.

The contractor must conduct a quality control pre-construction meeting to review the grounding and bonding quality control plan submittal. The meeting must include the

Designer of Record (DOR), Contractor QC manager, Special Inspector, Grounding/Bonding Contractor, Contractor Superintendent, government Engineering Technician (ET), the government Construction Manager (CM), and a government representative familiar with lightning protection, grounding and bonding systems for magazines.

3-10 SPECIAL INSPECTIONS.

Special inspections must be performed during construction of magazines. When developing a new magazine design or site adapting a standard design, the DOR must develop a list of Special Inspections in accordance with the International Building Code (IBC), Chapter 17. Special Inspections must include submittal of photographs and written inspection documentation on the bonding of the structural steel reinforcing bars for construction of concrete ECMs, as well as any other necessary IBC Chapter 17 requirements identified in consultation with the Service's explosives safety organization. See Appendix D for an example schedule of Special Inspection items.

3-11 STRUCTURAL OBSERVATIONS.

Provide structural observations per UFC 3-301-01 for structures.

3-12 DDESB AND SERVICE-SPECIFIC EXPLOSIVES SAFETY CONTACTS.

DDESB:
DoD Explosives Safety Board (DDESB)
4800 Mark Center Drive
Suite 16E12
Alexandria, VA 22350-3606

Air Force:
Air Force Safety Center (AFSEC)
Attn: AFSEC/SEW
9750 Avenue G, SE
Kirtland AFB, NM 87117-5670

Army:
Department of the Army projects for ammunition and explosive storage magazines, Per USACE Engineering Regulation 1110-1-8169 U.S. ARMY CORPS OF ENGINEERS FACILITIES EXPLOSIVES SAFETY MANDATORY CENTER OF EXPERTISE, inclusion of representative(s) from the USACE Facilities Explosives Safety Mandatory Center of Expertise as part of the project delivery team is mandatory. Contact information can be found at: https://mrsi.erdc.dren.mil/coe/mcx/fes/

U.S. Army Technical Center for Explosives Safety (USATCES)
Defense Ammunition Center (DAC)
Attn: SJMAC-EST
1C Tree Road
McAlester, OK 74501-9053

Marine Corps:

Commander, Marine Corps Systems Command (MARCORSYSCOM)
2200 Lester Street
Quantico, VA 22134-5010

Navy:

Naval Ordnance Safety and Security Activity (NOSSA)
Attn: N41
3817 Strauss Ave., Suite 108
Indian Head, MD 20640-5151

Naval Facilities Engineering Systems Command (NAVFAC)
Attn: NAVFAC Atlantic, PDC1
6506 Hampton Blvd
Norfolk, VA 23508-1278

NAVFAC Engineering and Expeditionary Warfare Center, Explosion Effects and Consequences
1100 23rd Avenue, Building 1100
Port Hueneme, CA 93043-4370

NAVFAC Engineering and Expeditionary Warfare Center,
DoD Lock Program Technical Support Hotline
(800) 290-7607, (805) 982-1212, DSN 551-1212
e-mail: NFESCLock-TSS@navy.mil
https://exwc.navfac.navy.mil/DoD-Lock-Program/

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APPENDIX A BEST PRACTICES

A-1 B 7-BAR AND 3-BAR ECM APPROVED FOR NEW CONSTRUCTION (IP UNITS).

The Whole Building Design Guide web site provides a listing of 7-Bar AND 3-Bar ECM designs that have been approved for new construction including internal dimensions, door opening dimensions and the maximum NEW that can be stored in the magazine. All new ECM projects must use the most current version of the approved design drawings - refer to the following website for further information; https://www.wbdg.org/building/ammunition-explosive-magazines. The source of this information is DDESB TP 15, Table AP1-1.

Magazine types are graphically depicted in the approved designs for 7-Bar and 3-Bar ECM. The most current version of the approved design drawings, approval letters, and additional information related to the approved designs can be accessed at the following web site: https://www.wbdg.org/dod/ecm/ecm-approved-new-construction approved-new-construction

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APPENDIX B SPECIAL INSPECTIONS

Special inspections are based on Chapter 17 of the IBC. The following Special Inspection Schedule must be revised to reflect specific project requirements and materials used. However, at a minimum the special items related to the blast structural strength designation must be inspected as shown on this schedule.

Table B-1 Special Inspection Schedule/Verification

Item	Extent of Inspection[1]	Reference	Comments/Scope
Concrete Construction			
Reinforcing Steel Placement	P	ACI 318: 20, 25.2, 25.3, 26.6.1-26.6.3	Inspect size, spacing, cover, positioning, and grade of reinforcing steel. Verify reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify bars are adequately tied and supported on chairs or bolsters. For magazines with precast walls, verify that the vertical footing dowels have been located per the contract documents.
Welding of Reinforcement	C	AWS D1.4, ACI 318: 26.6.4	Inspect all reinforcing steel welds. Verify weldability of reinforcing steel. Inspect pre-heating of steel when required. Welding of reinforcement in structural concrete is not allowed without approval.
Concrete Placement	C	ACI 318: 26.5	Inspect placement of concrete. Verify concrete conveyance and depositing avoids segregation or contamination. Verify concrete is properly consolidated. Observe installation of precast panels.
Sampling and Testing of Concrete	C	ASTM C172 ASTM C31 ACI 318: 26.5, 26.12	
Curing and Protection	P	ACI 318: 26.5.3-26.5.5	Inspect curing, cold weather protection, and hot weather protection procedures.
Formwork	P	ACI 318: 26.11.1.2(b)	Inspect formwork for shape, location, and dimensions of the concrete member being formed. For precast wall construction, verify ducts to receive the footing dowels are located per the contract documents.
Door Construction			
Fabricator Certification/ Quality Control Procedures	S		Review of fabricator's quality control procedures or AISC certification.
Fabricator Inspection	P		Inspect in-plant fabrication, or review fabricator's approved independent inspection agency's reports.

1 – Inspection Intervals are as follows:
C – Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.
P – Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.
S – Surveillance review of Shop Drawing submittal

Item	Extent of Inspection[1]	Reference	Comments/Scope
Electrical Construction		NFPA 780, DESR 6055.09	
Reinforcing steel bonding connections	P		Inspect all components establishing the Faraday-like shield including concrete reinforcing steel bonds and bonds between structural elements to ensure electrical continuity. Include photo documentation of the electrical bonding construction phase.
ECM Grounding	P		Inspect the bond between the floor slab and the Ground Ring Electrode. Include photo documentation of the electrical grounding construction phase.
Earth Electrode System	P		Prior to burial, inspect the Earth Electrode System conductors to ensure no damage, breakage, or corrosion has occurred to the conductors.
Lightning Protection System (LPS)	P		Inspect LPS components for secure mounting and protection against accidental mechanical displacement, and to ensure no damage, breakage, or corrosion has occurred.
Other Bonds	P		Inspect all other items bonded to the Ground Ring Electrode for corrosion and loose connections that might result in high-resistance connections.
Continuity Testing	P		Witness continuity testing.
Special Items Related to Blast Strength Designation			
Earth Cover	P		Inspect depth gauges on roof prior to earth cover placement for size and stability. Inspect earth cover depth and slope to ensure a 2 feet (0.61 m) minimum is provided above structure.

Door Laps	C		Inspect door laps at top and bottom of door frame.

1 – Inspection Intervals are as follows:
C – Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.
P – Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.

APPENDIX C GLOSSARY

C-1 ACRONYMS.

AA&E	Arms, Ammunition & Explosives
ACI	American Concrete Institute
AE	Ammunition and Explosives
AGM	Aboveground Magazine
AIB	Anti-Intrusion Barrier
AISC	American Institute of Steel Construction
AMC	US Army Materiel Command
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASHS	Assessment System for Hazard Surveys
ASTM	American Society of Testing and Materials
AWG	American Wire Gauge
AWS	American Welding Society
DDESB	Department of Defense Explosives Safety Board
DoD	Department of Defense
DOR	Designer of Record
ECM	Earth-Covered Magazine
EES	Earth Electrode System
ES	Exposed Site
ESS	Electronic Security Systems
ESS	Explosives Safety Siting
fc	Foot-Candles
HD	Hazard Division
HSILS	High Security Integrated Locking System

IBC	International Building Code
ILD	Internal Locking Device
IMD	Inter-magazine Distance
kg	Kilogram
lbs	Pounds
LDA	Loading Dock Area
LPS	Lightning Protection System
m	meter(s)
mc	meter-candle(s)
MCE	Maximum Credible Event
MHE	Material Handling Equipment
mm	Millimeter(s)
NEQ	Net Explosive Quantity
NEW	Net Explosive Weight
NFPA	National Fire Protection Association
OCONUS	Outside Continental United States
PEMB	Pre-engineered Metal Building
PES	Potential Explosion Site
PSF	Pounds per square feet
QD	Quantity-Distance
RC	Reinforced Concrete
sm	Square meter
SPD	Surge Protective Devices
SPGB	Single Point Ground Bar
TP	Technical Paper

UFC	Unified Facilities Criteria
UN	United Nations
WBDG	Whole Building Design Guide

C-2 DEFINITION OF TERMS.

Ammunition and Explosives (AE): Includes, but is not necessarily limited to, all items of U.S.-titled (i.e., owned by the U.S. Government through the DoD Components) ammunition; propellants, liquid and solid; pyrotechnics; high explosives; guided missiles; warheads; devices; and chemical agent substances, devices, and components presenting real or potential hazards to life, property and the environment. Excluded are wholly inert items and nuclear warheads and devices, except for considerations of storage and stowage compatibility, blast, fire, and non-nuclear fragment hazards associated with the explosives.

Bar: Short for barometric pressure. It is a common expression of the peak design pressure for ECMs.

Barricade: An intervening natural or artificial barrier of such type, size, and construction that limits the effect of an explosion on nearby buildings or exposures in a prescribed manner.

Barricaded Magazine: A magazine with an intervening barricade between it and either a PES or an ES.

Earth-Covered Magazine (ECM): An aboveground, earth-covered structure that meets DoD criteria for soil cover depth and slope requirements. ECMs are AE storage magazines that are covered by soil above, on the sides, and the rear. ECMs have three possible strength designations: 7-Bar, 3-Bar, or Undefined. The strength of an ECM's headwall and door determines its designation.

Exposed Site (ES): A location exposed to the potential hazardous effects from an explosion at a PES.

Hazard Division (HD): A division or subdivision denoting the character and predominant hazard within UN classes 1, 2,3,4,5 and 6.

Intermagazine Distance (IMD): Distance to be maintained between two AE storage locations.

Magazine: Any building or structure used exclusively for the storage of AE.

Maximum Credible Event (MCE): In hazards evaluation, the MCE from a hypothesized accidental explosion, fire, or toxic chemical agent release (with explosives contribution) is the worst single event that is likely to occur from a given quantity and disposition of AE. The event must be realistic with a reasonable probability of occurrence considering the explosion propagation, burning rate characteristics, and physical protection given to the items involved. The MCE evaluated on this basis may then be used as a basis for effects calculations and casualty predictions.

Net Explosive Weight (NEW): The total weight of all explosive substances (i.e., high explosive weight, propellant weight, and pyrotechnic weight) in the AE, expressed in pounds (lbs). The metric equivalent is net explosive quantity (NEQ).

Potential Explosion Site (PES): A location of a potential quantity of AE that will create blast, fragment, thermal, or debris hazard in the event of an accidental explosion of its contents.

Quantity-Distance (QD): The quantity of explosive material and distance separation relationships that provide defined levels of protection. The relationships are based on levels of risk considered acceptable for specific exposures and are tabulated in applicable QD tables in DESR 6055.09. These separation distances do not provide absolute safety or protection. Greater distances than those specified in DESR 6055.09 should be used if practical.

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APPENDIX D REFERENCES

AMERICAN CONCRETE INSTITUTE

https://www.concrete.org

ACI 318, *Building Code Requirements for Structural Concrete*

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS

https://www.ashrae.org

ASHRAE Handbook, *HVAC Applications*

ASHRAE Handbook, *Fundamentals*

ASHRAE 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

ASTM INTERNATIONAL

https://www.astm.org

ASTM C31, *Standard Practice for Making and Curing Concrete Test Specimens in the Field*

ASTM C172, *Standard Practice for Sampling Freshly Mixed Concrete*

AMERICAN WELDING SOCIETY

https://www.aws.org

AWS D1.4, *Structural Welding Code – Reinforcing Steel*

DEPARTMENT OF DEFENSE

https://www.denix.osd.mil/ddes/

DESR 6055.09, *Defense Explosives Safety Regulation*

DoD 4145.26-M, *DoD Contractors' Safety Manual for Ammunition and Explosives*

DoDM 5100.76, *Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives*

DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD

https://www.denix.osd.mil/ddes/

Technical Paper 15 (TP 15), *Approved Protective Construction*, https://www.denix.osd.mil/ddes/denix-files/sites/32/2020/08/DDESB-TP-15-Rev-5-Final.pdf

DDESB-PD Policy Memorandum, *Minimum Requirements to Validate Explosives Safety Protective Construction,* dated 21 October 2008, https://www.wbdg.org/FFC/DOD/ddesb_memo.pdf

DEPARTMENT OF DEFENSE, UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/dod/ufc

FC 2-000-05N, *Facility Planning Criteria For Navy and Marine Corps Shore Installations*

UFC 1-200-01, *General Building Requirements*

UFC 3-301-01, *Structural Engineering*

UFC 3-340-02, *Structures to Resist the Effects of Accidental Explosions*

UFC 3-400-02, *Design: Engineering Weather Data*

UFC 3-410-01, *DoD Minimum Antiterrorism Standards For Buildings*

UFC 3-501-01, *Electrical Engineering*

UFC 3-530-01, *Interior And Exterior Lighting Systems*

UFC 3-570-01, *Cathodic Protection*

UFC 3-575-01, *Lightning and Static Electricity Protection Systems*

UFC 3-580-01, *Telecommunications Interior Infrastructure Planning And Design*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 4-021-02, *Electronic Security Systems*

UFC 4-026-01, *Design To Resist Forced Entry*

UFC 4-021-02, *Electronic Security Systems*

DEPARTMENT OF THE ARMY

https://armypubs.army.mil/

AR 385-10, *U.S. Army Safety Program*

AR 190-11, *Physical Security of Arms, Ammunition, and Explosives*

DA PAM 385-64, *Ammunition and Explosives Safety Standards*

ARMY AMMUNITION CENTER AND SCHOOL (USDACS)

US Army Materiel Command Drawings 19-48-75-5, https://mhp.redstone.army.mil

Army Definitive Drawing DEF 149-30-01, *Standard Definitive Design of Barricades*

HNC-EDC-S-13-10, *Guide for Evaluating Blast Resistance of Existing Undefined Arch-Type Earth-Covered Magazines*

DEPARTMENT OF THE AIR FORCE

DESR 6055.09 AFMAN 91-201, *Explosives Safety Standards*
https://www.wbdg.org/dod/dod-manuals/desr-6055-09

DEPARTMENT OF THE NAVY

NAVSEA OP 5 Revision 8, *Ammunition and Explosives Safety Ashore,* Contact Government Project Manager or Contracting Officer for NAVSEA OP5 information.

OPNAVINST 5530.13D, *U.S. Navy Conventional Arms, Ammunition, and Explosives Physical Security Policy Manual*
https://www.secnav.navy.mil/doni/Directives/

INTERNATIONAL CODE COUNCIL

http://www.iccsafe.org

IBC, *International Building Code*

NATIONAL FIRE PROTECTION ASSOCIATION

https://www.nfpa.org

NFPA 70, *National Electrical Code*

NFPA 780, *Standard for the Installation of Lightning Protection Systems*

FC 4-420-07F
24 April 2018

FACILITIES CRITERIA (FC)

AIR FORCE NUCLEAR WEAPONS-CAPABLE MAINTENANCE AND STORAGE FACILITIES

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FACILITIES CRITERIA (FC)

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NUCLEAR WEAPONS-CAPABLE MAINTENANCE AND STORAGE FACILITIES

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This FC supersedes ETL 11-7, *Nuclear Weapons-Capable Maintenance and Storage Facilities*, dated 1 September 2011.

FOREWORD

Facilities Criteria (FC) provide functional requirements (i.e., defined by users and operational needs of a particular facility type) for specific DoD Component(s), and are intended for use with unified technical requirements published in DoD Unified Facilities Criteria (UFC). FC are applicable only to the DoD Component(s) indicated in the title and do not represent unified DoD requirements. Differences in functional requirements between DoD Components may exist due to differences in policies and operational needs.

All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and, in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the FC, the SOFA, the HNFA, and the BIA, as applicable.

Because FC are coordinated with unified DoD technical requirements, they form an element of the DoD UFC system applicable to specific facility types. The UFC system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and are applicable to the Military Departments, Defense Agencies, and DoD Field Activities. The UFC System also includes technical requirements and functional requirements for specific facility types, both published as UFC documents and FC documents.

FC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet site listed below.

FC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Refer to UFC 1-200-01, *General Building Requirements*, for implementation of new issuances on projects.

AUTHORIZED BY:



EDWIN H. OSHIBA, SES
Director, AF Civil Engineer Center

FACILITIES CRITERIA (FC)
NEW SUMMARY SHEET

Document: FC 4-420-07F, *Air Force Nuclear Weapons-Capable Maintenance and Storage Facilities*

Superseding: ETL 11-7, *Nuclear Weapons-Capable Maintenance and Storage Facilities*

Description:

This document provides criteria specific to new and existing nuclear weapons-capable maintenance and storage facilities, including unique criteria related to design, construction, sustainment, restoration, and modernization.

Reasons for Document:

This document supersedes ETL 11-7 to provide facilities criteria for the use and guidance of those charged with the design, construction, renovation, and maintenance of nuclear weapons-capable maintenance and storage facilities. The performance goals of this document are to ensure that:

- Lightning strikes to the facility will not result in a side flash inside the facility that will compromise the surety of nuclear weapons
- Facility power systems, including all emergency power systems, are adequate to supply power to facility systems required to maintain the surety of nuclear weapons
- Facility structural supports for hoists, cranes, and lifting devices are adequately rated for the design loads
- Security meets the requirements of Department of Defense (DoD) S-5210.41/Air Force Manual (AFMAN) 31-108
- Nuclear surety deviations for existing facilities and essential facility systems are documented in accordance with AFI 91-101
- Blast containment and isolation systems mitigate contamination of facilities and weapons by limiting radiation transport mechanisms such as explosions, blasts, and fires
- Studies, including a fire hazard analysis (FHA), an electromagnetic radiation environment (EMRE) survey, and a facility characterization for the seven-foot rule (if implemented), are conducted to support the adequate design and operational issues in these areas, ensure the safety of weapons, and provide baseline documentation

- Updates to these studies, including for the FHA, EMRE, and facility characterization (if implemented), are conducted if any proposed facility change or modification involves, affects, or impacts systems covered by the existing studies, and the updated studies reflect the effect of the modification on study conclusions and recommendations

- Fire safety designs are implemented to ensure that:

  - Fire during any operational state will not prevent the facility plant from maintaining nuclear weapons in a safe, secure, and stable condition

  - Fire will not result in a radiological release that adversely affects the public, facility personnel, or the environment

  - Fire hazards to personnel are minimized by adding areas of refuge to restricted access/egress rooms

  - A fire will be limited such that facility damage, economic loss, and interruption of support to DoD missions are limited to an acceptable level, as defined by the Cognizant Office of Responsibility

- Provide criteria for new combined industrial and storage limited-access facilities

This document is intended to be used as a basis for the development of detailed design documents (including scope, basis of design, technical requirements, plans, drawings, specifications, cost estimates, request for proposals, and invitations for bids) used for the procurement of facilities, facility similar equipment, and other infrastructure systems. This document must be used as a reference document and requirement in the procurement of architectural and engineering (A&E) services and other consulting services to prepare detailed design documents, including those for design-build projects. It is not intended to be used in lieu of detailed design documents in the procurement of facility construction.

Impact:

Relative to ETL 11-7, this FC should have no impact on design cost, initial cost, energy savings, or life cycle costs.

Disclaimer: Use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE

1-1.1 General

This document provides criteria specific to new and existing nuclear weapons-capable maintenance and storage facilities, including unique criteria related to (but not limited to) facility sustainment, restoration, and modernization (FSRM), and military construction (MILCON), including design and construction. These criteria apply both to spaces where nuclear weapons may be located and to spaces and supporting systems required for nuclear weapons surety. These facilities are relatively few in number and are uniquely designed to protect the Air Force mission, ensure continuity of facility operations, limit property damage, and provide on-site personnel safety.

1-1.2 Basis of Design

This document is intended to be used as a basis for the development of detailed design documents (including scope, basis of design, technical requirements, plans, drawings, specifications, cost estimates, request for proposals, and invitations for bids) used for the procurement of facilities, facility similar equipment, and other infrastructure systems.

1-1.3 Procurement of Services

This document must be used as a requirement in the procurement of architectural and engineering (A&E) services and other consulting services to prepare detailed design documents, including those for design-build projects. It is not intended to be used in lieu of detailed design documents in the procurement of facility construction.

1-1.4 Performance Goals

The performance goals of this document are to ensure that:

- Lightning strikes to the facility will not result in a side flash inside the facility that will compromise the surety of nuclear weapons
- Facility power systems, including all emergency power systems, are adequate to supply power to facility systems required to maintain the surety of nuclear weapons
- Facility structural supports for hoists, cranes, and lifting devices are adequately rated for the design loads
- Security meets the requirements of DoD S-5210.41 / AFMAN 31-108
- Nuclear surety deviations for existing facilities and essential facility systems are documented in accordance with AFI 91-101

- Blast containment and isolation systems mitigate contamination of facilities and weapons by limiting radiation transport mechanisms such as explosions, blasts, and fires
- Studies, including an FHA, an EMRE survey, and a facility characterization for the seven-foot rule (if implemented), are conducted to support the adequate design and operational issues in these areas, ensure the safety of weapons, and provide baseline documentation
- Updates to these studies, including for the FHA, EMRE, and facility characterization (if implemented), are conducted if any proposed facility change or modification involves, affects, or impacts systems covered by the existing studies, and the updated studies reflect the effect of the modification on study conclusions and recommendations
- Fire safety designs are implemented to ensure that:
    - Fire during any operational state will not prevent the facility from maintaining weapons in a safe, secure, and stable condition
    - Fire will not result in a radiological release that adversely affects the public, facility personnel, or the environment
    - Fire itself will not cause a loss of life to those not intimately exposed to the fire origin, and injuries are minimized for those that are intimately exposed
    - Fire hazards to personnel are minimized by adding areas of refuge to restricted access/egress rooms
    - A fire will be limited such that facility damage, economic loss, and interruption of support to DoD missions are limited to an acceptable level, as defined by the Cognizant Office of Responsibility

1-2 APPLICABILITY

This document is applicable to Air Force installations with nuclear weapons-capable maintenance and storage facilities.

1-3 GENERAL BUILDING REQUIREMENTS

Comply with UFC 1-200-01. UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high-performance and sustainability requirements, and safety. Use this FC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

Topics and criteria not included in this FC are those adequately addressed in the engineering criteria for DoD buildings as found in published UFC documents.

Unique fire protection and life safety criteria have been developed for nuclear weapons-capable maintenance and storage facilities as included in this FC.

1-4 REFERENCES

Appendix A contains a list of references used in this document. The publication date of the code or standard is not included in this document. In general, the latest available issuance of the reference is used.

1-5 GLOSSARY

Appendix C contains acronyms, abbreviations, and terms.

1-6 CRITERIA

National consensus criteria are utilized for the facilities addressed in this document as appropriate; however, consensus criteria for some systems and components necessary to accomplish the Air Force mission are not available. This document contains special criteria as needed to meet mission requirements.

1-7 CONFLICTS WITH EXISTING CRITERIA

In case of conflict with any UFC, the criteria in this document will take precedence.

1-8 COGNIZANT OFFICE OF RESPONSIBILITY

The following organizations each serve in the role of Cognizant Office of Responsibility for the establishment of specific requirements in this document:

- Air Force Civil Engineer Center, Operations and Programs Support Division (AFCEC/CO): Serves as preparing activity for this document and serves as the Cognizant Office of Responsibility for civil engineering-related issues. AFCEC also serves as the Cognizant Office of Responsibility for personnel safety-related issues. Equivalencies and exemptions to the requirements of this document (see paragraph 1-9) are issued by AFCEC after receiving coordination from other applicable Cognizant Offices of Responsibility.
- Air Force Nuclear Weapons Center (AFNWC): Serves as a Cognizant Office of Responsibility with particular emphasis on the effects on nuclear surety from facility design issues and FHAs.
- Air Force Safety Center, Weapons Safety Division (HQ AFSEC/SEW): Serves as a Cognizant Office of Responsibility for both nuclear weapons surety and specific personnel safety-related issues as annotated in this document.

- Headquarters Air Force Security Forces, Nuclear Security Division (AF/A4SN): Serves as a Cognizant Office of Responsibility for security-related issues.

The following organization serves in the role for implementation of specific requirements of this document:

- Headquarters, Air Force Global Strike Command (HQ AFGSC): Provides guidance to maintain operational and readiness issues affecting nuclear surety.

1-9 EQUIVALENCIES AND EXEMPTIONS

1-9.1 Equivalencies

Equivalencies to established criteria of this document may be proposed and developed by a Cognizant Office of Responsibility if the alternate engineering design provides an equivalent level of protection to that intended by this document. Requests for approval must be submitted to AFCEC by the appropriate Cognizant Office of Responsibility and must include written justification, including items such as a hazard analysis, cost comparison, criteria used, and other pertinent data. Lack of funds will not be considered sufficient justification for non-compliance with established criteria. Approved equivalencies and alternatives apply only to the specific facility involved and do not constitute blanket approval for similar cases. For issues involving physical security, refer to DoD S-5210.41-M / AFMAN 31-108. For issues involving weapons safety, refer to AFI 91-101.

NOTE: Nuclear surety deviations must also comply with paragraph 1-10 of this document.

NOTE: Certain paragraphs in this document include text similar to "…as approved by the Cognizant Office of Responsibility." That text is intended to indicate that the Cognizant Office of Responsibility is authorized to select a design option or modify that specific criteria without the requirement to submit a request for equivalency to AFCEC.

1-9.2 Exemptions

Exemptions to established criteria of this document may be proposed and developed by a Cognizant Office of Responsibility. Requests for approval must be submitted to AFCEC by the appropriate Cognizant Office of Responsibility and must include written justification. An exemption must demonstrate that the criteria cannot be technically executed or execution of the criteria will increase a hazard or create a new hazard and no technical alternatives exist. Request for exemption must include written justification, including items such as a hazards analysis, cost comparison, alternatives considered, and other pertinent data. Lack of funds or cost savings will not be considered sufficient justification for non-compliance with established criteria. Exemptions apply only to the

specific facility or project involved and do not constitute blanket approval for similar cases. Exemptions must follow the process outlined in MIL-STD-3007F. For issues involving physical security, refer to DoD S-5210.41-M / AFMAN 31-108. For issues involving weapons safety, refer to AFI 91-101.

NOTE: Nuclear surety deviations must also comply with paragraph 1-10 of this document.

NOTE: Certain paragraphs in this document include text similar to "…as approved by the Cognizant Office of Responsibility." That text is intended to indicate that the Cognizant Office of Responsibility is authorized to select a design option or modify that specific criteria without the requirement to submit a request for exemption to AFCEC.

1-10 NUCLEAR SURETY DEVIATIONS AND WAIVERS

In addition to the requirements of this document, all modifications/alterations to an existing nuclear-certified facility or an essential facility system as listed within this document must be documented using the deviation process outlined in AFI 91-101, Chapter 3. That document establishes procedures for MAJCOMs to request deviations to nuclear enterprise-related policy and guidance. This documentation requirement for deviations also includes security deviations.

For the purposes of facility nuclear certification, specific requirements herein are identified in a separate document known as the Certification Requirements Plan (CRP), in accordance with AFI 63-125. Those specific requirements included in the CRP depend on the individual facility's design and function.

If a proposed design modification/alteration conflicts with required nuclear surety-related design criteria, MAJCOMs must use the process in AFI 91-101 to obtain approval. Deviation requests are not required to be submitted for an existing operational system or component solely due to enhanced safety criteria that was implemented after the system or component was originally operationally certified. However, when subsequently modifying/altering an existing system or component, that enhanced safety criteria becomes applicable and deviation requests are required.

Waivers must be adjudicated using the process outlined in AFI 33-360.

1-11 RETROACTIVITY

1-11.1 Level of Protection

The provisions of this document are considered necessary to provide an acceptable level of protection against loss of life and property and to minimize impact to the facility mission. This document applies to new and existing facilities.

1-11.2 Application

Unless specifically noted in this document, the provisions of this document must not be applied retroactively unless determined by the FHA or other approved documented analyses that the existing situation involves a distinct hazard to life, mission, property, or the environment.

1-11.3 Alterations and Limitations

This document also applies when a facility is altered, renovated, or modernized (see specific definitions of these terms in UFC 3-600-01). It is recognized that certain requirements within this document are not possible or practical in existing structures; therefore, a documented evaluation will be provided to the Cognizant Office of Responsibility and, if applicable, to the system program manager (SPM) in accordance with AFI 63-125 as a technical justification for the acceptability of the proposed configuration. Such justifications must provide a sound technical basis for nonconformance that may include a benefit-to-cost analysis.

CHAPTER 2 LIGHTNING PROTECTION SYSTEMS AND SIDE FLASH PROTECTION

NOTE: Cognizant Offices of Responsibility for this chapter are AFCEC and AFSEC.

2-1 SCOPE

This chapter provides the criteria necessary for adequate protection of weapons from the energy of lightning strikes to new and existing nuclear weapons-capable facilities.

2-2 LIGHTNING PROTECTION SYSTEMS

2-2.1 Requirements

Lightning protection systems (LPS) for nuclear weapons-capable maintenance and storage facilities must meet the requirements of:

- Department of Defense Directive (DoDD) 6055.9E
- DoD 6055-09-M

Air Force LPSs must also comply with the following:

2-2.1.1 All facilities, except for underground facilities, will be provided with an LPS in accordance with National Fire Protection Association (NFPA) 780, AFI 32-1065, AFMAN 91-201, AFMAN 91-118, and UFC 3-520-01.

2-2.1.2 Underground facilities do not require an LPS. A counterpoise grounding system will be provided that meets the requirements of NFPA 70, AFI 32-1065, UFC 3-520-01, and AFMAN 91-201.

2-2.2 Design Approaches

LPSs will be designed to traditional LPS parameters. These systems must be designed to meet the requirements of AFI 32-1065, AFMAN 91-201, and NFPA 780. Traditional LPS design consists of the use of strike termination means, low impedance paths to ground, and earth electrode systems, coupled with bonding of all conductive penetrations into the protected facility, surge suppression, and side flash protection.

2-2.3 Special Documentation of LPS During Construction

During construction, establish clear, comprehensive documentation (including photographs) of the as-built installation of the LPS counterpoise, connection to ground rods, and interconnection to other systems. The photos must be taken while the counterpoise and connections are still exposed and visible prior to the placement of backfill or other coverage material. The installing contractor will include this documentation with the project as-built submittals with written certification of its accuracy. Provide Geographic Information System (GIS) data coordinates of photograph/connection locations and of the permanent reference points to enable base personnel to subsequently locate and uncover any connection point in the system. The

installing contractor will include this geospatial data with the project as-built submittals with written certification of its accuracy.

2-3 NUCLEAR WEAPONS SIDE FLASH PROTECTION REQUIREMENTS

2-3.1 Requirements

Side flash protection must be addressed as required in AFMAN 91-118 and AFMAN 91-201.

2-3.2 Lightning Side Flash Protection Policy for Nuclear Weapons Configurations

Apply standards in accordance with AFMAN 91-201. This is commonly referred to as the “seven-foot rule.”

2-3.3 Side Flash Protection Characterization

When the facility is determined under AFMAN 91-118 and AFMAN 91-201 as being subject to characterization under the seven-foot rule reduction, each bond will be given a unique identification number and be permanently tagged to display this number and the purpose of the bond, such as “FARADAY SHIELD BOND.” Document the location, configuration, and identity of each bond in a permanently maintained drawing file and with a geospatial record. Documentation must also include photos that show the connection method of the facility rebar forming the Faraday shield and the bonding of the penetrations.

2-3.3.1 Metallic Penetrations

Bonds will have a maximum resistance of 1 ohm across the connection to the Faraday shield to ground.

2-3.3.2 Alternative Measures for Communications and Data Circuits

When it is not practical to install suppression capable of interrupting the energy levels of the established 1 percentile lightning strike on communications and data circuits, alternatives must be in place to minimize the possibility of the lightning energy entering the facility through these conductors. Provide an evaluation and analysis of these alternatives to the Cognizant Offices of Responsibility for review and approval prior to implementation. Factors to consider in determining the practicality of installing the required surge suppression or the acceptability of alternatives will include at least:

- The quantity and associated costs of installing the required surge suppressors for the number of conductors involved
- The volume of space necessary to install the required suppression units
- The exposure of the portions of the system that are external to the Faraday shield to lightning strikes

- The impact on system performance if installing the required suppression units
- The protection provided using standard commercial surge suppressors manufactured for the application

2-3.3.3 Design of New Facilities

Design new facilities to successfully complete the characterization process prior to activating the facility.

2-3.3.4 Testing of New Facilities

Complete the characterization evaluation prior to activating the facility.

2-3.3.5 Testing of Existing Facilities

Complete the characterization evaluation prior to reducing the required separation distances less than those required by the seven-foot rule.

2-3.3.6 Documentation Retention

The facility will maintain documentation of the characterization process, including at least these items:

- Cognizant Offices of Responsibility requirements
- Testing methodology
- Transfer impedance evaluation results
- Bonding methodology
- Faraday shield bonding records
- Bonding length calculations
- Suppression alternatives and mitigation methods

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CHAPTER 3 ELECTRICAL POWER AND LIGHTING SYSTEMS

NOTE: Cognizant Office of Responsibility for this chapter is AFCEC.

3-1 SCOPE

This chapter provides the criteria for electrical power and lighting systems necessary to protect weapons from electrical energy and provide emergency power and lighting to maintain essential operations without impacting mission requirements.

3-2 ELECTRICAL SYSTEMS

NOTE: Cognizant Office of Responsibility for this paragraph is AFCEC.

3-2.1 Design Criteria

Electrical systems for nuclear weapons-capable maintenance and storage facilities must be designed to meet the requirements of UFC 3-501-01, UFC 3-520-01, UFC 3-520-05, and UFC 3-550-01. Electrical systems will comply with NFPA 70 and Institute of Electrical and Electronics Engineers (IEEE) C2, *National Electrical Safety Code* (NESC), except as modified by UFC 3-501-01, UFC 3-520-01, or UFC 3-550-01. Electrical systems must comply with AFI 32-1062, AFI 32-1065, and AFMAN 91-201.

Facilities will be provided with an emergency power system to supply electrical power to all facility subsystems necessary to maintain the safety and security of nuclear weapons in accordance with AFI 32-1062.

3-2.2 Special Documentation of Grounding System

During construction, establish clear, comprehensive documentation (including photographs) of the as-built installation of the facility's grounding electrode system, connection to ground rods, and interconnection to other systems. The photos must be taken while the grounding electrode system and connections are still exposed and visible, prior to the placement of backfill or other coverage material. Include geospatial data from permanent reference points to enable base personnel to subsequently locate and uncover any connection point in the system. The installing contractor will include this documentation with the project as-built submittals with written certification of its accuracy.

3-2.3 Transformers

3-2.3.1 Indoors

Dry-type or liquid-filled transformers using FR3 dielectric fluid will be used for indoor applications. Transformers with hydrocarbon-based insulating oils will not be used indoors. Polychlorinated biphenyl (PCB) -filled transformers will not be used. The installation will comply with NFPA 70 requirements for transformers located inside buildings.

3-2.3.2 Separation Distances Outdoors

Outdoor transformers must meet the minimum separation distances from structures as specified in AFMAN 91-201 and UFC 3-600-01.

3-2.3.3 Cold Weather Conditions

Outdoor transformers, other than dry-type transformers, must contain insulating oils suitable for the cold weather conditions of the geographic location of the nuclear weapons-capable maintenance and storage area.

NOTE: Some dielectric fluids used as an alternative to hydrocarbon-based oils have significant changes in their dielectric properties when exposed to below-freezing conditions. Although these fluids may function appropriately in a continuously energized transformer that keeps the fluids warm, the transformer must always remain energized. It may not be possible to safely reenergize these transformers from an extended shutdown period in cold environments.

3-2.3.4 Testing

3-2.3.4.1 Transformers containing insulating mineral oils will be tested at least every five years to the specifications of the American Society for Testing and Materials (ASTM).

3-2.3.4.2 Testing frequency will be increased to at least annually for any transformer showing indication of abnormal mineral oil conditions or impending transformer breakdown.

3-2.3.4.3 Results of the testing will be evaluated to detect impending transformer breakdown and permit corrective maintenance before a transformer failure causes an unplanned power outage.

3-2.3.4.4 Testing must include at least the following:

- Dissolved gas-in-oil analysis (IEEE C57.104 and ASTM D3612)
- Oil testing, including:
  - Dielectric breakdown strength (ASTM D877 and ASTM D1816)
  - Neutralization (ASTM D974)
  - Interfacial tension (ASTM D971)
  - Color (ASTM D1524)
  - Moisture content (ASTM D1533)
  - Specific gravity (ASTM D1298)
  - Transparency and opacity (ASTM D1524)
  - Power factor (ASTM D924)

3-2.3.5 Spare Transformers

If the FHA report identifies critical transformers that, if lost, could have a severe impact to the facility mission, and if these transformers have a long replacement time (e.g., longer than 30 days), feasibility of procurement of a spare transformer must be evaluated by the installation commander and the results of the evaluation provided to HQ AFGSC.

3-2.4 Cabling

Cabling within nuclear weapons-capable maintenance and storage facilities must meet the specifications in UFC 3-520-01. The specific areas that must exceed the criteria within UFC 3-520-01 are addressed in paragraphs 3-2.4.1 through 3-2.4.3.

3-2.4.1 Combustible Cable Insulation and Jacketing Material

Combustible cable insulation and jacketing material will meet the fire and flame test requirements of IEEE 383. Meeting the requirements of IEEE 383 will not eliminate the need for other fire protection features as specified in this document.

3-2.4.2 Fiber Optic Cable Insulation and Jacketing Material

Fiber optic cable insulation and jacketing material will meet the fire and flame test requirements of IEEE 383.

3-2.4.3 Wire Management Systems

All wiring, including power, signal, communication, and control, will be installed in metallic conduit, except that metallic conduit is not required for those portions of underground conduit more than 50 feet (15.3 meters) from the facility (see AFMAN 91-201). Wireways or cable trays will not be used without approval of the Cognizant Office of Responsibility. Wireways and cable trays will not be used to run cables through the boundary of a blast containment zone.

3-2.4.3.1 Wireways

If the use of wireways is approved by the Cognizant Office of Responsibility, wireways will be made of noncombustible materials.

3-2.4.3.2 Cable Trays

If the use of cable trays is approved by the Cognizant Office of Responsibility, only metal will be used for cable trays (e.g., fiberglass-reinforced plastics are not permitted).

If the use of cable trays is approved by the Cognizant Office of Responsibility, cable tray fire breaks must be installed every 20 feet (6.1 meters) for vertical cable trays that rise over 30 feet (9.1 meters) unless they are protected with a fire-resistive coating. Access to cable shafts must be provided every 40 feet (12.2 meters), with the topmost

access within 20 feet (6.1 meters) of the cable shaft ceiling. Automatic sprinkler protection and smoke detection must be provided at the ceiling of the vertical shaft.

If the use of cable trays is approved by the Cognizant Office of Responsibility, horizontal cable trays must be provided with cable tray fire breaks every 50 feet (15.2 meters) unless the cable trays are protected with a fire-resistive coating.

3-2.4.3.3 Conduits

Conduits with an inside diameter larger than the trade size of 4 inches (standard metric size 103 millimeters) that pass through a fire barrier wall must be provided with an internal fire seal that has a fire-resistive rating equivalent to that of the fire barrier, and the internal fire seal will be permitted to be installed on either side of the barrier but in a location that is as close to the barrier as possible. Blast walls will also be provided with an explosion-proof conduit seal meeting the requirements of NFPA 70 for a Class I, Division 1 boundary.

Conduits with an inside diameter equal to or less than the trade size of 4 inches (standard metric size 103 millimeters) that pass through a fire barrier wall that is not also a blast wall will be provided with a fire-rated internal seal unless the conduit extends greater than 5 feet (1.5 meters) on each side of the fire barrier. In this case, the conduit opening will be provided with noncombustible material to prevent the passage of smoke and hot gases. The fill depth of the material packed to a depth of 2 inches (51 millimeters) will constitute an acceptable smoke and hot gas seal in this application.

Conduits with an inside diameter equal to or less than the trade size of 4 inches (standard metric size 103 millimeters) that pass through a fire barrier wall that is also a blast wall must be provided with an explosion-proof conduit seal meeting the requirements of NFPA 70 for a Class I, Division 1 boundary.

3-2.5 Battery Rooms

Battery rooms will comply with UFC 3-520-05. Loss of ventilation in a battery room will cause an alarm to be received at a constantly attended location (e.g., in the security control room or munitions squadron control). Exhaust air from the battery room is not required to be discharged directly to the outside for battery rooms located in underground (see Chapter 14) or restricted access/egress (see Chapter 17) areas of the facility.

3-2.6 Electrical System Analyses

Current electrical coordination, short-circuit, and load flow analyses for the facility will be maintained and kept with other facility records. These analyses will be used to ensure that proposed system modifications will not adversely affect system reliability.

3-2.7 Priority and Normal Electrical Power Loads

3-2.7.1 Priority Loads

Priority loads are designated as electrical system loads whose failure could result in loss of human life or serious injuries, or result in serious mission or security issues. Priority loads will be served by a permanent emergency engine generator power system. These loads include, but are not limited to:

- Security systems
- Entry control systems
- Maintenance area lighting and power
- Storage area lighting
- Shelter-in-place (refuge area) lighting and power
- Egress lighting
- Life safety systems
- Mechanical systems associated with a blast containment management system (BCMS)
- Fire alarm and reporting systems

3-2.7.2 Normal Loads

Normal loads are any electrical system loads not classified as a priority load.

3-2.8 Hardening of Electrical Power Systems

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC, AF/A4S, and AFSEC.

Electrical power systems located within and serving the controlled areas of nuclear weapons-capable maintenance and storage facilities will be required to be hardened against unauthorized access and intentional acts that may result in damage to the systems. Hardening must incorporate one or more of these features: location within secured facility boundaries, active surveillance, alarms, physical barriers, access controls, shock- or vibration-resistant equipment mounts, or other methods that will prevent unauthorized access and damage to the supply, distribution, or controls of the normal and emergency power systems.

3-2.9 Emergency Power Systems

Emergency power systems must be capable of supporting all priority loads (see paragraph 3-2.7). Emergency power system types include, at a minimum, a real property installed equipment (RPIE) permanent engine-driven electric generator. In

addition, other types of electrical power systems may be approved by the Cognizant Office of Responsibility, such as uninterruptable power supplies (UPS) that use batteries as an interim source of emergency power. The capacity of a new or modified emergency power system must be approved by AFCEC at the 65 percent design point per AFI 32-1062.

3-2.9.1 Fuel Systems for Emergency Engine Generator Power Systems

Fuel systems for emergency engine generator power systems, including on-premises supply, will be afforded the same level of hardness required for the emergency engine generator power system itself. Furthermore, the on-premises supply will be sufficient to enable the emergency power systems to support all priority loads for at least 72 hours.

3-2.9.2 Automatic Transfer Switch (ATS)

ATSs connected to normal power and emergency power supplies must utilize a two-source-design, bypass-isolation transfer switch configuration. The design must allow the transfer switch to be isolated for inspection, calibration, and maintenance without requiring electrical system shutdown. The design must allow any single circuit breaker to be isolated for inspection, calibration, and maintenance of equipment without requiring electrical system shutdown. Circuit breaker-type bypass isolation transfer switches must be utilized when electrical coordination is required.

3-2.9.3 Manual Transfer Switch

Manual transfer switches connected to normal power and emergency power supplies must be provided with isolation and bypass breakers to allow the manual transfer switch or any single breaker to be isolated for inspection, calibration, and maintenance without requiring electrical system shutdown.

3-2.9.4 Tertiary Connection Point

Facilities will be provided with a tertiary connection point for a mobile engine generator system independent of the permanently installed facility engine generator set. This connection point must be capable of sustaining all priority loads.

3-2.10 Surge Protection

3-2.10.1 Existing Facilities

For existing facilities, unless approved in the FHA, provide surge protection sized to reduce transient voltages, including those produced by lightning, to a harmless level on all entering or exiting metallic power, intrusion detection, communication antennas, and instrumentation lines in accordance with UFC 3-520-01. Install the surge protection as near as practical to where the conductor enters the interior of the facility.

3-2.10.2 New Facilities

For all new facilities, surge protection must meet the requirements in Chapter 2 in addition to the requirements in UFC 3-520-01, AFI 32-1065, and AFMAN 91-201.

3-3 TEMPORARY ELECTRICAL WIRING

Comply with NFPA 70 and the requirements listed in paragraph 10-5.

3-4 LIGHTING

NOTE: Cognizant Office of Responsibility for this paragraph is AFCEC.

3-4.1 Normal Lighting

Normal lighting will be provided as required by UFC 3-530-01.

3-4.2 Photoluminescent Egress Path Marking

Non-powered luminescent path markings must be provided for egress access routes in all areas that may contain nuclear weapons and leading to areas of refuge. Non-powered luminescent path markings will meet the performance requirements listed in NFPA 101. The installation of luminescent path markings will consider the amount of ambient lighting available throughout the day to ensure the level is sufficient to keep the marking charged in accordance with the manufacturer's requirements.

3-4.3 Photoluminescent Egress Door Marking

Egress doors in areas that may contain nuclear weapons and doors into areas of refuge must be marked with non-powered photoluminescent signs that are uniquely marked to avoid confusion with normal egress doors. These signs will be installed in accordance with the manufacturer's requirements. Particular attention must be given to the requirement for the level of background ambient lighting to ensure the signs remain charged. If this criterion cannot be met then electrically powered exit marking must be used (e.g., light-emitting diode [LED] signs).

3-4.4 Emergency Lighting

Emergency lighting will be provided for the egress access routes, security staging and operating locations, and firefighting staging and operating locations in accordance with NFPA 101. Emergency lighting for security staging and operating locations and firefighting staging and operating locations may be required to be at a higher level to meet operational requirements. The required illumination levels will be documented in the FHA. Self-testing emergency lighting fixtures will be installed in all areas except when limited by EMRE considerations. In those EMRE-limited locations, normal power to the emergency lighting will be provided by a dedicated electrical circuit to allow periodic testing without de-energizing other electrical equipment.

3-4.4.1 Testing

Permanently mounted emergency lighting units using batteries will be tested and inspected to verify proper operation based on the requirements of NFPA 101.

3-5 SECURITY LIGHTING

AF/A4SN serves as the Cognizant Office of Responsibility for this section.

Security lighting will be in accordance with DoD S-5210.41-M / AFMAN 31-108. The Cognizant Office of Responsibility will specify if the facility will be classified as a lighted site or unlighted site.

CHAPTER 4 STRUCTURAL SUPPORT FOR HOISTS, CRANES, AND LIFTING DEVICES

NOTE: Cognizant Offices of Responsibility for this chapter are AFCEC and AFSEC.

4-1 SCOPE

This chapter provides criteria to ensure facility structural elements are capable of supporting the safety design requirements for those hoists, cranes, and lifting devices that are subject to AFMAN 91-118. In general, this chapter provides structural criteria that exceeds the minimum requirements of UFC 1-200-01.

4-2 STRUCTURAL REQUIREMENTS

Ensure items such as load frames, hoist trolleys, test and storage stands, and handling units provide at least the design load capability. See AFI 91-203 for additional requirements. The design load is the rated load multiplied by a factor as required in AFMAN 91-118. This design load is considered the minimum load for design of the facility structural elements required to support the hoist, crane, or similar device.

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CHAPTER 5 SECURITY SYSTEMS

NOTE: Cognizant Office of Responsibility for this chapter is AF/A4S.

5-1 SCOPE

This chapter provides criteria for the physical security necessary to meet the applicable DoD nuclear weapon system safety standards and considers systems design, access analysis, and other features to ensure the applicable standards have been met.

5-2 DESIGN CRITERIA

5-2.1 Minimum Physical Security Design

At a minimum, physical security design will be in accordance with DoD S-5210.41 / AFMAN 31-108.

5-2.2 Systems Engineering Perspective

Physical security system designs will be approached from a systems engineering perspective to identify potential impacts to the safety of nuclear weapons systems and to ensure compatibility (including an EMRE survey) with nuclear weapon systems.

5-2.3 Security Integration

Facility design must account for electronic security system (ESS) and Remote Targeting Engagement System (RTES) infrastructure requirements (e.g., wall penetrations, power/communications system requirements) to ensure construction and facility certification. See Chapter 7 for additional requirements.

5-3 SECURITY CONTROL ROOM COMPLEX

5-3.1 When Required

Provide a security control room complex when required by other chapters in this document.

5-3.2 Physical Separation

The security control room complex must be protected against exposure fire damage and will be separated from other fire areas of the plant by floors, walls, doors, and ceilings having a minimum fire resistance rating of 3 hours.

5-3.3 Windows

Windows in fire barriers for the security control room complex will be provided with a listed or approved fire shutter or automatic wall curtain having a minimum fire resistance rating of 3 hours.

5-3.4 Peripheral Rooms

Peripheral rooms supporting the security control room complex but within the same fire area must have an automatic water-based suppression system, and will be separated from the control room by noncombustible construction with a minimum fire resistance rating of 1 hour.

5-3.5 Ventilation System Openings

Ventilation system openings between the control room and the peripheral rooms must have automatic smoke or combination fire and smoke dampers installed that will close on operation of the fire detection or fire suppression systems.

5-3.6 Manual Firefighting

Manual firefighting capability will be provided for:

- Fires originating within a cabinet, console, or connecting cables
- Exposure fires involving combustible materials in the general surrounding room areas

A fire hose station will be installed immediately outside of the security control room (see Chapter 11).

5-3.7 Portable Fire Extinguishers

Portable Class A and Class C fire extinguishers will be located in the security control room. Clean agent or carbon dioxide (CO_2) portable fire extinguishers will be used for electrical hazards.

5-3.8 Smoke Detection

Smoke detectors will be provided in the control room complex, including the interior of electrical cabinets and consoles (see Chapter 11).

5-3.9 Breathing Apparatus

Provision for breathing air (e.g., dedicated ventilation system or breathing apparatus) for the security control room operators must be readily available, with a minimum 72-hour capacity.

5-3.10 Smoke Venting

Manually operated smoke venting of the security control room will be available to the control room personnel (see Chapter 11).

5-3.11 Electrical Cables

All electrical cables that enter the control room will terminate in the control room. No cabling will be routed through the control room from one area to another. Fully enclosed electrical raceways located in such under-floor and ceiling spaces, if over 1 cubic foot (0.03 cubic meter), must have automatic fire suppression internally. Area automatic fire suppression must be provided for under-floor and ceiling spaces if used for cable runs unless all cable is located in 4-inch (standard metric size 103 millimeter) or smaller steel conduit, or unless cables are fully enclosed within raceways internally protected by automatic fire suppression. See Chapter 3 regarding the use of wireways or raceways and for requirements for conduit seals.

5-3.12 Air Handling

Air handling functions will be ducted separately from cable runs. If cables are routed in under-floor or ceiling spaces, these spaces will not be used as air plenums for ventilation of the control room.

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CHAPTER 6 FACILITY AUTOMATA AND SOFTWARE

NOTE: Cognizant Office of Responsibility for this chapter is AFSEC.

6-1 SCOPE

This chapter provides criteria for facility automata and software that is unique and developed or written specifically to control essential facility systems (EFS).

6-2 DEFINITION OF EFS

EFS are defined as those facility systems that directly impact the safe maintenance, handling, and storage of nuclear weapons (see AFMAN 91-118).

6-3 AUTOMATA AND SOFTWARE REQUIREMENTS

6-3.1 Software

All software (including facility security system software) that is unique and developed or written specifically to control EFS must meet the requirements of AFMAN 91-119.

6-3.2 Exempted Embedded Software and Firmware

Embedded software and firmware that is installed by the equipment manufacturer, is commercially available, is incapable of being modified without the manufacturer's authorization, and is common to all identical equipment without modification to the program itself does not fall under the requirements of AFMAN 91-119 and does not require separate nuclear safety certification for the software and firmware.

6-4 EFS DESIGN CONSIDERATIONS

6-4.1 Protection of EFS Interfaces

Control of EFS is nearly always accomplished by embedded software and firmware, or, in some instances, by unique software written specifically for that purpose. Typically, EFS are interconnected and provide integrated systems operations. Interfaces between EFS must be designed to ensure the nuclear surety environment is maintained. Design considerations may include, but are not limited to:

- Placing control panels and interface connections and equipment in locked, secure cabinets and placing the cabinets in a secure environment
- Ensuring the interconnections and equipment are passive
- Minimizing exposure of interconnection wiring to unauthorized access (i.e., enclosing in conduit)

6-4.2 Protection from Power Fluctuations

All software and computer system hardware for EFS must be robust and insensitive to normal power fluctuations, spikes, and dips. Hardware will be provided with supplemental power such as battery backup or UPS, or be connected to a power supply that has reserve capabilities.

CHAPTER 7 CONTAINMENT AND ISOLATION FEATURES

NOTE: Cognizant Office of Responsibility for this chapter is AFSEC.

7-1 SCOPE

This chapter provides criteria and requirements for hazard classification and containment and isolation features for the purpose of limiting the spread of contamination and consequential damage to weapons, areas within the facility, and the environment.

NOTE: Fire protection (e.g., automatic sprinklers) and fire detection (e.g., fire alarm systems) are intended to be configured to coincide with required containment zones and with corresponding heating, ventilation, and air conditioning (HVAC) zones. This will reduce penetrations through the barrier walls by the fire protection equipment and also improve the survivability of the systems (refer to Chapters 5 and 11). Life safety issues related to containment are discussed in subsequent chapters of this document.

7-2 REFERENCES

Guidance for hazard classification and containment and isolation system features, including blast, fire, and contamination, is provided in the following documents:

- AFMAN 91-201
- AFMAN 91-118
- DoD 6055.09
- DOE O 440.1B
- UFC 3-340-02
- DDESB Memorandum “Minimum Requirements to Validate Explosive Safety Protective Construction,” dated 21 October 2008
- DDESB Technical Paper 16, “Methodologies for Calculating Primary Fragment Characteristics,” Revision 4, dated 2 August 2012

7-3 DESIGN FEATURES

Facility containment and isolation design features shall include, as a minimum:

- The ability to contain and/or isolate the maximum credible event (MCE), also referred to as the design basis accident (government-furnished information). If the MCE does not involve a blast scenario, measures are still required to prevent spread of contamination

- The ability to mitigate contamination of facilities, weapons, and the environment by limiting radiation transport mechanisms such as explosions, blasts, and fires
- Incorporation of containment and/or isolation zones for the purpose of limiting the spread of contamination and consequential damage to the facility, stored critical assets, or to the environment
- Blast-resistant barriers separating blast zones (if required) that are capable of withstanding explosions commensurate with the maximum credible event of the zone as described in paragraph 7.5
- Compatibility between factors such as site requirements, blast zones and/or containment zones, overpressures, isolation requirements, HVAC, penetrations, doors, and drainage requirements
- Appropriate filtering capable of removing radioactive airborne materials from exhaust air (not including tritium gas).
- The capability for venting or isolating the facility with respect to environmental air
- The capability for monitoring the interior of the facility for specific types of radiation
- Integration with other systems, such as HVAC, fire alarm, and security, to achieve a coordinated and managed environment.
- The ability to accomplish remote control of containment/isolation systems by specific authorized personnel in the facility control center

7-4 CONTAINMENT SYSTEM ELEMENTS

7-4.1 Containment Zones

Containment zones shall be arranged to coincide with HVAC zones and fire zones (as separated by fire barrier walls) to the maximum extent possible (also see Chapter 11).

7-4.2 Radiological Filter Systems

A radiological filter system will be provided to protect against contaminated air being released to the outside environment without suitable filtering. The radiological filter system may be designed to serve one or more containment zones.

7-4.3 Plumbing Valves

7-4.3.1 Remotely air-operated, quick-acting isolation ball valves will be added in the construction to aid in contaminant control in air systems. Remotely air-operated quick-acting isolation ball valves shall be placed on domestic water lines, sewer lines,

fuel lines, and other plumbing lines to prevent contaminating particles from reaching the water source. These valves shall be configured to fail in the closed position.

7-4.3.2 These valves shall be integrated with the radiation monitoring system**.**

7-5 BLAST CONTAINMENT/ISOLATION SYSTEM ELEMENTS

When the MCE includes a potential blast, the elements of this section apply.

NOTE: Not all facilities require the use of blast containment and isolation features. Contact the Cognizant Offices of Responsibility for the applicability of this chapter to a new or existing facility.

7-5.1 Blast Containment and Isolation System Elements

Blast containment and isolation system elements include, but are not limited to, blast containment zones, blast-resistant barriers (i.e., walls, floors, and ceilings), blast doors, blast valves, HVAC systems, and plumbing systems.

7-5.2 Blast Containment Zones

Blast containment zones shall be arranged to coincide with HVAC zones and fire zones (as separated by fire barrier walls) to the maximum extent possible (also see Chapter 11). Blast containment zones shall be constructed to be as gastight as possible. The construction of the area shall meet the gastight criteria, e.g., reinforced concrete, steel blast doors, pipes, valves, and seals. Each area shall be designed such that both during and after an explosive event the gastight capability of the area will not be less than that required of the seals of the blast doors (see paragraph 7-5.4)

7-5.3 Blast-Resistant Barriers

Blast-resistant barriers, such as walls, floors, and ceilings, will be designed to resist blast loads in any area subject to accidental explosion. Concrete cracking shall be limited to discontinuous hairline-type cracks such that the migration of contaminants through these cracks will be severely limited. Spalling on the protected side of the wall shall be limited, and the integrity of the wall shall be maintained considering the combined fragment impact and blast pressure commensurate with the maximum credible event. Penetrations of the blast-resistant barriers shall be limited to only those services necessary to serve the blast zone encompassed by the blast-resistant barriers. The penetrations will be protected by blast valves, explosion-proof seals, or other such means necessary to maintain the integrity of the barrier. Where sprinkler piping penetrates a blast barrier, other means of protection shall be considered to ensure that the system maintains NFPA code compliance, such as zoning the sprinkler systems such that a single sprinkler system would service a single blast zone.

NOTE: When necessary to prevent subsequent criticality events following a blast the sprinkler system inside the blast zone may need to be isolated simultaneously with the operation of the blast valves.

7-5.4 Blast Doors

7-5.4.1 Configuration

The preferred configuration is a single-leaf swing blast door; however, other configurations are acceptable (e.g., vertical sliding blast doors) if the blast doors will provide the required protection and blast containment.

7-5.4.2 Construction

The doors shall be constructed of material that will provide the required blast resistance characteristics. When required, the door shall also be constructed of material that will provide the required delay characteristics. There shall be specific test data or modeling, as approved by the Cognizant Office of Responsibility, which demonstrates the capability of the material selected to meet the required blast resistance and, if required, also delay characteristics.

7-5.4.3 Blast Resistance

The door material shall be of sufficient thickness and strength to withstand the blast pressures imposed on it. At a minimum, it shall resist the blast pressure associated with the maximum credible event of the area being protected.

7-5.4.4 Door Operators

The door operating system shall include a stored energy system that shall be capable of operating through not less than two complete cycles without relying on external power. Furthermore, upon loss of power, the door operating system shall automatically cycle the doors to a failsafe position that meets the applicable security and safety requirements.

7-5.4.5 Door Control

NOTE: Cognizant Offices of Responsibility for this paragraph are AFSEC and AF/A4S.

Controls for the door operators shall be compatible with the physical security requirements mandated by the applicable criteria of DoD S-5210.41-M / AFMAN 31-108. A manual means of opening the door from either side shall be provided.

7-5.4.6 Seals

Blast doors shall be provided with seals around the perimeter of the door. Blast door systems, including the seals, shall be gastight before and after an explosive detonation and fragmentation impact. The maximum leakage permitted around the seals is 1 standard cubic foot (28.3 liters) of air per hour per 1 linear foot (30.5 centimeters) of seal. Each blast door system shall be designed with the inherent capability to test leakage around the seals with the door and seals in place and without separate equipment or special procedures.

7-5.4.7 Hinge Requirements

The hinge design capacity shall be at least 150 percent of the calculated load to which the hinge will be subjected, including each component and mounting hardware. The life expectancy of the hinges shall be not less than 20 years, with a normal number of operating cycles per day based on a conservative evaluation of past facility operations (for existing facilities) or anticipated operations (for new facilities). The hinges shall allow the door to be adjusted in both the x- and y-axis of the door plane, which shall not require specialized tools, hinge disassembly, machining of hinge or door surfaces, cutting or welding, or any other such special procedures.

7-5.4.8 Equivalency to Fire Doors

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC

In most cases, blast doors will be within fire-rated walls. Blast doors are not listed by nationally recognized testing laboratories as fire doors; however, based on their massive construction, they likely meet most of the listing agencies' criteria for a fire door. In cases where a blast door is within a fire barrier wall, a qualified fire protection engineer shall evaluate the door and determine if it meets the intent and function of a fire-rated door. The evaluation should include at least the types and amount of combustible materials used in construction of the door, a qualitative consideration of the door’s thermal transfer characteristics, the means of mounting the door into the blast wall and the door frame, and the size and means of sealing gaps around the door when closed. The evaluation shall be reviewed and approved by the Cognizant Office of Responsibility. If the evaluation proves that the door is not equivalent to a fire-rated door, other means shall be provided to ensure that the rating of the wall is maintained. Such configurations can include a fire-rated vestibule with fire-rated doors.

7-5.4.9 Communication Capability

Capability for communication by personnel shall be present on both sides of the blast doors.

7-5.4.10 Emergency Operation of Vertical Blast Doors

NOTE: Cognizant Offices of Responsibility for this paragraph are AFSEC and AF/A4S

If vertical blast doors are used, they shall be evaluated and configured such that in the event of an explosion within the space, the damaged door can be operated from the exterior of the room by an emergency means (e.g., providing the door with the necessary hardware to permit the use of a forklift to lift the door after an explosive event).

7-5.5 Blast Valves

NOTE: Cognizant Office of Responsibility for this paragraph is AFSEC

Blast valves shall be installed on HVAC hardened ducts and plumbing piping that penetrate blast-resistant barriers. These valves and their installation shall prevent over- and under-pressure blast waves from reaching the supply and exhaust airstreams. These valves shall be self-contained and capable of automatically closing upon an explosive event.

7-5.6 HVAC Systems

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC

7-5.6.1 Zones

HVAC zones will be arranged to coincide with blast zones and fire areas to the maximum extent possible (refer to Chapter 11).

7-5.6.2 Valves

Blast valves and gastight butterfly valves will be used to isolate each ventilation air pipe crossing blast-resistant barriers. Butterfly valves (Wafer-Sphere®) shall be the quick-acting, gastight isolation type that are air driven, spring closed to isolate a zone immediately after an internal blast. Butterfly valves shall be triggered by blast detectors located within each contamination zone.

7-5.6.3 Hardened Duct

Hardened duct will be used for any duct penetrating a blast-resistant barrier or for any duct extending through a blast zone. Duct that remains entirely within a blast zone is not required to be a hardened duct.

7-5.6.4 Individual Air Handling Components

Each blast-protected containment zone will be served by individual air-handling components designed so that any contaminated air generated within that containment zone shall not be able to enter any containment zones or HVAC zones. Operation of any single blast containment zone shall not impair operation of the ventilation system for other containment zones or HVAC zones in the facility.

7-5.6.5 Ventilation Air Plenums

Ventilation air shall be supplied and exhausted through the blast wall from the mechanical plenums in either steel ducts or welded Schedule 40 steel pipes. The use of flexible ducts shall be permitted only with the approval of the Cognizant Office of Responsibility.

7-5.6.6 Containment of Blast Byproducts

The various weapon handling areas of the main facility will each be designed to contain the byproducts of an accidental explosion entirely within themselves until the byproducts can be safely vented outside.

7-5.7 Penetrations

Penetrations through blast resistant barriers include electrical conduit, hydraulic piping, compressed air piping, domestic water piping, floor drains, and water suppression piping. This list is not exhaustive. Penetrations will be limited to only those services necessary to serve that particular blast zone.

Wireways and cable trays shall not be permitted to cross the boundary of a blast containment zone (refer to Chapter 3).

7-5.8 Fire Sprinkler System

Remotely air-operated quick-acting isolation ball valves shall be placed on sprinkler lines for individual blast zones when it is necessary to prevent subsequent nuclear criticality events following a blast. These valves shall be configured to fail in the closed position. These valves shall also close at the same time as the blast valves. The valves shall be electrically supervised by the fire alarm system and initiate a trouble signal when closed.

7-5.9 Electrical

Explosion-proof conduit seals shall be provided for each conduit run passing through the boundary of a blast containment zone (refer to Chapter 3). Wireways and cable trays are not permitted to cross the boundary of a blast containment zone (refer to Chapter 3).

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CHAPTER 8 STUDIES AND DOCUMENTATION

8-1 SCOPE

This chapter provides criteria and requirements for conducting the specified studies in sufficient detail to ensure the safety of weapons and to provide baseline documentation to the Cognizant Office of Responsibility. The unique requirements for fire safety, including fire suppression systems and life safety components, are a key issue; however, principles of fire safety applicable to other types of facilities that handle special nuclear materials are available within certain national consensus standards and within the Department of Energy (DOE). Such principles were considered in developing this chapter.

The principles of facility safety, life safety, and fire protection required for nuclear weapons-capable maintenance and storage facilities were developed by collecting and refining criteria from DoD fire protection guidance, munitions safety guidance, and national consensus fire safety standards, including NFPA 801, NFPA 804, and NFPA 805. Also considered were DOE criteria, including DOE O 420.1C, DOE O 440.1B, and DOE-STD-1066-2012.

NOTE: Specific and unique fire protection and life safety criteria have been developed for nuclear weapons-capable maintenance and storage facilities. These criteria would not be appropriate for most DoD buildings. Consequently, the criteria in this document will take precedence in case of conflict with UFC-3-600-01.

8-2 APPLICATION

Studies will be accomplished on all nuclear weapons-capable maintenance and storage facilities as described in the following sections. Following the initial study efforts, if any proposed facility change or modification involves, affects, or impacts systems covered by the studies, they will be updated to include the effect of the modification on the study conclusions and recommendations.

These studies, new or revised, will be used to support or maintain facility certification actions. Facility certification actions will be accomplished in accordance with AFI 63-125.

8-3 FIRE HAZARD ANALYSIS (FHA)

NOTE: Cognizant Offices of Responsibility for this paragraph are AFNWC and AFCEC.

The purpose of the FHA is to comprehensively and quantitatively assess the risk from a fire originating from within individual fire areas in an Air Force facility to ascertain if Air Force fire safety objectives are being met.

8-3.1 FHA References

8-3.1.1 The FHA should include appropriate requirements and guidelines from the most current editions of the following publications:

- UFC 3-600-01
- NFPA 801
- AFMAN 91-201
- AFI 91-202
- Department of Defense Instruction (DoDI) 6055.06
- DoDD 6055.9E
- DoD 6055-09-M
- NFPA 550
- Society of Fire Protection Engineers (SFPE) *Handbook of Fire Protection Engineering*
- NFPA 13
- NFPA 14
- NFPA 72
- NFPA 101
- NFPA *Fire Protection Handbook*

NOTE: Other NFPA standards not included in this list should be considered, when appropriate.

8-3.1.2 With respect to nuclear weapons safety, security, and control, the FHA must be guided by the concepts and requirements contained in the most current edition of applicable publications, including, but not limited to:

- AFI 90-201
- Air Force Policy Directive (AFPD) 91-1
- AFI 91-101
- AFI 91-102
- AFI 91-103
- AFI 91-107
- AFI 91-116
- AFMAN 91-118
- DoDD 3150.02

- DoDM 3150.02
- DoD S-5210.41-M / AFMAN 31-108

8-3.2 Qualifications of FHA Personnel

8-3.2.1 The FHA will be accomplished by one or more qualified engineers.

8-3.2.2 At least one qualified engineer will be a fire protection engineer.

8-3.2.3 At least one qualified engineer will be an engineer who must meet one of the following conditions:

- At least five years of experience in design, construction, operations, or maintenance for civilian-owned or government-owned nuclear reactors or other nuclear facilities.
- At least five years of experience in design, construction, operations, or maintenance of US Navy nuclear-powered reactors.
- At least five years of experience in the design, commissioning, operations, maintenance, or de-commissioning of nuclear weapons.

8-3.2.4 A qualified engineer is defined as an individual meeting one of the following conditions:

- A registered professional engineer (P.E.) who has passed the engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES) in his or her area of expertise.
- An engineer who is not registered but can demonstrate a minimum of 10 years of documented engineering experience in his or her area of expertise, and who has been specifically approved by the Cognizant Offices of Responsibility to serve in the capacity of a qualified engineer.

8-3.2.5 The qualified engineer(s) will be supported by an engineering firm having experience in performing FHAs for a wide range and types of facilities and hazards—especially nuclear hazards. The engineering firm will have employees or ready access to individuals who are knowledgeable of nuclear facility operations, maintenance procedures, equipment design, training of facility personnel, and firefighting procedures. The engineering firm will have employees or ready access to individuals who are knowledgeable of issues unique to nuclear weapons-capable maintenance and storage facilities (e.g., security requirements versus life safety requirements).

8-3.2.6 The qualified engineer(s) accomplishing the FHA will obtain support from other appropriate engineering disciplines as needed, including, but not limited to, fire

protection, nuclear, electrical, mechanical, civil, structural, chemical, and systems engineers.

8-3.2.7 The qualified engineers accomplishing the FHA will consult with appropriate government or national laboratory representatives who are knowledgeable of weapon design and weapon system responses to ensure potential fires will not exceed weapon safety limits.

8-3.3 General FHA Considerations

8-3.3.1 Fire Areas

The focus of the FHA will be the individual fire areas. Fire areas are those areas of the facility that are bounded by fire barriers. Where a facility is not subdivided by fire-rated construction, the exterior walls and roof of the facility will define the fire area.

8-3.3.2 Conflicts

The FHA will identify specific sections of national consensus codes and standards that might be considered in conflict with the nuclear safety and security requirements of the facility. These will be documented within the FHA and alternative measures to achieve fire protection objectives will be recommended where appropriate.

NOTE: Conflicts between the specific requirements of this document and national consensus codes and standards are not required to be documented in the FHA.

8-3.3.3 Air Distribution Systems

The FHA must consider fire propagation and the potential for fire-induced radiological dispersal through the facility's air distribution system. These effects will be considered for both the normal operating mode of the air distribution system as well as operation in alternate modes, including system shutdown that may result from the fire.

8-3.3.4 Flammable and Combustible Materials

The quantity and associated hazards of flammable and combustible materials that can be expected to be found within the fire area will be factored into the analyses. Consideration must also be given to the presence of normal as well as unexpected transient combustible materials associated with the function and operation of the facilities.

8-3.3.5 High-Bay Locations

FHAs for high-bay locations will consider the effects of smoke and hot gas stratification that may occur at some intermediate point below the roof or ceiling. Similarly, the effect of smoke movement through doors and dampers held open by fusible links must be addressed. The impact of the height to automatic fire suppression and detection systems will also be evaluated. A fire model may be necessary to evaluate the response time of the suppression and detection systems at the ceiling of high-bay areas.

8-3.3.6 Natural Hazards

The FHA must consider natural hazards (e.g., earthquake, flood, wind, lightning, wild land fires) as related to their impact on fire safety within the facility.

8-3.3.7 Hostile Act Scenarios

The FHA will consider certain hostile act scenarios (defined by AF/A4SN) and their impact on fire-induced radiological dispersal.

8-3.3.8 Fire Models

Tools that will be used in the development of an FHA include fire models such as those developed by the National Institute of Standards and Technology (NIST); however, the use of such models is predicated on their being conservative and validated. Air Force acceptance of individual models will be considered on a case-by-case basis.

8-3.3.9 Fire Protection: Defense-In-Depth

Fire protection criteria are based on the principle of defense-in-depth. This document supplements and, in some cases, modifies the fire protection requirements of UFC 3-600-01 to meet the unique mission requirements of these facilities. Defense-in-depth is achieved when a balance of each of the following elements is provided in the facility:

- Preventing the initiation of fires
- Rapidly detecting all fires that do occur
- Controlling and promptly extinguishing fires to limit damage, personnel injury, and consequences to acceptable levels
- Providing a level of fire protection for structures, systems, and components so that a fire that is not promptly extinguished will not prevent essential facility functions from being performed and weapon safety limit from being exceeded

8-3.3.10 Life Safety Objectives

The FHA will analyze if life safety objectives are achieved, including:

- Any occupants that are not within the affected fire area are protected to a level such that they can safely exit the facility
- Occupants within the fire area must be protected to a level such that they have a reasonable expectation to safely exit the facility or be able to safely stay within a designated area of refuge
- Life safety configurations must also be arranged to provide adequate protection for essential and emergency response personnel

8-3.4 Determination of FHA Update for Existing Facilities

For existing facilities, the approved FHA will be evaluated by the owning facility program office no later than the end of the fifth calendar year after the date of the last FHA. If no changes have occurred to a maintenance or maintenance and storage facility's baseline configuration or maintenance concept of operations then the owning facility program office may defer the requirement for an FHA update for one additional five-year period by documenting that "no changes have occurred to the facility's baseline configuration or maintenance concept of operations" and update the existing approved FHA with that determination in a memorandum for record signed by the facility program office manager. If no changes have occurred to a storage-only facility's baseline configuration or storage concept of operations then the owning facility program office may continue to defer the requirement for an FHA update for additional five-year periods by documenting that "no changes have occurred to the facility's baseline configuration or storage concept of operations" in a memorandum for record signed by the facility program office manager. If it is determined that changes have occurred to the facility's baseline configuration then a FHA update will be required by a qualified engineer (see paragraph 8-3.5.3). Additionally, an updated FHA may be required when configuration changes are made to the existing facility's structure or systems if the changes have, or may have, impacted the facility's compliance with the fire prevention and fire protection requirements of this document. When updating the FHA for existing facilities, the qualified engineer(s) will contact facility personnel who are knowledgeable of facility maintenance, operations, equipment, training, and procedures. Additionally, the qualified engineer(s) will contact nuclear certification personnel at AFNWC/NTS, HQ AFGSC/A4C, HQ AFGSC/A4W and AFSEC/SEW.

8-3.5 FHA Content

8-3.5.1 Design FHA

During the design phase, the FHA for a new or existing facility must include an assessment of the risk from fire and related hazards (e.g., direct flame impingement, hot gases, smoke migration, firefighting water damage and drainage) in relation to existing or proposed fire safety features to ensure the facility can be safely controlled and stabilized during and after a fire. The Design FHA will be initiated early in the design phase to ensure an acceptable level of protection is being incorporated into the design. The Design FHA will be updated throughout the design phase as significant design changes occur that may affect any individual fire area. This Design FHA will serve as the basis document for the Post-Construction FHA. The level of detail necessary for an acceptable Design FHA is directly related to the complexity of the facility, the scope of the proposed design changes (for existing facilities), and the potential risk to the public and facility personnel. The scope and content of a Design FHA will be limited to those issues that are relevant to the facility. The Design FHA must comprehensively, qualitatively, and quantitatively accomplish the following:

8-3.5.1.1 Assess the potential and probability for fires within each new or modified fire area within a facility.

8-3.5.1.2 Evaluate the effects of possible fires and related perils (e.g., direct flame impingement, hot gases, smoke migration, firefighting water damage) in relation to the capabilities of fire safety features to ensure fire events can be safely controlled and stabilized for each new or modified fire area.

8-3.5.1.2.1 The evaluation will assume all potentially vulnerable systems will be damaged within the fire area. Acceptable exceptions to this assumption are water-filled steel pipes, tanks, and similar components of superior structural integrity with welded fittings and adequate pressure relief. Passive fire protection features, such as blank fire-rated walls, floors, and ceilings, and continuous fire-rated cable wraps, are assumed to remain viable.

8-3.5.1.2.2 The evaluation will determine the effect of possible fires when any single automatic fire detection or fire suppression system is not available to perform its intended function. Active fire protection features, such as fire dampers, window shutters, and self-closing fire doors in fire barrier walls, will also be evaluated using the criteria of a single fire protection feature not being available.

NOTE: This non-availability may result from an equipment failure (non-fire related) or because the fire occurs during a time the system has been disabled for routine maintenance.

If redundant automatic fire protection systems are provided in the area, only the one system or component that causes the most vulnerable condition need be assumed to be unavailable. Passive fire protection features, such as blank fire-rated walls, floors, and ceilings, and continuous fire-rated cable wraps, are assumed to remain viable.

8-3.5.1.3 Model the thermal parameters of fire events for each new or modified fire area that may contain a nuclear weapon and compare the results to weapons safety screening levels. Non-classified weapons safety screening levels (available from the government) must be used in the modeling.

8-3.5.1.4 Evaluate the impact of the facility fire protection and prevention system on nuclear criticality following the fire events and blast events (if applicable) for each new or modified fire area.

8-3.5.1.5 Model the fire events in each new or modified fire area designated as underground or limited egress areas and evaluate the safety to life for occupant egress, including the ability to use designated areas of refuge.

8-3.5.1.6 Establish the probability of resultant injuries to occupants for fire events within each new or modified fire area within a facility.

8-3.5.1.7 Establish the probability of damage to buildings or equipment for fire events within each new or modified fire area.

8-3.5.1.8 Evaluate the impact on mission continuity from the fire events for each new or modified fire area.

8-3.5.1.9 Quantify the costs related to fire damage to buildings or equipment from the fire events for each new or modified fire area.

8-3.5.1.10 For new facilities, determine the fire event creating the maximum credible fire loss (MCFL) and maximum possible fire loss (MPFL) for all analyzed fire events with respect to facility function as well as value.

8-3.5.1.10.1 In determining the MCFL, the basic assumption will be that automatic fire protection and suppression systems function properly as designed but that manual fire suppression activities are not possible for the first 30 minutes of the fire event in any controlled-access areas of the facility.

8-3.5.1.10.2 In determining the MPFL, which might be used by the government to assess the need for fire protection systems, the basic assumption will be that there is no automatic or manual fire suppression.

8-3.5.1.10.3 The loss determination for MCFL and MPFL must include all direct and indirect costs associated with the fire and clean-up operations. Clean-up costs due to radioactive contamination will be based on service-specific historical data or estimated from other historical data (e.g., data used by the DOE).

8-3.5.2 Post-Construction FHA

Prior to operation and certification of a new or modified facility, a Post-Construction FHA must be accomplished. The Post-Construction FHA must include at least the following:

- Evaluation of the as-built construction to ensure the validity of the Design FHA.
- Assessment of facility programs for minimizing the effects of fire on personnel, facilities, equipment, and mission.
- Assessment of organizational response, requirements, capabilities, training, and procedures as related to fire protection and response.
- Assessment of the adequacy of portable fire protection and prevention systems and equipment.

8-3.5.3 Updated FHA for Existing Facility

When required (see paragraph 8-3.4), an updated FHA for an existing facility will include at least the following:

- Evaluation of the design changes to the facility since the last FHA and the potential effects of those changes on nuclear surety and life safety.
- Evaluation of the potential effects of operational changes in weapons handling, maintenance, or storage since the last FHA.
- Assessment of any changes made to organizational response, requirements, capabilities, training, and procedures, as related to fire protection and response, since the last FHA.
- Assessment of any changes to facility programs intended to minimize the effects of fire on personnel, facilities, equipment, and mission since the last FHA.
- Assessment of any changes in portable fire protection and prevention systems and equipment since the last FHA.

8-3.6 Additional Considerations

The FHA must examine compliance and noncompliance in existing and post-construction facilities and will include these elements:

- Recommendations for correction or mitigation of noncompliance; the recommendations must identify specific mitigation strategies for the noncompliance (e.g., the need for a fire suppression system, the type of fire suppression needed, and the water requirement)
- For any noncompliance, the FHA will include a risk assessment of the noncompliance in case the recommendations are not approved for implementation
- Recommendations for improvement of features in compliance
- For recommendations for improvement of features in compliance, the FHA will include a qualitative risk assessment in case the improvement is not approved for implementation

Once approved by the Cognizant Offices of Responsibility, the results of the FHA will take precedence over previous or conflicting design criteria.

8-3.7 FHA Report

As a minimum, the FHA report must contain and document these items:

- All specific evaluations, modeling, analyses, considerations, and other requirements as detailed in paragraph 8-3 of this document
- A description and assessment of general facility construction, including the type, location, ratings (in hours), and construction of fire barriers

- A description and assessment of fire detection and fire suppression systems, equipment, and related components (including, but not limited to, HVAC systems)
- A description and assessment of fire hazards from adjacent facilities and construction, as appropriate
- An inventory of all priority electrical loads (e.g., fire alarm, emergency power) within the fire area that are susceptible to fire damage, including mechanical and electrical systems, which must function effectively during and after a fire event; this will also include an assessment of the adequacy and protection afforded these priority electrical loads
- Critical transformers that, if lost, would have a severe impact on the facility mission
- Emergency lighting illumination levels for security staging and operating locations and firefighting staging and operating locations
- An evaluation of the potential for flame spread, fire spread, and smoke development due to cabling within the facility with respect to the requirements in Chapter 3
- An assessment of fire response and fire response plans, including organization, capabilities, training, and requirements
- An itemization of areas and issues of noncompliance, including the comprehensive and qualitative risk assessment of the noncompliance items if not accomplished
- An itemization of areas and issues in compliance that are recommended as candidates for improvement
- Recommendations for correction or mitigation of noncompliance
- Recommendations for action on candidates for improvement
- A description of any critical process equipment
- A description of any high-value property
- The potential for a toxic, biological, or radiological incident due to fire
- Life safety considerations
- Emergency planning
- Recovery potential
- Exposure to fire potential and the potential for fire spread between two fire areas

8-3.8 Implementation of FHA Results

Project requirements for existing buildings and design adjustments for new facilities are developed based on the results of the FHA or other analyses performed on existing structures and approved by the Cognizant Offices of Responsibility. To the greatest extent practical, the level of protection for existing and new structures should be identical; however, implementing current levels of protection into all existing structures will not be feasible. In these cases, a technical evaluation or other approved analysis can provide to the Cognizant Offices of Responsibility a suitable justification for the acceptability of the existing configuration.

8-4 EMRE SURVEY

NOTE: Cognizant Office of Responsibility for this paragraph is AFSEC.

An EMRE survey is a comprehensive assessment of the EMRE within each facility to ensure that exposures of weapons systems to the EMRE from all equipment installed or used within the facility, individually and collectively, does not result in an overall EMRE that exceeds the weapons stockpile-to-target sequence (STS) levels. The EMRE survey will meet or exceed the requirements and guidelines of the most current edition of AFMAN 91-118, Section 2I, paragraph 2.45.9, and Section 4H, paragraphs 4.8.1.7 and 4.8.1.10 (see paragraph 8-4.1 of this document for other references).

NOTE: An EMRE survey is typically funded by the facility occupant.

8-4.1 EMRE References

The EMRE survey must meet or exceed the requirements and guidelines of the most current edition of these publications. (Other publications may also apply.)

- AFMAN 91-201
- DoDD 6055.9E
- DoD 6055-09-M

The EMRE survey will consider the concepts and requirements with respect to nuclear weapons safety, security, and control as contained in the most current edition of these publications. (Other publications may also apply.)

- AFI 90-201
- AFPD 91-1
- AFI 91-101
- AFI 91-102
- AFI 91-103
- AFI 91-107

- AFI 91-116
- AFMAN 91-118, Section 2I, paragraph 2.45.9, and Section 4H, paragraphs 4.8.1.7 and 4.8.1.10
- DoDD 3150.02
- DoDM 3150.02

8-4.2 Qualifications of Survey Personnel

EMRE calculations (straw-man analysis) during project design should be performed by the electrical engineer on the project.

EMRE surveys for background or at facilities will be accomplished by the 85th Engineering Installation Squadron (EIS) Specialized Engineering Flight, Keesler Air Force Base, Mississippi.

8-4.3 Survey Frequency

8-4.3.1 New Facilities

On all new facilities, a background EMRE survey will be accomplished at the beginning of the design process at the site where the facility is to be built.

During design, analyze anticipated EMRE emitters using straw man data to project anticipated EMRE levels and to adjust facility design, equipment selection, and procedures as necessary to reduce EMRE levels. In these cases, the survey will consist of an analysis of anticipated EMRE emitters using straw man data to project EMRE levels.

8-4.3.2 Post-Construction Survey

Conduct a complete EMRE survey upon activation of the facility to ensure actual levels do not exceed maximum permitted EMRE values.

8-4.3.3 Existing Facilities

The EMRE survey will be accomplished on any existing facility when configuration changes are made to the facility or facility systems or changes are made in the tools and equipment that impact the EMRE. The EMRE survey will help ensure the overall EMRE, as a result of such changes, does not exceed the weapon's STS levels.

8-4.3.4 Renewal

The EMRE survey will be updated on all facilities no later than the end of the fifth calendar year after the date of the last EMRE survey.

8-4.4 EMRE Survey-Specific Requirements

8-4.4.1 EMRE Survey Elements

The EMRE survey must:

8-4.4.1.1 Accomplish discrete tests of all unintentional EMRE emitters used in close proximity to critical equipment within the facility. These unintentional EMRE emitters include, but are not limited to, fluorescent lighting; motors; hand tools; computers and monitors; communication equipment such as phones and intercoms; entertainment devices such as televisions, MP3 players, and radios; and fire alarm control panels.

8-4.4.1.2 Accomplish discrete tests of all intentional EMRE emitters used in close proximity to critical equipment within the facility. These intentional EMRE emitters include, but are not limited to, computers using wireless devices or networks; radio transmitters; motion sensors; and “lossy” antenna distribution systems.

8-4.4.1.3 Measure ambient levels in representative areas and measure specific classes of emitters used in close proximity to critical equipment.

8-4.4.1.4 Perform an external ambient survey outside of the facility to obtain an overview of the typical EMRE levels encountered in the nearby area.

8-4.4.1.5 Evaluate and analyze the results to determine compliance with AFMAN 91-201. Identify compatibility anomalies and make recommendations for mitigating these anomalies.

8-4.4.2 EMRE Survey Report

As a minimum, the EMRE survey report must contain and document these items:

- A detailed list of test equipment with calibration dates
- A detailed list of the equipment tested (including locations, if appropriate for the equipment)
- A testing strategy and survey plan
- A graphical comparison of EMRE from tested equipment in comparison to appropriate STS curves
- A simulated composite EMRE environment to determine the maximum practicable level that could be expected
- Conclusions on any findings and recommendations for corrective measures

8-5 FACILITY CHARACTERIZATION

NOTE: Cognizant Office of Responsibility for this paragraph is AFSEC.

8-5.1 General Requirement

Facility characterization will meet the criteria and requirements of Chapter 2.

NOTE: Facility characterization may be accomplished when deviation from the seven-foot rule as defined in AFMAN 91-201 is proposed. Facilities that have not been characterized must comply with the seven-foot rule. Any deviation from the seven-foot rule requires specific approval of the Cognizant Office of Responsibility.

8-5.2 Specific Requirements

8-5.2.1 Facility characterization will be accomplished:

- By the 85th EIS Specialized Engineering Flight, Keesler Air Force Base, Mississippi
- On all new facilities upon completion of the facility construction
- On existing facilities when specifically approved by the Cognizant Office of Responsibility
- On any facility that has been previously characterized and when configuration changes to the facility or facility systems are made that may have impacted the facility characterization requirements of this document. A qualified electrical engineer will determine if a total or partial revision to the previous facility characterization is required.

8-5.2.2 Facility characterizations will be updated on all facilities no later than the end of the tenth calendar year after the date of the last facility characterization.

8-5.2.3 On facilities that have been characterized, comply with the requirements in AFMAN 91-201, including the requirements for periodic maintenance and inspection. This must include retesting the Faraday shield, bonding, and surge suppression features.

8-6 FIRE DEPARTMENT BASELINE NEEDS ASSESSMENT

NOTE: Cognizant Office of Responsibility for this paragraph is AFCEC.

8-6.1 Baseline Needs Assessment

The base fire department must have a baseline needs assessment that establishes the minimum required capabilities of base firefighting forces. This includes minimum staffing, apparatus, facilities, equipment, training, fire pre-plans, off-site assistance requirements, and procedures. Information from this assessment will be incorporated into the site emergency plan. Baseline needs assessments are approved by the Cognizant Offices of Responsibility.

8-6.2 Updates

Baseline needs assessments for firefighting forces are periodically performed through independent assessors who are regarded as experts in the field. Frequencies of updates are not formally established but updates are performed when there is a significant change in base or facility mission, size, or hazards.

8-7 FIRE PREVENTION PROGRAMS

NOTE: Cognizant Office of Responsibility for this paragraph is AFSEC.

Nuclear weapons-capable maintenance and storage facilities will implement fire prevention programs. Such programs can be part of an overall base fire prevention program or be established as a specialized program for the facility.

At a minimum, the fire prevention program must include:

- Fire department inspections
- Combustible loading limitations and inspections
- Storage criteria
- Use and handling of flammable and combustible liquids
- Use of heat-producing appliances
- Hot work and hot work permits
- Roofing operations permits
- Use of fuel-fired heaters and equipment

8-8 FIRE PROTECTION IMPAIRMENTS AND DEFICIENCIES

NOTE: Cognizant Office of Responsibility for this paragraph is AFCEC.

Nuclear weapons-capable facilities will have implemented fire protection impairment and deficiency programs. These programs can be part of an overall base impairment and deficiency program or be established as a specialized program for the facility.

The programs must include the identification, tagging, and tracking of impaired equipment, and the determination of compensatory fire protection and prevention measures.

The programs will comply with AFI 32-10141.

8-8.1 Application

The programs must apply to all active fire protection systems, including automatic sprinkler systems, fire detection systems, filter plenum fire suppression, and special hazard suppression systems. The application of the program to passive fire protection systems, including fire barriers, dampers, lightning protection components, and fire extinguishers, and to any work activities not directly related to active fire protection systems, may be included at the discretion of the facility manager unless otherwise directed by the Cognizant Offices of Responsibility.

8-8.2 Tracking Requirements

A fire protection system impairments and deficiencies program will be used to track and trend all system failures, planned outages, minor system discrepancies, or removal of systems from active service. Systems removed from service for the purpose of facility demolition must be tracked until demolition completion.

8-8.3 Impairment Coordinator

The facility user will designate an impairment coordinator to track impairments and deficiencies.

CHAPTER 9 FIREFIGHTING GUIDANCE

NOTE: Cognizant Office of Responsibility for this chapter is AFCEC.

9-1 SCOPE

This chapter provides criteria and requirements for developing detailed pre-fire plans. Pre-fire plans are also known as pre-incident plans and the terms can be used interchangeably.

9-2 DEVELOPMENT OF PRE-FIRE PLANS

Detailed pre-fire plans will be developed for all facility areas. The plans will detail the fire area configurations and fire hazards along with any nuclear weapon-related components and fire protection systems and features. Pre-fire plans will be reviewed and, if necessary, updated at least every two years. Pre-fire plans will be available in the security control room.

In developing a schedule for pre-fire plans, these items will be considered:

- Potential life safety hazard
- Facility size and complexity
- Value
- Mission importance
- Presence of hazardous materials
- Susceptibility to natural phenomena

The emergency response organizations must be trained to the pre-fire plan program as well as the individual pre-fire plans.

9-3 ELEMENTS OF PRE-FIRE PLANS

The physical elements of a pre-fire plan are addressed in paragraphs 9-3.1 through 9-3.9.9.

9-3.1 Internal Site Conditions

9-3.1.1 Construction and Building Features

Include information on these features:

- Construction, floor construction, construction of interior walls, suspended ceiling assemblies, raised floors, concealed spaces, windows for rescue, confined space, and fire resistance of structural members
- Area and height

- Building services, including utilities (electric, transformers, emergency power, domestic water, compressed and liquefied gases, steam, and fuels)
- Building features: the structural integrity of walls, roofs, and floors, including added live and dead loads; indications of deterioration and structural weakening and other conditions that would impact fire spread; ability of responding personnel to access the building; and the potential for falling debris

9-3.1.2 Occupant Considerations

The number and type of occupants in a facility will have a substantial impact on the pre-fire plan. Critical information to be gathered includes the expected number of occupants and their duties within the facility.

9-3.1.3 Life Safety Considerations

Life safety considerations are a priority that must be addressed to permit responding emergency service personnel to assist immediate and safe evacuation of facility personnel. Considerations must also be included on the actions of the facility security personnel and their duties during emergency events.

Unique life safety egress facility configurations must be documented within the pre-fire plan.

9-3.2 External Site Conditions

9-3.2.1 Fences

The height and construction of fences will be noted. Security measures for these fences will also be included.

9-3.2.2 Exposures

The grounds surrounding the facility will be evaluated to identify buildings, structures, equipment, and storage that could be exposed by an incident.

9-3.3 Communications Impact

Include the results of a functional test of the communications system as it will be used in an emergency. This information is critical for many of the unique facilities across the Air Force.

Data regarding communications impact that will be recorded include the following:

- Interference or poor coverage as a result of construction or radio system design, including coverage in below-grade and shielded areas, interiors of large structures, and the upper floors of high-rise buildings
- Assignment of radio channels
- Other supplemental communications available within or external to the facility

9-3.4 Security Data

Information about security measures will be included to ensure prompt ingress to the facility at all times on a need-to-know basis. Comply with security classification requirements for the installation.

9-3.5 Personnel Interactions

The interaction between firefighting personnel and the facility and external security personnel must be addressed within the pre-fire plan. In a number of situations, fire forces and security forces may have conflicting missions during an emergency. These situations must be addressed within the pre-fire plan so agreements between the two groups may be established in advance. It is also advisable to practice drills that implement these agreements to ensure they can be carried out in the proper manner.

9-3.6 Defend-in-Place Methods

Defend-in-place methods to be used because complete evacuation is either impossible or impractical will be noted within the pre-fire plan. Comply with security classification requirements for the installation.

9-3.7 Hazards Information

9-3.7.1 Hazardous Materials Coordinator

If a facility has an individual or department that is responsible for maintaining material safety data sheets (MSDS) and inventories of hazardous materials, the pre-fire plan will contain information on contacting this individual. If a facility or base has an internal computer-based hazardous materials system, means to access this system will be detailed within the plan.

9-3.7.2 Special Hazards

Special hazards within the facility will be documented. These hazards may include flammable and combustible liquids, explosives, toxic agents, radioactive materials (ionizing radiation and contamination), reactive chemicals, electrical and mechanical hazards, and special hazards.

9-3.8 Incident Operations

The plan will address the standard response to the facility and the incident command system as it applies to the building.

9-3.9 Fire Protection Systems Information

Information on fire protection systems (detection and suppression) will be determined in the development of the pre-fire plan. The required information is addressed in paragraphs 9-3.9.1 through 9-3.9.9.

9-3.9.1 Information on Primary Water Supply

Included will be the required fire flow for the building based on criteria developed in the approved FHA. Evaluation of the water supply may require testing of the water system or obtaining information from the installation engineering branch.

9-3.9.2 Fire Department Connections (FDC)

Data concerning the FDCs will be included within the plan. The information required is the physical location, areas covered, and the type of system supplied.

9-3.9.3 Fire Pumps

Data regarding facility fire pumps will be provided that includes the location, type of driver, capacity, water source, operation (automatic, manual, or remote manual), areas served, and contact information for the department responsible for maintenance and operation during an emergency.

9-3.9.4 Fire Hydrants

Data regarding facility fire hydrants will be provided that includes the location and type of each hydrant, number and diameter of each outlet, size of the water main location, and the approximate flow at 20 pounds per square inch gauge (psig) (138 kilopascals gauge).

9-3.9.5 Automatic Sprinkler Systems

Data concerning automatic sprinkler protection will be documented, including the type of system (wet, dry, pre-action), hazard classification of the system and occupancy, location of all controlling valves for the system, location and identification of all risers, location of audible flow alarms, and extent of the sprinkler coverage.

9-3.9.6 Standpipe System

Data concerning standpipe systems will be documented that includes the type of system, location and size of outlets, pressure available at the hose outlets, water supply, location of isolation valves, and the location and identification of all risers.

9-3.9.7 Protective Signaling Systems

Data for the facility fire alarm systems will include the method of system activation, areas of coverage, location of the fire alarm control panel and the remote fire alarm panels, type of detectors, any public address system or voice alarm capability, and the method and extent of occupant notification. Information on the DoD-required mass notification system (MNS) will be included, including details on the configuration of the system (e.g., combination system with the fire alarm system or stand-alone system).

9-3.9.8 Special Hazard Protection Systems

Data for special hazard fire protection systems that will be included within the pre-fire plan include the type of system, hazard, or area protected by the system, location of control panels, activation method, personnel hazards of the protective agent (if any), and method and extent of occupant notification.

9-3.9.9 Smoke Management

Data regarding any smoke management systems will be included. This may include the type of system, location of the areas served by the system, and location of the primary control panel for the system. This will also include any portable ventilation equipment or systems (see Chapter 12).

9-4 ROBOTIC FIREFIGHTING RESPONSE VEHICLES

The use of robotic firefighting response vehicles located within areas capable of maintaining or storing nuclear weapons may be considered when necessary to reduce the response time to an incident. Use of such vehicles is not a general practice and must not be implemented without prior approval of the Cognizant Office of Responsibility. Requests to use robotic firefighting methods will evaluate operational impacts such as training, staffing levels, initial and recurring equipment costs, required supplies and costs, environmental impacts, EMRE, and other related issues.

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CHAPTER 10 TEMPORARY INTERIOR CONSTRUCTION

NOTE: Cognizant Office of Responsibility for this chapter is AFSEC.

10-1 SCOPE

This chapter provides criteria and requirements for temporary interior construction. For the purposes of this document, “temporary” is defined as any structure in place for less than 12 months. Any temporary construction features not covered by this chapter will, by default, be required to meet the criteria of permanent construction.

10-2 FIRE-RETARDANT WOOD

If wood is used for interior temporary construction, the wood must be noncombustible, limited-combustible, or fire-retardant, pressure-impregnated wood. Fire-retardant coatings are not acceptable on walking surfaces or surfaces subject to mechanical damage. Industrial safety personnel will be contacted prior to coating scaffolding with a fire-retardant coating since the coating may have an effect on the wood that must be evaluated.

10-3 FIRE-RETARDANT TARPAULINS

The use of interior temporary coverings will be limited to special conditions for which interior temporary coverings are necessary, e.g., contamination control structures (interior tents). They must be constructed of approved fire-retardant plastics or tarpaulins and meet the testing requirements of NFPA 701.

10-4 FIRE EXTINGUISHERS

All interior temporary construction must have the appropriate type and size of portable fire extinguisher, spaced in accordance with NFPA 10.

10-5 TEMPORARY ELECTRICAL WIRING

The potential for ignition of flammable materials will be minimized by requiring that all temporary electrical wiring:

- Be kept to a minimum
- Be suitable for the location
- Be installed and maintained in accordance with NFPA 70 or IEEE C2, as appropriate
- Be arranged so energy can be isolated by operation of a single switch
- Be arranged so energy can be isolated when not needed

10-6 TEMPORARY HEATING APPLIANCES

10-6.1 Types Permitted

Only safely installed, approved, electrically powered heating devices will be used in all locations. All heating devices must comply with AFI 91-203.

10-6.2 Automatic Shutdown Feature

Heating devices must be situated so they are not likely to overturn and will be provided by the factory with an automatic shutoff feature per AFI 91-203.

10-6.3 Monitoring and Maintenance

Temporary heating equipment, when used, will be monitored and maintained by properly trained personnel.

10-7 PLASTIC SHEATHING

If plastic sheathing is used for temporary construction or containment structures (plastic tents), it must meet the testing requirements of NFPA 701.

CHAPTER 11 FIRE PROTECTION SYSTEMS

NOTE: Cognizant Office of Responsibility for this chapter is AFCEC.

11-1 SCOPE

This chapter includes the criteria and requirements for fire detection, fire suppression, fire alarm, and mass notification systems (MNS) applicable to nuclear weapons-capable maintenance and storage facilities.

11-2 GENERAL REQUIREMENTS

Fire protection systems will be designed in accordance with UFC 3-600-01, except as modified in this document.

Fire suppression and fire detection systems will be configured to coincide with the blast zones (if provided) and HVAC zones unless approved by the Cognizant Office of Responsibility.

NOTE: This requirement is intended to reduce the number of penetrations through the blast walls by the fire protection equipment and may also improve the survivability of the fire protection systems.

11-3 LISTED EQUIPMENT

Fire protection equipment must be listed or approved for its intended service by a nationally recognized testing laboratory (NRTL), except for certain equipment for which such listing or approval is not practical because of the unique nature of nuclear weapons-capable facilities. For example, a blast door or security door, by nature of its construction, might serve adequately as a fire door but has never been listed or approved for such a purpose. In these cases, the use of non-listed or non-approved equipment will be approved by the Cognizant Office of Responsibility.

11-4 WATER SUPPLIES

11-4.1 Two Independent Sources

At least two independent sources of water must be provided, each of not less than 300,000 gallons (1,135,600 liters). A water supply independent of the potable water supply is not required for water-based fire suppression systems unless so specified in the FHA. Examples of independent water supply systems include:

- Base/municipal potable water system capable of supplying not less than 300,000 gallons (1,135,600 liters) in one elevated tank (can count as one independent source of water)

- Base/municipal potable water system capable of supplying not less than 300,000 gallons (1,135,600 liters) in each of two or more elevated tanks (can count as two independent sources of water)
- Base/municipal potable water system supplied by a reservoir exceeding 1,000,000 gallons (3,785,400 liters), with at least two independent supply connections from the reservoir to the potable water system (can count as two independent sources of water)
- One elevated water tank with a capacity of 300,000 gallons (1,135,600 liters) (can count as one independent source of water)
- Several smaller elevated water tanks with a combined capacity of 300,000 gallons (1,135,600 liters) supplying the same water main (can count as one independent source of water)
- Two elevated water tanks, each with a capacity of 300,000 gallons (1,135,600 liters) (can count as two independent sources of water)
- Two ground-level water tanks, each with a capacity of 300,000 gallons (1,135,600 liters), with dedicated fire pumps (can count as two independent sources of water)
- Pressure tanks internal to the facility (e.g., when the FHA permits a tank volume of less than 300,000 gallons [1,135,600 liters]).

11-4.2 Interconnection

The water supplies must be interconnected such that if fire pumps are used, they can take suction from any source. A failure in one source must not cause both sources to fail.

11-4.3 Replenishing Supply

The water source for replenishing the supply for fire protection in at least one tank must be capable of restoring the tank within an eight-hour period.

11-4.4 Multiple Water Supplies

If multiple water supplies are used, each water supply must be connected to the fire main by a separate connection that is arranged and valve-controlled to minimize the possibility of multiple supplies being simultaneously impaired. Generally, the two supplies should be connected such that they are hydraulically remote from each other.

11-4.5 Water Supply Limitations

Provide a water supply that will not be susceptible to bio-fouling, scaling, microbiologically induced corrosion (MIC), or sedimentation. The tanks must not be supplied by an untreated, raw water source.

11-5 FIRE SUPPRESSION SYSTEMS

11-5.1 Water-Based Fire Suppression Systems

An automatic water-based suppression system will be provided in all areas of the facility and must be designed to control and suppress a fire based on the fire hazard in each area. This analysis will be included in the FHA. Refer to Chapter 12 for fire suppression systems installed to protect filters that collect combustible material.

NOTE: Based on the hazards generally found within nuclear weapons-capable maintenance and storage facilities, it is expected that a wet-pipe type of automatic sprinkler system or water mist fire suppression system will be needed in most areas, with a dry-pipe type of system used in those areas subject to temperatures below or approaching freezing (e.g., truck bays, earth-covered magazines). Firefighting foam-based fire suppression systems are expected to be required in special areas such as refueling areas or areas where the FHA identifies hazards from combustible or flammable liquids.

11-5.1.1 Hardening of System

Suppression systems in weapon handling areas must be hardened against possible internal or external damage to the building (e.g., breach control valves, redundant sprinkler headers). See Chapter 7 for additional requirements for individual blast zones when it is necessary to prevent subsequent nuclear criticality events following a blast.

NOTE: Appendix B provides guidance on the selection and design of hardened fire protection systems.

11-5.1.2 Calculations

Domestic water distribution systems that also serve fire protection requirements will be designed to simultaneously meet the calculated fire protection demand (e.g., sprinklers and hose streams) and the peak domestic demand. When not otherwise identified, the peak domestic demand will be calculated as 2.5 times the calculated average daily demand plus appropriate special demands. The domestic water distribution system will be capable of meeting this combined demand at a minimum residual pressure of 20 pounds per square inch (psi) (137.9 kilopascals) at ground elevation for a period of not less than two hours.

11-5.1.3 Looped System

Water-based fire suppression systems must be looped with at least two independent means of water supply into the fire suppression system. The supply points must be separated so that external damage to one supply point (e.g., mechanical damage by a backhoe) must not simultaneously damage other supply points. This separation will be no less than 20 feet (6.1 meters).

11-5.1.4 Piping Under Buildings

Water supply piping must not be located under buildings. The water distribution piping to a building may penetrate the building slab at a location as close as practical to the building's exterior wall.

11-5.1.5 Sectional Control Valves

Sectional control valves will be provided to isolate damaged portions of the looped fire suppression system while permitting undamaged portions to remain in service.

11-5.1.6 Outside Screw and Yoke (OS&Y) Valve

In addition to an exterior isolation valve, each system must be equipped with an approved OS&Y gate valve or other approved interior isolation valve.

11-5.1.7 Location of Risers and Alarm Valves

Sprinkler system risers and alarm valves will be located as close as practical to a building or fire zone entry point intended for access by responding emergency service personnel.

11-5.1.8 Independence

The piping serving each zone of an automatic water-based suppression system must be independent from piping to other zones.

11-5.1.9 Alarm Annunciation

Each fire suppression system will be equipped with approved alarming devices that will annunciate an alarm in a constantly attended area (e.g., installation fire department) and will activate internal and external fire alarms in the facility.

11-5.1.10 Domestic Water

Within the facility, domestic water will be supplied to the greatest extent practical by a separate service line and not be designed as a combined fire protection and potable water service or as a combined process and potable water service. Where combined fire and domestic-process water systems are necessary (e.g., to reduce penetrations through blast containment walls), the distribution piping must be provided with isolation valves so domestic or process systems can be isolated from the fire protection system.

11-5.2 Foam Fire Suppression Systems

Foam fire suppression systems designed in accordance with NFPA 11 will be used where flammable or combustible liquids are of significant concern and in other areas as specified in the FHA.

11-5.3 Water Mist Systems

Water mist systems designed in accordance with NFPA 750 will be used in nuclear weapons-capable maintenance and storage facilities in lieu of automatic sprinklers when specified in the FHA.

11-5.4 Fire Suppression Systems for Specific Hazards

11-5.4.1 Enclosed Vehicle Loading Docks

Enclosed vehicle loading docks must be provided with automatic fixed water-based suppression systems. Automatic sprinkler systems must be designed for a density of no less than 0.30 gallon per minute per square foot (12.2 liters per minute per square meter). The area of the entire vehicle loading dock or 5000 square feet (465 square meters) (whichever is less) will be considered the sprinkler design area unless otherwise approved by the Cognizant Office of Responsibility.

NOTE: Generally, it is expected that these enclosed vehicle loading docks will be protected with dry-pipe sprinklers.

11-6 SEISMIC CAPABILITIES

The water supply systems will be capable of supplying water to automatic water-based fire suppression systems, standpipes, and hose stations in all areas designated for the transportation, storage, and maintenance of nuclear weapons following a design basis earthquake.

11-7 SUPPLY MAINS AND HYDRANTS

11-7.1 Yard Fire Main Loop

11-7.1.1 Design and Installation

An underground yard fire main loop will be designed and installed in accordance with NFPA 24. The loop will be sized to accommodate emergent mission requirements.

Design of the pipe and provision for water treatment must consider the potential for tuberculation and MIC. Means for easily inspecting and flushing the systems will be provided.

11-7.1.2 Isolation

Means will be provided to isolate portions of the yard fire main loop for maintenance or repair without simultaneously shutting off both supplies to fixed fire suppression systems and fire hose stations. Approved visually indicating sectional control valves such as post-indicator valves will be provided to isolate portions of the main for maintenance or repair. Isolation valves must be configured so that no more than five connections (sprinkler systems, hydrants, or hose connections) are impaired at any one time.

11-7.1.3 Headers

Each automatic suppression system and standpipe will be supplied from two physically separated headers supplied by the yard fire main loop. Schedule 40 or thicker steel piping and fittings meeting the requirements of American Society of Mechanical Engineers (ASME) B31.1 will be used above ground for the headers (up to and including the first valve) supplying the automatic suppression systems where such headers are part of the seismically analyzed hose standpipe system. Where provided, such headers will be considered an extension of the yard main system. Each sprinkler and standpipe system will be equipped with an OS&Y gate valve or other listed or approved shutoff valve.

11-7.2 Hydrants

11-7.2.1 Location

Hydrants will be located every 250 feet (76 meters) apart on the yard main system when the yard loop also supplies water to above-ground buildings that support the underground facility. Valves will be installed to permit isolation of outside hydrants from the fire main for maintenance or repair without interrupting the water supply to automatic or manual fire suppression systems.

11-7.2.2 Compatibility

Threads compatible with those used by local fire departments will be provided on all hydrants.

11-8 STANDPIPES AND HOSE STATIONS

11-8.1 Standpipe Locations

Class I dry standpipes designed in accordance with NFPA 14 will be provided within each fire area and within each enclosed vehicle loading dock.

11-8.2 Standpipe Connections

Fire department connections to the standpipes will be located near the locations of entry to the fire area that will be used by emergency responders. Connections will be

provided in stairwells in multi-story facilities. The size and type of threads on the standpipe connections must be compatible with the equipment used by the fire department. A fire hose station will be installed immediately outside of the security control room (see Chapter 5).

11-8.3 Hose Station Locations

Hose stations or a mobile means of providing hose and associated equipment, such as hose carts or trucks, will be provided in all fire areas designated for the transportation, storage, or maintenance of nuclear weapons.

11-8.4 Water Flow Rate and Nozzle Pressures

Water flow rate and nozzle pressures as determined in the FHA must be provided to hose stations.

NOTE: Hose station pressure reducers may be needed for the safety of fire department personnel as specified in the FHA.

11-8.5 Hose Nozzles

The types of hose nozzles to be located at each hose station will be based on the fire area's particular fire hazards and on the operational requirements of the fire department. Hose nozzles must have shutoff capability and be able to control water flow from fully open to fully shut. Hoses and nozzles may be omitted at locations where so documented in the FHA.

NOTE: The commonly used combination spray and straight-stream nozzle should not be used in areas where a straight stream could cause unacceptable damage or create an electrical hazard to firefighting personnel. Approved electrically safe, fixed fog nozzles should be provided at locations where high-voltage electrical shock hazards could exist.

11-9 VALVES

11-9.1 Inspection and Supervision

All fire protection water supply and fire suppression system control valves must be supervised by one of the following methods:

- Electrical supervision with audible and visual signals in the security control room or other suitable constantly attended location.
- Locking valves in their normal position when so documented in the FHA. Keys will be controlled and made available only to authorized personnel.
- Sealing valves in their normal positions when so documented in the FHA. This option will be utilized only where valves are located within fenced areas or under the direct control of approved facility personnel.

11-9.2 Operators

Operators (e.g., hand wheels) of valves that require manual manipulation must be readily accessible. If the hand wheel is located more than 5 feet (1.5 meters) above the floor or ground, the hand wheel must be provided with either a chain operator or a permanent platform. The platform must be of sufficient size to allow the operator to safely perform the manual action.

11-10 FIRE PUMPS

Fire pumps are not required for nuclear weapons-capable maintenance and storage facilities when reliable means of meeting the fire protection demands are provided and when the omission of the fire pumps is approved by the Cognizant Office of Responsibility.

11-10.1 Design and Installation

Fire pumps must be designed and installed in accordance with NFPA 20 to ensure that at least100 percent of the required flow rate and pressure are available, assuming failure of the largest pump or pump controller. The flow requirements will be met based on 100 percent of the capacity of the pump (not 150 percent as is commonly used in other types of facilities).

11-10.2 Configuration

11-10.2.1 Multiple Facilities

Fire pumps may be configured to serve more than one nuclear weapons facility when approved by the Cognizant Office of Responsibility.

11-10.2.2 Number of Pumps

For maximum reliability, three fire pumps will be provided so that two pumps meet the maximum demand plus hose streams. When approved by the Cognizant Office of Responsibility, use of two fire pumps is an acceptable alternative, provided either of the fire pumps can supply the maximum demand plus hose streams at no more than 120 percent of the fire pump’s rated capacity.

11-10.2.3 Flow Testing

Fire pumps will be configured to permit ease of flow testing. Provide a test discharge header that is piped back into the tank or provide piping to a location where the test nozzles can be flowed with minimal operational impact (e.g., into a pond or open field).

11-10.2.4 Separation of Pumps

Each pump and its driver and controls must be separated from other fire pumps by 2-hour-rated fire barriers and also from the rest of the facility by 2-hour-rated fire barriers.

11-10.2.5 Manual Shutdown

Fire pumps must be provided with automatic start but only manual shutdown. The manual shutdown must be located at the pump controllers. A remote manual start is permitted in addition to the automatic start.

11-10.2.6 Sectionalizing Valves

Individual fire pump connections to the yard fire main loop will be provided and separated with sectionalizing valves between connections such that loss of one fire pump connection to the loop can be isolated without isolating the other pumps.

11-10.2.7 Jockey Pump

A method of automatic pressure maintenance of the fire protection water system (commonly referred to as a jockey pump) must be provided independent of the fire pumps.

11-10.2.8 Alarm Annunciation

Means will be provided to immediately notify a constantly attended location (e.g., installation fire department) of the operation, failure, or receipt of supervisory signals of the fire pumps.

11-11 GASEOUS FIRE SUPPRESSION SYSTEMS

An automatic total flooding or local application gaseous fire suppression system may be installed to supplement but not replace the required automatic water-based suppression system. The requirement for such a system must be approved by the Cognizant Office of Responsibility for the protection of unique situations or to address unique hazards. The system will be designed and installed in accordance with NFPA 2001.

11-11.1 Annunciation

Operation of gaseous fire suppression systems will annunciate an alarm in a constantly attended location.

11-11.2 Ventilation System Design

Ventilation system design must prevent space over-pressurization during agent injection and provide adequate sealing to prevent loss of agent.

11-11.3 Disarming Device

Provisions for locally disarming automatic gaseous suppression systems will be secured and maintained under strict administrative control. Activation of the disarming device will initiate a supervisory alarm on the fire alarm control panel.

11-11.4 Prohibited Systems

Installation of carbon dioxide, Halon 1211, and Halon 301 systems are prohibited.

11-11.5 Global Warning Potential

Procurement of hydrofluorocarbon gases with high global warming potential are to be avoided, when possible, in accordance with Federal Acquisition Regulations.

11-12 SMOKE DETECTION SYSTEMS

An approved smoke detection system is required in all areas of a facility where nuclear weapons are stored, inspected, or maintained in addition to the automatic suppression system. Also, smoke detection will be provided in the security control room complex (see Chapter 5), sleeping rooms, computer or information technology rooms, and in the vicinity of the fire alarm control panel (FACP), in addition to the automatic suppression system. An approved smoke detection system is not required in support areas (e.g., offices, mechanical spaces, corridors) where an automatic water-based fire suppression system has been provided (see paragraph 11-5). Appliances and other smoke detection equipment will be installed in accordance with NFPA 72 and UFC 3-600-01.

NOTE: An air-aspirating type of ultrasensitive smoke detection (i.e., very early smoke detection) or other smoke detection technology (e.g., open-area light-scattering smoke detection) should be used in areas designated as approved for the storage of nuclear weapons when EMRE requirements can be met (refer to Chapter 8).

11-13 FIRE ALARM SYSTEMS AND MASS NOTIFICATION SYSTEMS (MNS)

A combination system serving as the fire alarm system and MNS will be installed in accordance with UFC 3-600-01 and UFC 4-021-01.

11-13.1 Voice Communication

Means will be provided to allow a person observing a fire at any location in the facility to quickly and reliably alert the appropriate personnel using voice communication to the security control room or other suitable constantly attended location.

11-13.2 Signal Transmission

Signals will be transmitted to a constantly attended location from which required notifications and emergency response can be initiated. All signals must be permanently recorded in accordance with NFPA 72. These signals will include fire, trouble, and supervisory signals, and include at least the following:

- Actuation of any fire detection device
- Actuation of any fixed fire suppression system
- Actuation of any manual fire alarm station

- Starting of any fire pump
- Actuation of any supervisory device or signal
- Indication of alarm system trouble condition

11-13.3 Fire Department Notification

Means will be provided to promptly notify the fire department of any fire emergency in such a way as to allow the fire department to determine an appropriate course of action.

11-13.4 Security Forces Notification

Means will be provided to promptly notify the security forces of the nuclear weapons-capable maintenance and storage facility of any fire emergency in such a way as to allow the security forces to determine an appropriate course of action.

11-14 PORTABLE FIRE EXTINGUISHERS

See Chapter 5.

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CHAPTER 12 HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

NOTE: Cognizant Office of Responsibility for this chapter is AFCEC.

12-1 SCOPE

This chapter includes the criteria and requirements for HVAC applicable to nuclear weapons-capable maintenance and storage facilities.

12-2 DESIGN CONSIDERATIONS

12-2.1 Design of the System

HVAC systems for nuclear weapons-capable maintenance and storage facilities must be designed to meet the requirements of UFC 3-400-02, UFC 3-401-01, and UFC 3-410-01.

Suitable design of the ventilation system can limit the consequences of a fire by preventing the spread of the products of combustion to other fire areas. The design of the ventilation system must provide a means to ventilate, exhaust, or isolate the fire area as necessary, and consideration must be given to the consequences of failure of the ventilation system due to fire, causing loss of control for ventilating, exhausting, or isolating a given fire area.

12-2.1.1. The capability to ventilate, exhaust, or isolate is particularly important in underground nuclear weapons-capable maintenance and storage facilities to ensure the habitability of rooms and spaces that will remain occupied throughout the fire emergency (e.g., security control rooms). Areas of refuge also require particular attention since these are designated locations designed to help occupants survive for a specified period of time if they become trapped by a fire.

12-2.1.2. Automatic damper closure or shutdown of ventilation systems must be designed based on considerations of nuclear safety, nuclear security, and the life safety of personnel.

12-2.1.3. Facilities will be provided with 100 percent redundant chiller systems for those areas of the facility where lack of cooling could result in loss of human life or serious injuries, or result in serious mission or security issues.

12-2.1.4. In addition to the normal HVAC function, ventilation systems will also protect against chemical-biological (CB) agents when required by the Cognizant Offices of Responsibility.

12-2.2 Balanced Air Differentials

Ventilation of a nuclear weapons-capable storage facility involves balanced air differentials between building or blast zones, comfort ventilation, and heat removal from areas where heat is generated by equipment. This need for ventilation also includes fire

area isolation and smoke removal equipment, and may include equipment for high efficiency particulate air (HEPA) filtering of radioactive particulates.

12-2.3 Ventilation Design Standards

The design standards of the ventilation system will be in accordance with UFC 1-200-01.

12-2.4 Configuration

HVAC zones, fire areas (or zones), and blast zones (if used) should be arranged to coincide with each other (refer to Chapters 7 and 11).

12-3 INTERCONNECTIONS

Interconnections of individual fire areas via the ventilation system must be kept to a minimum. If an interconnection is made, it must be properly protected by fire stopping, fire and smoke dampers, and blast containment, as appropriate.

12-4 PORTABLE VENTILATION EQUIPMENT

In the event that fixed ventilation systems malfunction or are damaged and not capable of removing smoke and heat, portable ventilation equipment must be available. This equipment will be staged in the facility or be verified as readily available from the installation fire department. Sizing of the portable equipment and means to provide any required electrical power must be considered in the FHA and documented within the fire pre-plan.

12-5 HVAC INTAKE AND OUTLET LOCATIONS

HVAC intakes must be located and protected to prevent the accidental or intentional introduction of harmful gases or other materials.

Intakes and outlets for air-cleaning systems must be located to reduce the potential for the spread of radioactive contamination during maintenance.

12-6 FIRE, SMOKE, AND COMBINATION FIRE AND SMOKE DAMPERS

12-6.1 Fire Area Boundaries

Dampers will be provided at those fire area boundaries required to have a fire resistance rating of greater than 1 hour for both ventilation duct penetrations and air transfer openings. Where shutdown of the ventilation system is not permitted due to operational or security requirements, fire dampers will not be required for ventilation duct penetrations and an alternative means of protecting against fire propagation must be provided.

NOTE: This section is intended to address fire barriers within blast zones. Interconnections between blast zones are strongly discouraged.

NOTE: The need for automatic dampers and ventilation system shutdown can be minimized by installing separate ventilation systems for each fire area and blast zone or by installing fire-resistive ducting enclosures that provide the required fire barrier while passing through adjacent areas.

12-6.2 Fire Rating

Dampers having a rating of 1.5 hours must be installed where ventilation ducts penetrate fire barriers having a required fire resistance rating of 2 hours. Where ventilation ducts penetrate required 3-hour fire barriers, approved dampers having a fire protection rating of 3 hours must be installed.

12-6.3 Access

Access will be provided to ensure the damper can be properly and easily inspected, tested, and maintained, with particular consideration for the required periodic replacement of the damper's thermal elements.

12-6.4 Installation in Fire Barriers

Dampers will be installed directly into the fire barrier wall in accordance with the manufacturer's requirements. Dampers will be equipped with visible indicators to show damper position.

12-6.5 Listing

Dampers must be designed and installed in accordance with their listing and, where possible, installed in a configuration such that air movement in the duct assists in closing the damper.

12-7 FILTERS

12-7.1 Pre-filters

Air pre-filters located upstream or as part of the final HEPA filter exhaust plenums will be listed as Class 1 air filter units as tested in accordance with UL 900.

12-7.2 HEPA Filters

When used in nuclear ventilation exhaust systems, HEPA filters must meet the requirements for HEPA filters in ASME AG-1, Section FC, and be listed as a "high-efficiency, particulate, air filter unit" as tested in accordance with UL 586.

12-7.3 Self-Cleaning Filters

Self-cleaning filters are not permitted.

12-7.4 Spare Filters

At least a 100 percent supply of specialized spare filters, such as HEPA filters, will be maintained.

12-7.5 Noncombustible Materials

Roughing or pre-filters, where necessary, must be constructed of noncombustible materials.

12-7.6 Filter Framing Systems

Filter framing systems may be constructed of combustible material provided that the material has a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

12-7.7 Filter Plenum Fire Separation

Filter plenums located inside nuclear weapons-capable buildings must be separated from all parts of the facility by 2-hour fire-rated construction.

12-7.8 Small Filter Plenums

Small filter plenums that serve as a final filter and have a leading surface area of 16 square feet (1.5 square meters) or less need not be separated by fire-rated construction from other parts of a facility or be located in a separate fire-rated enclosure if the filter plenum is located in an area provided with an automatic sprinkler system designed and installed in accordance with UFC 3-600-01.

12-7.9 Fire Suppression Systems

12-7.9.1 Fire suppression systems will be installed to protect filters that collect combustible material.

12-7.9.2 Where combustible filters, combustible particulates, or combustible ductwork (e.g., fiberglass-reinforced plastic) is present in the ventilation system, fire suppression systems must be provided. Additional fire protection features will be provided as appropriate for the fire hazard and the requirements documented in the FHA.

12-7.9.3 Fixed water spray systems must be provided for charcoal absorber beds containing more than 100 pounds (45.4 kilograms) of charcoal.

12-7.9.4 Automatic and manual water deluge spray systems will be provided inside all final filter plenums for protection of the filters where they have a leading filter surface area greater than 16 square feet (1.5 square meters).

12-7.9.5 Deluge spray sprinkler systems must operate upon activation of the fire alarm system heat detectors or pilot sprinklers located in either the final ducting or filter plenum housing. Manual activation will also be provided.

12-7.9.6 The design of the water deluge spray systems must reflect the potential for filter failure mechanisms, such as filter media damage resulting from weakened media due to water absorption and excessive differential pressures during water discharge.

NOTE: Such filter failure mechanisms can be significantly mitigated by throttling back fan controls to reduce filter pressure or by providing redundant filters.

12-7.9.7 Automatic deluge spray systems will be designed per the applicable provisions of NFPA 13 and NFPA 15, and as follows:

- Water spray density will be 0.25 gallon per minute per square foot (10.2 liters per minute per square meter) over the entire filter area or 1 gallon per minute (3.8 liters per minute) per 500 cubic feet per minute (14.2 cubic meters) of air flow, whichever is greater.
- Spray sprinklers must be of the deluge type.

12-7.9.8 The spray pattern of the deluge sprinklers must be in the form of a downward vertical water curtain approximately 6 inches (15 centimeters) in front of the pre-filter or demister. In addition, deluge sprinklers must be spaced so that each sprinkler does not exceed 4 lineal feet (1.2 lineal meters) of curtain coverage.

12-7.9.9 Manual spray systems must be designed per NFPA 15 with these specific requirements:

- Water spray density will be 0.25 gallon per minute per square foot (10.2 liters per minute per square meter) over the entire filter area.
- Nozzles will be deluge spray nozzles that form a full-circle, solid-cone discharge.
- Spray nozzles will be horizontally directed at the face of the first series of HEPA filters so all areas of the first stage filters and framing support system are wetted.
- Activation will be by activating the deluge valve or by opening a normally closed valve. Control devices to activate the manual spray system will be provided in the process operator's control room or other locations accessible to emergency response personnel. When a deluge valve is

used, manual activation may also be provided at the location of the deluge valve.

12-7.9.10 Water for the deluge spray systems must be provided by two separate water supply connections for reliability.

12-7.9.11 Automatic and manual water spray system water supplies will be hydraulically calculated. They must be capable of supplying a simultaneous flow of water for two hours to the automatic and manual water spray systems as well as the overhead ceiling automatic sprinkler systems in the fire area providing air to the HVAC plenum.

12-7.10 Demisters

12-7.10.1 Where automatic deluge spray systems are installed in filter plenum enclosures that do not contain pre-filters, metal demisters will be installed downstream of the automatic deluge spray sprinklers and upstream of the first series of HEPA filters.

Where automatic deluge spray systems are installed in the final filter plenum enclosures that contain pre-filters, water spray deluge sprinklers will be located upstream from the pre-filters.

NOTE: In this configuration, the pre-filters act as a demister.

Demisters must be located as far away as practical from HEPA filters but no closer than 36 inches (91 centimeters), and at approximately 6 inches (15 centimeters) from the deluge spray sprinklers.

12-7.10.2 Demisters will have an approximately 100 weight percent efficiency for water drops 50 microns and larger. They will have efficiency greater than 99 weight percent for 1 to 50 microns when air flow velocities are present of 500 to 600 feet per minute (150 to 185 meters per minute), or at operating air flow velocities with the deluge system operating water flow delivery rate.

12-7.11 Fire Screens

Fire screens must be located upstream from the pre-filters and final filter plenums. Fire screens with metal meshes from eight to sixteen openings per inch (three to six openings per square centimeter) will be provided and located at least 4 to 5 feet (1.2 to 1.5 meters) upstream from all pre-filters and at least 20 feet (6.1 meters) upstream from all final filter plenum enclosures. Where pre-filters are located in final filter enclosures, fire screens will be located at least 20 feet (6.1 meters) upstream from the pre-filters.

12-7.12 Heat Detection

Heat detectors or pilot sprinklers, when required to comply with paragraph 12-7.9, will be provided in ducting prior to final filter enclosures. Airflow must be considered when

determining detector or pilot sprinkler location. Heat detectors or pilot sprinklers will also be provided in the final filter enclosures. If filter plenum automatic deluge spray systems are actuated by pilot sprinklers, heat detectors are not required in the ducting or the final filter enclosure unless specified in the FHA.

12-7.13 Fire Alarm

The detection system or pilot sprinkler system will be arranged to detect a rise in airflow temperatures, actuate automatic fire suppression systems, and transmit an alarm to a constantly attended location (refer to paragraph 11-13.2). A pilot-operated system will be used only when an automatic water deluge spray system is installed.

12-7.14 Fire Detector Configuration for Testing

12-7.14.1 Fire detectors must be engineered and installed so they can be tested during the life of the detector. Easily removable panels will be provided to allow access for inspection and maintenance.

12-7.14.2 Where radiological contamination is not a concern, fire detectors may be installed such that the fire detector can be removed from the plenum enclosure and externally tested.

12-7.14.3 Remote testing must be provided for detectors that are not accessible due to facility configurations or personnel hazards.

12-7.14.4 If line-type heat detection is used, a heat testing pad will be provided outside of the plenum for operability testing of the system.

12-7.15 Lighting

Lighting must be provided inside the filter plenum in front of or between the filter banks in the area where the automatic and manual sprinklers and nozzles are located. Such lighting may be provided with an on-and-off switch, provided the switch is located outside the plenum at an accessible location.

12-7.16 Viewing Ports

Window viewing ports constructed of either wire glass, laminated lead safety glass, or fire-rated glass will be provided for viewing inside the filter plenum. The window viewing ports will be provided at each location where fire protection spray system sprinklers and nozzles are located and will be placed such that all sprinklers and nozzles are visible from the outside of the plenum to facilitate flow testing of the system.

12-8 DUCTWORK

Ductwork from areas containing radioactive materials that passes through nonradioactive areas must be of noncombustible construction and will be protected from possible exposure fires by materials having a fire resistance rating as approved by the

Cognizant Offices of Responsibility. For blast zones (see Chapter 7) this includes a requirement for hardened ductwork (i.e., steel piping).

Where the corrosive nature of the effluents conveyed precludes the use of metallic ducts, other materials will be permitted as approved by the Cognizant Offices of Responsibility.

12-9 SMOKE CONTROL

12-9.1 Where Required

Smoke control systems must be provided for facilities or portions of facilities classified as an “underground structure” or “limited access structure” as defined in NFPA 101.

12-9.2 Venting

Smoke, corrosive gases, and non-radioactive substances released by a fire will be vented from their place of origin directly to a location outside the facility where these substances will have the minimum potential to affect personnel outside of the facility.

12-9.3 Circulation

The smoke control system must be designed, located, and protected such that airborne corrosive products or contamination are not circulated (e.g., once-through ventilation systems).

12-9.4 Control of Radioactive Materials

Radioactive materials released by fire will be confined or removed and filtered from the exhaust ventilation airstream. Smoke exhaust from areas that contain radioactive substances must not be ventilated outside the building unless filtered through at least two stages of HEPA filters. Smoke control systems for such areas will be connected to treatment systems to preclude release of radioactive substances.

12-9.5 Release of Radioactive Material

The possible release to the environment of smoke containing radioactive materials must be monitored and modeled in accordance with emergency plans.

12-9.6 Fresh Air Inlets

Fresh air inlets will be located where contaminants are least likely to be present to reduce the potential of introducing smoke, toxic materials, or radioactive contaminants into the facility.

12-9.7 Enclosed Stairwells

Enclosed stairwells will be designed to minimize smoke infiltration during a fire via stairwell pressurization systems.

12-9.8 Natural Convection

Where natural convection ventilation is approved by the Cognizant Offices of Responsibility, the smoke and heat ventilation will provide a minimum ratio of vent area to floor area of at least 1 to 200, except in oil hazard areas, where at least a 1 to 100 ratio must be provided.

12-9.9 Firefighting

To facilitate manual firefighting, a method of operation of the smoke control systems must be provided for switchgear rooms, battery rooms, emergency power generation areas, fuel oil storage areas, and other areas where the potential exists for heavy smoke and heat conditions. The method of operation may be provided using local controls in the vicinity of the affected area or by remote controls under control of facility leadership.

12-10 LEAK TESTING

Open flame or combustion-generated smoke will not be used for leak testing.

12-11 POWER SUPPLIES AND CONTROLS

The power supply and controls for an HVAC system will be located outside the fire area served by the system. The security control room, facility control room, or other designated control location will be capable of remote monitoring and control of every ventilation system.

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CHAPTER 13 HOT WORK

NOTE: Cognizant Office of Responsibility for this chapter is AFSEC.

13-1 SCOPE

Hot work includes any temporary operation involving open flames or that produces heat or sparks, including brazing, cutting, grinding, soldering, arc welding, work on a pipe that would conduct heat through a wall or in contact with a wall, or torch-applied roofing. Non-powered (i.e., manual) cutting and grinding that do not generate sufficient heat or sparks to be considered a significant source of ignition to surrounding combustible materials do not require a permit.

13-2 PERMITS

Hot work must be coordinated and permitted through the appropriate local or base fire department.

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CHAPTER 14 UNDERGROUND FACILITIES

NOTE: Cognizant Office of Responsibility for this chapter is AFCEC.

14-1 SCOPE

This chapter includes requirements in addition to the requirements of Chapters 1 through 13 (unless otherwise specified) that are applicable to facilities where nuclear weapons-capable maintenance and storage areas are located underground.

14-2 ARCHITECTURAL REQUIREMENTS

Architectural requirements are provided in UFC 1-200-01.

14-2.1 Construction Type

Buildings will be constructed to be fire-resistant or noncombustible (Type I or Type II in accordance with the International Building Code [IBC]). All walls, floors, and structural components, except interior finish materials in office and support areas, will be of noncombustible construction. Use of combustible interior finishes must be minimized.

14-2.2 Hardened Fire Protection Systems

Buildings will be provided with hardened fire suppression systems in all areas and smoke detection systems (refer to Chapter 11 and Appendix B).

14-2.3 Fire Areas

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC.

Facilities capable of storing nuclear weapons components will be subdivided into separate fire areas to minimize the risk of fire spread and the resultant consequential damage from fire gases, smoke, heat, radioactive contamination, and firefighting activities. In addition, the subdivision into fire areas must allow adequate access for manual fire suppression activities and be as consistent as possible with the blast zones.

14-2.3.1 Establishment of Boundaries

The boundaries of fire areas will be as established in the FHA based on general fire protection criteria that include these elements:

- Types, quantities, density, and locations of combustible materials and radioactive materials
- Location of blast doors and security access portals
- Location and configuration of equipment
- Consequences of inoperable equipment

- Location or zoning of fire detection and suppression systems
- Personnel safety, exiting, area of refuge requirement

14-2.3.2 Boundary Objectives

In underground facilities, fire area boundaries will accomplish fire protection objectives, including:

- To separate all contiguous buildings or portions thereof serving different purposes, such as storage, maintenance, service, administration, and other occupancy designations
- To separate weapons maintenance areas and weapons storage areas from each other and from adjacent areas
- To separate other types of maintenance areas from adjacent areas
- To separate security and other control rooms, computer rooms, and combined control and computer rooms from adjacent areas
- To separate rooms with major concentrations of electrical equipment, such as switchgear rooms and relay rooms, from adjacent areas
- To separate battery rooms from adjacent areas
- To separate each fire pump and its associated equipment from all other pumps in the same room or pump house
- To separate each fire pump from adjacent areas
- To separate warehouse areas and combustible storage areas from adjacent areas
- To separate standby or emergency power generators from each other and from adjacent areas
- To separate fan rooms and plenum chambers from adjacent areas
- To separate office areas from adjacent areas

14-2.3.3 Fire Barriers Separating Fire Areas

Fire barriers separating fire areas will have a minimum 3-hour fire resistance rating with listed 3-hour-rated penetration seals, and comply with the International Building Code.

14-2.3.4 Fire Doors and Fire Windows in Fire Barriers

Fire doors and fire windows used in fire barriers will be installed and maintained in accordance with NFPA 80. In the case of blast doors in fire barriers, refer to Chapter 7 of this document.

Typically, closed fire doors in fire barriers will be identified with a sign indicating, “Fire Door — Keep Closed.”

Windows in fire barriers, such as for a security control room or computer room, must be provided with a listed or approved fire shutter, automatic wall curtain, or fire resistance glazing.

14-2.4 Vertical Shafts and Plenums

To prevent the vertical spread of fire, all stairways, elevator shafts, escape ladders, and other vertical shafts and plenums must be enclosed with barriers having a fire resistance rating of at least 2 hours. Openings in such barriers must be protected with listed automatic or self-closing fire doors having a fire protection rating of at least 1.5 hours.

14-3 COMBUSTIBLE MATERIALS AND FINISHES

14-3.1 Weapons Storage Areas

Combustible materials must be excluded from fire areas designated for weapons storage, except for incidental amounts of combustible materials as determined by the FHA. Such incidental amounts might include solid wood blocks that serve as chocks for weapons support or small amounts of solvent used for weapons maintenance in the storage location.

14-3.2 Blast Shielding Materials

Permanent and temporary shielding materials will be noncombustible or limited combustible, based on:

- ASTM E84
- NFPA 253
- NFPA 255
- UL 94

Polystyrene used for sand walls is not required to be encased with fire-resistant materials.

14-3.3 Interior Finishes

14-3.3.1 Interior Wall and Ceiling Finish

Interior wall and ceiling finish in areas for processing or storing radioactive materials will be Class A in accordance with NFPA 255.

NOTE: The design should consider a potential radiation contamination incident and include wall and ceiling finishes that are easy to clean.

14-3.3.2 Interior Floor Finish

Interior floor finish in areas for processing or storing radioactive materials will be Class I in accordance with NFPA 253.

NOTE: The design should consider a potential radiation contamination incident and include floor finishes that are easy to clean.

14-3.4 Other Materials

Thermal insulation materials, radiation shielding materials, ventilation duct materials, soundproofing materials, and suspended ceilings, including light diffusers and their supports, will be noncombustible or limited combustible. If polypropylene or polyethylene is required for neutron shielding, it must be totally encased with a noncombustible material such as steel or 5/8-inch (16-millimeter) type X gypsum board. Approximately 3/8-inch (10-millimeter) vent holes must be provided within the encasement to permit the venting of gases from the poly material.

NOTE: Encasement is required because many plastic materials, including flame- and fire-retardant materials, will burn with an intensity and energy production in a range similar to that of ordinary hydrocarbons. When burning, they produce heavy smoke that obscures visibility and can plug air filters, especially charcoal and HEPA filters. When burning, halogenated plastics also release free chloride and hydrogen chloride. These gases are toxic to humans and corrosive to equipment.

14-4 HAZARD CONTROL

14-4.1 Flammable and Combustible Liquids

14-4.1.1 Where oil-burning equipment, stationary combustion engines, or gas turbines are used, they will be installed and used in accordance with NFPA 31 or NFPA 37, as appropriate.

14-4.1.2 Flammable and combustible liquid and gas piping will be in accordance with ASME B31.1 or the ASME *Boiler and Pressure Vessel Code*, Section III, as applicable.

14-4.2 Hydraulic Systems

Hydraulic systems will use only listed fire-resistant hydraulic fluids.

14-4.3 Solvents

Where a flammable or combustible solvent is used, it must be handled such that the uncontrolled release of vapors is not permitted.

14-4.4 Gases

Flammable and combustible gases will be stored and handled in accordance with NFPA 54, NFPA 55, and NFPA 58.

Bulk flammable gas storage, either compressed or cryogenic, will not be permitted inside structures capable of storing nuclear weapons.

Storage of flammable gas, such as hydrogen, will be located outdoors or in separate detached buildings so a fire or explosion will not adversely affect any nuclear weapons storage facility systems or equipment.

14-5 LIQUID RUN-OFF CONTROL

Drainage will be provided in all areas of the facility for the removal of all liquids directly to safe areas, or for containment in the area without adverse flooding of equipment and without endangering other areas.

14-5.1 Methods

Drainage and the prevention of equipment water damage will be accomplished by one or more of these methods:

- Floor drains
- Floor trenches
- Open doorways or other wall openings
- Curbs for containing or directing drainage
- Equipment pedestals
- Pits, sumps, and sump pumps

14-5.2 Sump Pump Systems

Waste and drainage sump pump systems must be provided with 100 percent redundant pumps.

14-5.3 Drainage and Drainage Facility Size

Drainage and any associated drainage facilities for a given area will be sized to accommodate the volume of liquid produced by all of these sources:

- The spill of the largest single container of any flammable or combustible liquids in the area.
- The credible volume of discharge (as determined by the FHA) released by the automatic suppression system operating for a period of 30 minutes

unless the approved FHA authorizes use of a different flow rate and duration.

- The contents of piping systems and containers that could fail in a fire.
- The volume of water discharged based on a manual firefighting flow rate of 500 gallons per minute (1,890 liters per minute) for 30 minutes unless the approved FHA authorizes use of a different flow rate and duration.
- For areas open to the outside, such as underground loading docks, credible environmental factors such as rain and snow.

14-5.4 Staging Equipment

Necessary equipment must be staged to assist with routing water from the affected area. The use of the staging equipment will be addressed in the fire department pre-fire plan.

14-5.5 Floor Drainage

Floor drainage from areas containing flammable or combustible liquids will be trapped to prevent the spread of burning liquids beyond the fire area.

14-5.5.1 Areas with Radioactive Materials

Floor drainage from areas containing nuclear weapons components must be trapped to prevent the spread of radioactive materials beyond the facility's controlled boundaries. If the drainage system leads to tanks, the tanks will be designed to be criticality safe.

Water drainage from areas that might contain radioactivity must be collected, sampled, and analyzed before discharge to the environment or outside the boundaries of the facility.

Water released during fire suppression operations in areas containing radioactivity will be drained to a location that would be acceptable for the containment of radioactive materials.

14-5.5.2 Facilities with Gaseous Fire Suppression Systems

Where gaseous fire suppression systems are installed, floor drains will be provided with adequate seals or the fire suppression system will be sized to compensate for the loss of the gaseous fire suppression agent through the drains.

14-6 THROUGH PENETRATION FIRE STOPS

14-6.1 Where Required

Fire stops for penetrations such as pipes, conduits, bus ducts, cables, wires, pneumatic tubes and ducts, and similar building service equipment that passes through fire barriers

will be provided to prevent the spread of fire using listed or approved materials (caulking) or devices (sleeves).

If the fire barriers coincide with or are also serving as a blast-resistant barrier, these penetrations will also require blast-resistant devices. If the blast-resistant device is sufficient to serve as protection from the spread of fire, no additional protection is necessary. If the blast-resistant penetration device is not listed or approved for fire penetrations, it can be evaluated by a qualified fire protection engineer and accepted as a fire barrier product by the Cognizant Office of Responsibility.

14-6.2 Annular Spaces

The annular space between the penetrating item and the through opening in the fire barrier must be filled with a qualified (listed or approved) fire-resistive penetration seal assembly capable of maintaining the fire resistance of the fire barrier. The assembly will be qualified by tests in accordance with fire test protocols or be protected by a listed fire-rated device for the specified fire-resistive period. Penetration seals provided for electrical and mechanical openings will be listed as meeting the requirements of ASTM E814 or UL 1479.

14-6.3 Conduit Seals

Refer to Chapter 3.

14-6.4 Leak Testing

Open flame- or combustion-generated smoke must not be used for leak testing.

14-7 COMMUNICATIONS

Communication systems using a commonly described “lossy” antenna distribution system within the facility will be limited as much as possible and will be within the allowable electromagnetic radiation (EMR) limits of the applicable STS.

All electrical equipment and devices are either intentional or unintentional EMR emitters as defined in Chapter 8. All such equipment to be used in close proximity to critical equipment interior to the facility must not exceed the allowable EMR limits of the applicable STS. Anticipated EMR emitters will be analyzed to evaluate anticipated EMRE levels. If the EMRE levels exceed allowable limits, facility design, equipment selection, or procedures must be adjusted to mitigate EMRE levels.

14-8 LIFE SAFETY AND MEANS OF EGRESS

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC.

14-8.1 Life Safety Performance Criteria

The following performance criteria will be met during all operational modes and plant configurations:

- Provide safe egress or areas of refuge for all occupants of the facility.
- Provide adequate protection, including emergency lighting and communication, for essential personnel to perform necessary weapons safety and security functions in case of a fire event.
- Provide adequate protection (e.g., self-contained breathing apparatus [SCBA] units, supplied air connections) for other facility personnel designated to provide emergency response services during or following a fire.

14-8.2 Occupancy Classification

14-8.2.1 Storage

Those areas involved in the storage of nuclear weapons will be considered special-purpose industrial occupancies and as underground spaces as defined in NFPA 101.

Warehouses and storage areas designated for the storage of materials other than nuclear weapons will conform to the ordinary hazard storage occupancy (refer to Chapters 6 and 42 of NFPA 101) and underground space requirements in NFPA 101.

14-8.2.2 Maintenance

Those areas involved in the maintenance of nuclear weapons will be considered special-purpose industrial occupancies and as underground spaces as defined in NFPA 101.

14-8.2.3 Other Areas

General office areas, break rooms, security control rooms, office buildings, and training facilities will conform to the business occupancy and underground space requirements in NFPA 101.

14-8.3 Occupant Load

In determining the exiting requirements for a nuclear weapons-capable maintenance and storage facility, the actual number of assigned personnel and expected number of visitors during operations, maintenance, and testing, with an added safety factor of 20 percent, will be used to determine the occupant load in lieu of other criteria within NFPA 101.

14-8.4 Number of Means of Egress

Fire areas will have at least one means of egress for those facilities protected throughout by an automatic fire suppression system. When nuclear security requirements prohibit the use of approved egress components (such as a listed fire door meeting the requirements of NFPA 101) for the means of egress, an area of refuge must also be provided within the fire area (refer to paragraph 14-9.6).

Two means of egress out of the fire area will be provided for facilities not protected throughout by a fire suppression system. One of these means of egress may be an area of refuge. When nuclear security requirements prohibit the use of approved egress components (such as a listed fire door meeting the requirements of NFPA 101) for the means of egress, an area of refuge must be provided within the fire area (refer to paragraph 14-9.6).

14-8.5 Horizontal Exit

A horizontal exit will be considered to be any adjacent fire area separated by at least 3-hour fire-rated construction and accessible through listed fire doors meeting the requirements of NFPA 101 and NFPA 80.

14-8.6 Area of Refuge

An area of refuge must:

- Be separated from adjacent areas by at least 3-hour fire-rated construction
- Minimize the entrance of smoke
- Be protected throughout by automatic sprinklers
- Be provided with two-way communication (including instructions on the operation of the equipment)

Areas of refuge must be provided with protective heat-resistant clothing, emergency drinking water, and sufficient breathing air to permit survival for at least 72 hours based on the expected occupant load. The occupant capacity for the area of refuge will be established in the FHA.

NOTE: When possible, the area of refuge within a fire area should be located near the nuclear security access doors into the fire area.

14-8.7 Travel Distances

14-8.7.1 Weapon Storage Areas

For weapon storage areas, travel distances to an exterior exit, horizontal exit, or area of refuge within the fire area will not exceed 400 feet (122 meters) for facilities protected throughout by an automatic fire suppression system. For facilities not protected

throughout by an automatic fire suppression system, these travel distances will not exceed 200 feet (61 meters).

14-8.7.2 All Other Areas

For all other areas, travel distances to an exterior exit, horizontal exit, or area of refuge within the fire area will not exceed 300 feet (91 meters) for facilities protected throughout by an automatic fire suppression system. For facilities not protected throughout by an automatic fire suppression system, these travel distances will not exceed 200 feet (61 meters).

14-8.8 Common Path of Travel

14-8.8.1 Weapon Storage Areas

For weapon storage areas, common path of travel distances are not limited, provided the areas are protected with an automatic fire suppression system. For facilities not protected throughout by an automatic fire suppression system, common path of travel must not exceed 75 feet (23 meters).

14-8.8.2 All Other Areas

For all other areas, common path of travel must not exceed 100 feet (30 meters) for facilities protected throughout by an automatic fire suppression system. For facilities not protected throughout by an automatic fire suppression system, common path of travel must not exceed 75 feet (23 meters).

14-8.9 Dead-End Corridors

14-8.9.1 Weapon Storage Areas

For weapon storage areas, dead-end corridor distances are not limited, provided travel distances and common path of travel distances are not exceeded (see paragraphs 14-9.7 and 14-9.8).

14-8.9.2 All Other Areas

For all other areas, dead-end corridors must not exceed 50 feet (15 meters) for facilities protected throughout by an automatic fire suppression system. For facilities not protected throughout by an automatic fire suppression system, dead-end corridors must not exceed 20 feet (6.1 meters).

14-8.10 Special Locking Devices

Special locking devices (e.g., dead bolts and slide bolts) may be installed and left engaged on exit doors during periods of occupancy in addition to the normal door locking devices, provided the devices are required by security, are clearly visible to the building occupants, and the building occupants are advised of their presence.

NOTE: Such locking devices should be marked or painted with a bright contrasting color (e.g., orange, yellow, red) to be clearly visible to the occupants.

14-9 FIRE HYDRANTS IN VEHICLE LOADING TUNNELS

Hydrants will be installed within approximately 50 feet (15 meters) of each end of each vehicle loading tunnel provided for the underground structures.

14-10 SECURITY CONTROL ROOM COMPLEX

See Chapter 5 for security control room complex requirements.

14-11 COMMUNICATIONS

For all communication systems that are wireless or EMR-emitting devices, the restrictions of Chapter 8 will be implemented, as appropriate.

Prior to the introduction of wireless devices, the devices must be reviewed by the Host Wing, Weapons Safety Office.

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CHAPTER 15 INDUSTRIAL FACILITIES

NOTE: Cognizant Office of Responsibility for this chapter is AFCEC.

15-1 SCOPE

This chapter includes requirements in addition to the requirements (unless otherwise specified) of Chapters 1 through 13 that are applicable to ground-level industrial facilities where nuclear weapons-capable activities such as inspection, testing, and maintenance take place, but not storage. For restricted access/egress, ground-level facilities where inspection, testing, maintenance, and storage takes place will comply with Chapter 17 in lieu of this chapter. For underground facilities, comply with Chapter 14 in lieu of this chapter.

15-2 ARCHITECTURAL REQUIREMENTS

Architectural requirements are provided in UFC 1-200-01.

15-2.1 Construction Type

Buildings will be constructed to be fire-resistant or noncombustible (Type I or Type II in accordance with the IBC). All walls, floors, and structural components, except interior finish materials in office and support areas, will be of noncombustible construction. Use of combustible interior finishes will be minimized.

15-2.2 Hardened Fire Protection Systems

Buildings will be provided with hardened fire suppression systems in all areas and smoke detection systems (refer to Chapter 11 and Appendix B).

15-2.3 Fire Areas

Facilities capable of inspecting, maintaining, or storing nuclear weapons components must be subdivided into separate fire areas to minimize the risk of fire spread and the resultant consequential damage from fire gases, smoke, heat, radioactive contamination, and firefighting activities. In addition, the subdivision into fire areas will allow adequate access for manual fire suppression activities and be as consistent as possible with the blast zones.

15-2.3.1 Establishment of Boundaries

The boundaries of fire areas will be established in the FHA based on general fire protection criteria that include these elements:

- Types, quantities, density, and locations of combustible materials and radioactive materials
- Location of blast doors and security access portals

- Location and configuration of equipment
- Consequences of inoperable equipment
- Location or zoning of fire detection and suppression systems
- Personnel safety, exiting, and area of refuge requirements
- Building separations and occupancy separation requirements

15-2.3.2 Boundary Objectives

In industrial facilities, fire area boundaries will accomplish fire protection objectives, including:

- To separate all contiguous buildings or portions thereof serving different purposes, such as storage of combustible materials, maintenance, service, administration, and other occupancy designations
- To separate weapons maintenance areas from adjacent areas
- To separate fueling areas from adjacent areas
- To separate security and other control rooms, computer rooms, or combined control and computer rooms from adjacent areas
- To separate rooms with major concentrations of electrical equipment, such as switchgear rooms and relay rooms, from adjacent areas
- To separate battery rooms from adjacent areas
- To separate each fire pump and its associated equipment from all other pumps in the same room or pump house
- To separate each fire pump from adjacent areas
- To separate warehouse areas and combustible storage areas from adjacent areas
- To separate standby or emergency power generators from each other and from adjacent areas
- To separate fan rooms and plenum chambers from adjacent areas
- To separate office areas from adjacent areas

15-2.3.3 Fire Barriers Separating Fire Areas

Fire barriers separating fire areas must have a minimum 2-hour fire resistance rating with listed 2-hour-rated penetration seals.

15-2.3.4 Fire Doors and Fire Windows in Fire Barriers

Fire doors and fire windows in fire barriers will be installed and maintained in accordance with NFPA 80. In the case of blast doors in fire barriers, refer to paragraph 7-4.3.8 of this document.

Typically, closed fire doors in fire barriers will be identified with a sign indicating, “Fire Door — Keep Closed.”

Windows in fire barriers, such as for a security control room or computer room, must be provided with a listed or approved fire shutter, automatic wall curtain, or fire resistance glazing.

15-2.4 Vertical Shafts and Plenums

To prevent vertical spread of fire, all stairways, elevator shafts, escape ladders, and other vertical shafts and plenums will be enclosed with barriers having a fire resistance rating of at least 2 hours. Openings in such barriers must be protected with listed automatic or self-closing fire doors having a fire protection rating of at least 1.5 hours.

15-3 COMBUSTIBLE MATERIALS AND FINISHES

15-3.1 Blast Shielding Materials

Permanent and temporary shielding materials will be noncombustible or limited combustible, based on:

- ASTM E84
- NFPA 253
- NFPA 255
- UL 94

Polystyrene used for sand walls is not required to be encased with fire-resistant materials.

15-3.2 Interior Finishes

15-3.2.1 Interior Wall and Ceiling Finish

Interior wall and ceiling finish in areas processing or storing radioactive materials must be Class A in accordance with NFPA 255.

NOTE: The design should consider a potential radiation contamination incident and include wall and ceiling finishes that are easy to clean.

15-3.2.2 Interior Floor Finish

Interior floor finish in areas processing or storing radioactive materials will be Class I in accordance with NFPA 253. If required to meet weapon maintenance environmental conditions, anti-static flooring having less than a Class I fire rating is permitted when approved by the Cognizant Office of Responsibility.

NOTE: The design should consider a potential radiation contamination incident and include floor finishes that are easy to clean.

15-3.3 Other Materials

Thermal insulation materials, radiation shielding materials, ventilation duct materials, soundproofing materials, and suspended ceilings, including light diffusers and their supports, must be noncombustible or limited combustible. If polypropylene or polyethylene is required for neutron shielding, it must be totally encased with a noncombustible material such as steel or 5/8-inch (16-millimeter) type X gypsum board. Approximately 3/8-inch (10-millimeter) vent holes must be provided within the encasement to permit the venting of gases from the poly material.

NOTE: Encasement is required because many plastic materials, including flame- and fire-retardant materials, will burn with an intensity and energy production in a range similar to that of ordinary hydrocarbons. When burning, these materials produce heavy smoke that obscures visibility and can plug air filters, especially charcoal and HEPA filters. When burning, halogenated plastics also release free chloride and hydrogen chloride. These gases are toxic to humans and corrosive to equipment.

15-4 HAZARD CONTROL

15-4.1 Flammable and Combustible Liquids

15-4.1.1 Where oil-burning equipment, stationary combustion engines, or gas turbines are used, they will be installed and used in accordance with NFPA 31 or NFPA 37, as appropriate.

15-4.1.2 Flammable and combustible liquid and gas piping will be in accordance with ASME B31.1 or the ASME *Boiler and Pressure Vessel Code*, Section III, as applicable.

15-4.2 Hydraulic Systems

Hydraulic systems must use only listed fire-resistant hydraulic fluids. Such fluids will be approved by the Factory Mutual Research Corporation or the Mine Safety and Health Administration.

15-4.3 Solvents

Where a flammable or combustible solvent is used, it will be handled such that the uncontrolled release of vapors is not permitted.

15-4.4 Gases

Flammable and combustible gases will be stored and handled in accordance with NFPA 54, NFPA 55, and NFPA 58.

Bulk flammable gas storage, either compressed or cryogenic, will not be permitted inside structures capable of maintaining nuclear weapons.

Storage of flammable gas, such as hydrogen, will be located outdoors or in separate detached buildings so that a fire or explosion will not adversely affect any nuclear weapons maintenance facility systems or equipment.

15-5 REFUELING AREAS

15-5.1 Automatic Fire Suppression

Automatic foam fire suppression systems will protect the area from the hazards defined within the FHA and be designed in accordance with NFPA 11.

15-5.2 Electrical Equipment

Electrical equipment will comply with NFPA 70, including Chapter 5, “Special Occupancies,” and other NFPA 70 requirements related to hazardous locations.

15-5.3 Fuel Transfer Pumps

Where pumps are used for liquid fuel transfer, means will be provided to shut down liquid transfer in the event of a spill or fire.

15-5.4 Fuel Storage Tanks

Fuel storage (i.e., day tanks) located within refueling areas must not exceed 200 gallons (757 liters).

Fuel storage tanks will be equipped with overfill protection.

15-5.5 Fuel Line Shutoff

Fuel supply lines entering refueling areas must be arranged with a spring-loaded automatic shutoff valve that is activated via a fusible link.

15-5.6 Curbing in Refueling Areas

Refueling areas must be provided with curbing designed to capture the entire contents of the fuel within the facility and the discharge of the fire suppression system for 30 minutes.

15-5.7 Ventilation

15-5.7.1 Refueling Areas

Refueling areas will be provided with either a gravity system or a continuous mechanical exhaust ventilation system.

15-5.7.2 Exhaust Location

Exhaust air must be taken from a point near a wall on one side of the room and within 12 inches (30.5 centimeters) of the floor, with one or more make-up inlets located on the opposite side of the room within 12 inches (30.5 centimeters) of the floor.

15-5.7.3 Air Openings

The location of both the exhaust and inlet air openings must be arranged to provide air movement across all portions of the floor to prevent the accumulation of vapors.

15-5.7.4 Recirculation

Exhaust from the room must be conducted directly to the exterior of the building and must not be recirculated.

15-5.7.5 Ducts

If ducts are used, they must not be used for any other purpose and will comply with NFPA 91.

15-5.7.6 Make-Up Air

If make-up air to a mechanical system is taken from within the building, the opening will be equipped with a fire door or damper as required in NFPA 91.

15-5.7.7 Gravity Systems

For gravity systems, the make-up air must be supplied from outside of the building.

15-5.7.8 Capacity

Mechanical ventilation systems must provide at least 1 cubic foot per minute (28.3 liters per minute) of exhaust air for each square foot (0.09 square meter) of floor area, but not less than 150 cubic feet per minute (4,248 liters per minute).

15-5.7.9 Dispensing Areas

The mechanical ventilation system for dispensing areas must be equipped with an airflow switch or other equally reliable method that is interlocked to sound an audible alarm upon failure of the ventilation system.

15-5.7.10 Air Intake Height

The minimum height of air intakes in these areas must be in accordance with UFC 4-010-01.

15-5.8 Static Electricity

Means must be provided to minimize the generation of static electricity in the refueling area. See AFI 91-203, NFPA 77, and NFPA 407.

15-6 LIQUID RUN-OFF CONTROL

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC.

Drainage will be provided in all areas of the facility for the removal of all liquids directly to safe areas, or for containment in the area without adverse flooding of equipment and without endangering other areas.

15-6.1 Methods

Drainage and the prevention of equipment water damage will be accomplished by one or more of these methods:

- Floor drains
- Floor trenches
- Open doorways or other wall openings
- Curbs for containing or directing drainage
- Equipment pedestals
- Pits, sumps, and sump pumps

15-6.2 Sump Pump Systems

Waste and drainage sump pump systems must be provided with 100 percent redundant pumps.

15-6.3 Drainage and Drainage Facility Size

Drainage and any associated drainage facilities for a given area will be sized to accommodate the volume of liquid produced by all of these sources:

- The spill of the largest single container of any flammable or combustible liquids in the area
- The credible volume of discharge (as determined by the FHA) released by the automatic suppression system operating for a period of 30 minutes, unless the approved FHA authorizes a different flow rate and duration
- The contents of piping systems and containers that could fail in a fire
- The volume of water discharged based on a manual firefighting flow rate of 500 gallons per minute (1,890 liters per minute) for 30 minutes unless the approved FHA authorizes a different flow rate and duration
- For areas open to the outside, such as underground loading docks, credible environmental factors such as rain and snow

15-6.4 Staging Equipment

Necessary equipment must be staged to assist with routing water from the affected area. The use of the staging equipment will be addressed in the fire department pre-fire plan.

15-6.5 Floor Drainage

Floor drainage from areas containing flammable or combustible liquids must be trapped to prevent the spread of burning liquids beyond the fire area.

15-6.5.1 Areas with Radioactive Materials

Floor drainage from areas containing nuclear weapons components must be trapped to prevent the spread of radioactive materials beyond the facility's controlled boundaries. If the drainage system leads to tanks, the tanks will be designed to be criticality safe.

Water drainage from areas that might contain radioactivity must be collected, sampled, and analyzed before discharge to the environment or outside the boundaries of the facility.

Water released during fire suppression operations in areas containing radioactivity must be drained to a location that would be acceptable for the containment of radioactive materials.

15-6.5.2 Facilities with Gaseous Fire Suppression Systems

Where gaseous fire suppression systems are installed, floor drains must be provided with adequate seals or the fire suppression system will be sized to compensate for the loss of the gaseous fire suppression agent through the drains.

15-7 THROUGH PENETRATION FIRE STOPS

15-7.1 Where Required

15-7.1.1 Penetrations

Fire stops for penetrations such as pipes, conduits, bus ducts, cables, wires, pneumatic tubes and ducts, and similar building service equipment that passes through fire barriers will be provided to prevent the spread of fire using listed or approved materials (caulking) or devices (sleeves).

15-7.1.2 Blast-Resistant Barrier

If the fire barriers coincide with or are also serving as a blast-resistant barrier, these penetrations will also require blast-resistant devices. If the blast-resistant device is sufficient to serve as protection from the spread of fire, no additional protection is necessary. If the blast-resistant penetration device is not listed or approved for fire penetrations, it can be evaluated by a qualified fire protection engineer and accepted as a fire barrier product by the Cognizant Office of Responsibility.

15-7.2 Annular Spaces

The annular space between the penetrating item and the through opening in the fire barrier will be filled with a qualified (listed or approved) fire-resistive penetration seal assembly capable of maintaining the fire resistance of the fire barrier. The assembly must be qualified by tests in accordance with fire test protocols or be protected by a listed fire-rated device for the specified fire-resistive period. Penetration seals provided for electrical and mechanical openings will be listed as meeting the requirements of ASTM E814 or UL 1479.

15-7.3 Conduit Seals

Refer to Chapter 3.

15-7.4 Leak Testing

Open flame- or combustion-generated smoke must not be used for leak testing.

15-8 COMMUNICATIONS

NOTE: Cognizant Office of Responsibility for this paragraph is AFSEC.

Communication systems using a lossy antenna distribution system within the facility will be limited as much as possible and will be within the allowable EMR limits of the STS.

All electrical equipment and devices are either intentional or unintentional EMR emitters and must be evaluated as discussed in Chapter 8. All such equipment to be used in close proximity to critical equipment interior to the facility must not exceed the

allowable EMR limits of the STS. Anticipated EMR emitters will be analyzed to evaluate anticipated EMRE levels. If the EMRE levels exceed allowable limits, facility design, equipment selection, or procedures must be adjusted to mitigate EMRE levels.

15-9 LIFE SAFETY AND MEANS OF EGRESS

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC.

15-9.1 Life Safety Performance Criteria

The following performance criteria must be met during all operational modes and plant configurations:

- Provide safe egress or areas of refuge for all occupants of the facility.
- Provide adequate protection, including emergency lighting and communication, for essential personnel to perform necessary weapons safety and security functions in case of a fire event.
- Provide adequate protection (e.g., SCBA units, supplied air connections) for other facility personnel designated to provide emergency response services during or following a fire.

15-9.2 Occupancy Classification

Industrial facilities involved in the inspection, testing, and maintenance of nuclear weapons will be considered special purpose industrial occupancies as defined in NFPA 101.

General office areas, break rooms, security control rooms, office buildings, and training facilities will conform to the business occupancy requirements in NFPA 101.

Warehouses and storage areas designated for the storage of materials other than nuclear weapons will conform to the ordinary hazard storage occupancy requirements in NFPA 101 (refer to Chapters 6 and 42 of NFPA 101).

15-9.3 Occupant Load

In determining the exiting requirements for a nuclear weapons-capable maintenance and storage facility, the actual number of assigned personnel and expected number of visitors during operations, maintenance, and testing with an added safety factor of 30 percent will be used to determine occupant load in lieu of other criteria within NFPA 101.

15-9.4 Number of Means of Egress

15-9.4.1 Two Means of Egress

Fire areas must have at least two means of egress, including those facilities protected throughout by an automatic fire suppression system.

15-9.4.2 Single Means of Egress

A single means of egress will be permitted from any story or section of an industrial facility, provided that the exit can be reached within 100 feet (30 meters) for a sprinklered facility (50 feet [15 meters] for a nonsprinklered facility) and when the single means of egress is approved by the Cognizant Offices of Responsibility.

15-9.4.3 Refueling Areas

Refueling areas must have not less than two means of egress, one of which must include an exit directly to the exterior of the facility.

15-9.4.4 Area of Refuge

When nuclear security requirements prohibit the use of approved egress components (such as a listed fire door meeting the requirements of NFPA 101) in the means of egress, an area of refuge must be provided within the fire area (refer to paragraph 15-10.6.

15-9.5 Horizontal Exit

A horizontal exit will be considered to be any adjacent fire area separated by at least 2-hour fire-rated construction and accessible through listed fire doors meeting the requirements of NFPA 101 and NFPA 80.

15-9.6 Area of Refuge

An area of refuge will:

- Be separated from adjacent areas by at least 3-hour fire-rated construction
- Minimize the entrance of smoke
- Be protected throughout by automatic sprinklers
- Be provided with two-way communication (including instructions on the operation of the equipment)

An area of refuge will be provided with protective heat-resistant clothing, emergency drinking water, and sufficient breathing air to permit survival for at least 72 hours based on the expected occupant load. The occupant capacity for the area of refuge will be established in the FHA.

NOTE: When possible, the area of refuge within a fire area should be located near the nuclear security access doors into the fire area.

15-9.7 Travel Distances

Travel distances to an exterior exit, horizontal exit, or area of refuge within the fire area must not exceed 400 feet (122 meters) for facilities protected throughout by an automatic fire suppression system. For facilities not protected throughout by an automatic fire suppression system, travel distances to an exterior exit, horizontal exit, or area of refuge within the fire area must not exceed 200 feet (61 meters).

For refueling areas, travel distances to an exterior exit must not exceed 75 feet (23 meters).

15-9.8 Common Path of Travel

The common path of travel must not exceed 100 feet (30 meters) for facilities protected throughout by an automatic fire suppression system. For facilities not protected throughout by an automatic fire suppression system, the common path of travel must not exceed 75 feet (23 meters).

15-9.9 Dead-End Corridors

Dead-end corridors must not exceed 50 feet (15 meters) for facilities protected throughout by an automatic fire suppression system. For facilities not protected throughout by an automatic fire suppression system, dead-end corridors must not exceed 20 feet (6.1 meters).

15-9.10 Special Locking Devices

Special locking devices (such as dead bolts and slide bolts) may be installed and left engaged on exit doors during periods of occupancy in addition to the normal door locking devices, provided the devices are required by security, are clearly visible to the building occupants, and the building occupants are advised of their presence.

NOTE: Such locking devices should be marked or painted with a bright contrasting color (e.g., orange, yellow, red) to be clearly visible to the occupants.

15-10 SECURITY CONTROL ROOM COMPLEX

See Chapter 5 for security control room complex requirements.

15-11 COMMUNICATIONS

For all communication systems that are wireless or EMR emitting devices, the restrictions in Chapter 8 must be considered and implemented as appropriate.

Prior to the introduction of wireless devices, the devices must be reviewed by the Host Wing, Weapons Safety Office.

15-12 ELECTROEXPLOSIVE DEVICES (EED)

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC.

15-12.1 Storage and Testing Area Criteria

Areas where EEDs are stored or tested will meet the following criteria:

15-12.1.1 Separation

EED areas must be separated from the remainder of the industrial facility by not less than 3-hour-rated walls.

15-12.1.2 Seals

All permanent penetrations into and out of the room will be sealed by a listed or approved means (i.e., penetration seals, fire and smoke dampers).

Penetrations provided for use in remote testing or remote electrical testing may be covered with a movable steel door or “flap” that is configured with a small slit that allows temporary wiring needed for the testing to penetrate the wall.

15-12.1.3 Ventilation Ductwork

Ventilation ductwork that penetrates the room must be equipped with fire or combination fire and smoke dampers with at least a 3-hour fire rating. Alternate means of protection of the ductwork (i.e., without dampers) are not permitted.

15-12.1.4 Blast Doors

Blast doors into the rooms will be evaluated by a qualified fire protection engineer to determine if the door may be considered as equivalent to that of a 3-hour-rated fire door. Use of blast doors for this purpose must be approved by the Cognizant Offices of Responsibility.

15-12.1.5 Fire Suppression

The room must be protected by an automatic sprinkler fire suppression system.

NOTE: The sprinklers should be supplied from above the ceiling and also provided with sprinkler guards. These features will help reduce damage to the sprinkler system due to explosion.

15-12.1.6 Grounding

Grounding or bonding to an earth ground will be provided (refer to Chapter 3).

15-12.2 Deflagration Venting

Areas where EEDs are stored or tested must be provided with deflagration venting in accordance with NFPA 68. The following features will be provided:

NOTE: According to the NFPA *Fire Protection Handbook*, industry experience shows that detonations cannot be adequately vented; however, deflagration venting should still be provided as a best management practice.

15-12.2.1 Exterior Wall

The vent area will be located in an exterior wall.

15-12.2.2 Symmetry

The vent area will be distributed symmetrically and evenly on the external wall.

15-12.2.3 Vent Closures

The types of building vent closures permitted include:

- Hinged doors
- Windows and panel closures that swing in the outward direction and have latches or similar hardware that automatically release under calculated release pressure
- Friction, spring-loaded, or magnetic latches of the type used for doors on industrial ovens

15-12.2.4 Fasteners

Shear and pull-through fasteners are permitted to be used where the vent design requires large areas, such as the entire wall of an EED room.

15-12.2.5 Restraints

The means of restraining large panels will be documented in the FHA.

15-12.2.6 Restriction of Vent Area

No restraint for any vent closure will result in restricting the vent area.

15-12.2.7 Total Mass of Closure

Any hardware added to a vent closure will be included when determining the total mass of the closure.

15-12.2.8 Hinges

Hinged doors or covers will be permitted to be designed to function as vent closures. The hinge must be designed to ensure the closure device remains intact during venting.

15-12.3 Inspection

Explosive venting systems will be inspected annually and the inspection will include at least these system conditions:

- The opening is clear of obstructions on both sides.
- The exhaust from the opening does not discharge to an occupied area.
- Changes made to the venting system installation since the last inspection.
- The venting system is not corroded or otherwise damaged.
- The explosive venting configuration is clearly identified.
- The explosive venting configuration is not damaged and will not be obstructed by snow, ice, insects, animals, plant growth, or other environmental conditions.
- The explosive venting device will not be impeded in its operation.

15-13 ARMORIES

15-13.1.1 Fire Rating

Armories will be separated from the remainder of the facility by a minimum of 2-hour fire-rated walls and 1.5-hour-rated fire doors.

15-13.1.2 Fire Stops

Penetrations into armories must be fire stopped (e.g., fire dampers, penetration seals) in addition to security requirements.

15-13.1.3 Automatic Sprinklers

Armories will be protected with automatic sprinklers unless approved in the FHA when the introduction of water through the sprinkler system creates a greater hazard. The sprinkler piping into an armory may be valved to permit isolation of the system in the event of an emergency when approved by the Cognizant Office of Responsibility.

15-13.1.4 Security Doors

Security doors into armories will be evaluated by a qualified fire protection engineer to determine if a door may be considered as equivalent to that of a 1.5-hour-rated fire door. Use of security doors for this purpose must be approved by the Cognizant Office of Responsibility.

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CHAPTER 16 EARTH-COVERED MAGAZINE (ECM) STRUCTURES

NOTE: Cognizant Offices of Responsibility for this chapter are AFCEC and AFSEC.

16-1 SCOPE

This chapter includes requirements in addition to the requirements (unless otherwise specified) of Chapters 1 through 13 that are applicable to ECM structures where nuclear weapons are authorized to be stored but not tested or maintained.

16-2 ARCHITECTURAL REQUIREMENTS

16-2.1 Uniform Minimum Ammunition and Explosive (AE) Safety Standards

Uniform minimum AE safety standards established by the Department of Defense Explosives Safety Board (DDESB) will be incorporated.

NOTE: The DDESB has established uniform minimum AE safety standards for personnel and property that have the potential of being exposed to the effects of an accidental explosion. These standards govern the design, construction, and use of all AE storage magazines within DoD.

16-2.2 ECM Siting

ECM structures will be sited using DDESB uniform minimum AE safety standards.

16-2.3 Hardened Fire Protection Systems

Buildings will be provided with hardened fire suppression systems in all areas and smoke detection systems (refer to Chapter 11 and Appendix B).

NOTE: ECM structures are built to store AE. ECM structures are not necessarily designed to contain the damaging effects from an internal explosion, although these structures will usually contain the effects of a very small quantity of AE. Instead, ECMs are intended to protect their contents from an explosion that may occur in an adjacent structure, such as another ECM, piers, aboveground magazines, rail sidings, or classification yards. The ECM may not be adequate to prevent damage to its contents from all external events. Protection from such events should be addressed in the FHA.

16-3 APPROVAL REQUIREMENTS

16-3.1 DDESB Review

Plans for ECM structure modification and new construction must be reviewed and approved by the local wing weapons safety office in accordance with AFMAN 91-201. The ECM modification or new construction will be included in a site plan package that will be reviewed and approved by the DDESB to ensure that minimum DoD explosive safety considerations have been addressed. Situations requiring approval include:

- New construction or major modification
- Changes in use of facilities that affect the siting separation distances

16-3.2 Pre-approved ECM Designs

If pre-approved ECM designs are used, the project site plan and the drawing numbers of the ECM design must be submitted for approval. All new 7- and 3-bar ECM designs must be approved by the DDESB before they may be used. The approval will require the submission of test results or detailed structural calculations.

16-3.3 Undefined ECM Designs

All new, undefined ECM designs require prior approval from the DDESB to ensure that minimum design and construction criteria are met.

16-4 LIFE SAFETY AND MEANS OF EGRESS

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC.

16-4.1 Life Safety Performance Criteria

These performance criteria will be met during all operational modes and ECM configurations:

- Provide safe egress for all occupants of the facility.
- Provide adequate protection, including emergency lighting and communication, for essential personnel to perform necessary weapons safety and security functions in case of a fire event.

NOTE: Typical DoD ECMs are small structures that are occupied only for brief periods to permit the addition or removal of weapons systems from the structure. The weapons systems are then transported to an industrial facility (refer to Chapter 15), an underground facility (refer to Chapter 14), or transported off the DoD installation. The only other expected periods of occupancy will be temporary access by a limited number of personnel to perform maintenance on the ECM's infrastructure systems. Otherwise, security measures will effectively prevent access by all personnel to the ECM. Life safety performance criteria provided in the FHA should incorporate such operational considerations.

16-4.2 Occupancy Classification

ECM structures used for the storage of nuclear weapons will be considered special-purpose industrial occupancies.

16-4.3 Occupant Load

In determining the exiting requirements for a nuclear weapons-capable maintenance and storage facility, the actual number of assigned personnel and expected number of security personnel during operations in the ECM with an added safety factor of 20 percent will be used to determine occupant load in lieu of other criteria within NFPA 101.

16-4.4 Number of Means of Egress

One means of egress from an ECM is permitted.

16-4.5 Travel Distances

Travel distances to an exterior exit must not exceed 400 feet (122 meters) for facilities protected throughout by an automatic fire suppression system. For facilities not protected throughout by an automatic fire suppression system, travel distances to an exterior exit must not exceed 200 feet (61 meters).

16-4.6 Common Path of Travel

The common path of travel distance is not limited.

16-4.7 Dead-End Corridors

Dead-end corridors are not permitted.

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CHAPTER 17 COMBINED MAINTENANCE AND STORAGE FACILITIES

NOTE: Cognizant Office of Responsibility for this chapter is AFCEC unless otherwise specified.

17-1 SCOPE

This chapter includes requirements in addition to the requirements (unless otherwise specified) of Chapters 1 through 13 that are applicable to restricted access/egress facilities where combined maintenance and storage activities such as inspection, testing, fueling, and periodic maintenance take place. This type of facility is located at ground level but portions of the facility exterior walls are strengthened to resist an exterior threat in accordance with DoDM S-5210.41 / AFMAN 31-108. For facilities that are located underground, comply with Chapter 14 in lieu of this chapter.

17-2 ARCHITECTURAL REQUIREMENTS

17-2.1 Construction Type

Buildings will be constructed to be fire-resistant or noncombustible (Type I or Type II in accordance with the IBC). All walls, floors, and structural components, except interior finish materials in office and support areas, will be of noncombustible construction. Use of combustible interior finishes will be minimized.

17-2.2 Fire Areas

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC.

Facilities capable of inspecting, maintaining or storing nuclear weapons components will be subdivided into separate fire areas to minimize the risk of fire spread and the resultant consequential damage from fire gases, smoke, heat, radioactive contamination, and firefighting activities. In addition, the subdivision into fire areas will allow adequate access for manual fire suppression activities and be as consistent as possible with the blast zones (when provided).

17-2.2.1 Establishment of Boundaries

The boundaries of fire areas will be established in the FHA based on general fire protection criteria that include these elements:

- Types, quantities, density, and locations of combustible and flammable materials, and of radioactive materials
- Location of blast doors (if provided)
- Location of security access portals
- Location and configuration of equipment
- Consequences of inoperable equipment

- Location or zoning of fire detection and suppression systems
- Personnel safety, exiting, and area of refuge requirements
- Building separations and occupancy separation requirements

17-2.2.2 Boundary Objectives

In limited-access combined industrial and storage facilities, fire area boundaries will accomplish fire protection objectives, including:

- To separate all contiguous buildings or portions thereof serving different purposes, such as storage, maintenance, service, administration, and other occupancy designations
- To separate weapons storage areas from adjacent areas
- To separate weapons maintenance areas from adjacent areas
- To separate fueling areas from adjacent areas
- To separate security and other control rooms, computer rooms, or combined control and computer rooms from adjacent areas
- To separate rooms with major concentrations of electrical equipment, such as switchgear rooms and relay rooms, from adjacent areas
- To separate battery rooms from adjacent areas
- To separate each fire pump and its associated equipment from all other pumps in the same room or pump house
- To separate each fire pump from adjacent areas
- To separate warehouse areas and combustible storage areas from adjacent areas
- To separate standby or emergency power generators from each other and from adjacent areas
- To separate fan rooms and plenum chambers from adjacent areas
- To separate office areas from adjacent areas

17-2.2.3 Fire Barriers Separating Fire Areas

Fire barriers separating fire areas must be of a minimum 3-hour fire resistance rating with listed 3-hour-rated penetration seals.

17-2.2.4 Fire Doors and Fire Windows in Fire Barriers

Fire doors and fire windows used in fire barriers will be installed and maintained in accordance with NFPA 80. In the case of blast doors in fire barriers, refer to paragraph 7-4.3.8.

Normally, closed fire doors in fire barriers will be identified with a sign indicating, “Fire Door — Keep Closed.”

Windows in fire barriers, such as for a security control room or computer room, will be provided with a listed or approved fire shutter, automatic wall curtain, or fire resistance glazing.

17-2.3 Vertical Shafts and Plenums

To prevent vertical spread of fire, all stairways, elevator shafts, escape ladders, and other vertical shafts and plenums will be enclosed with barriers having a fire resistance rating of at least 2 hours. Openings in such barriers will be protected with listed automatic or self-closing fire doors having a fire protection rating of at least 1.5 hours.

17-3 COMBUSTIBLE MATERIALS AND FINISHES

17-3.1 Areas Where Weapons Are Maintained or Stored

Combustible materials, other than materials fully contained within and designed to serve as part of the weapon or weapon delivery vehicle/system, must be excluded from fire areas designated for weapon maintenance and storage except for incidental amounts of combustible materials as determined by the FHA. Such incidental amounts might include solid wood blocks that serve as chocks for weapons support or small amounts of solvent used for weapons maintenance.

17-3.2 Blast Shielding Materials

Permanent and temporary shielding materials must be noncombustible or limited combustible, based on:

- ASTM E84
- NFPA 253
- NFPA 255
- UL 94

Polystyrene used for sand walls is not required to be encased with fire-resistant materials.

17-3.3 Interior Finishes

17-3.3.1 Interior Wall and Ceiling Finish

Interior wall and ceiling finish in areas processing or storing radioactive materials will be Class A in accordance with NFPA 255.

NOTE: The design should consider a potential radiation contamination incident and include wall and ceiling finishes that are easy to clean.

17-3.3.2 Interior Floor Finish

Interior floor finish in areas processing or storing radioactive materials will be Class I in accordance with NFPA 253. If required to meet weapon maintenance environmental conditions, anti-static flooring having less than a Class I fire rating is permitted when approved by the Cognizant Office of Responsibility.

NOTE: The design should consider a potential radiation contamination incident and include floor finishes that are easy to clean.

17-3.4 Other Materials

Thermal insulation materials, radiation shielding materials, ventilation duct materials, soundproofing materials, and suspended ceilings, including light diffusers and their supports, will be noncombustible or limited combustible. If polypropylene or polyethylene is required for neutron shielding, it must be totally encased with a noncombustible material such as steel or 5/8-inch (16-millimeter) type X gypsum board. Approximately 3/8-inch (10-millimeter) vent holes must be provided within the encasement to permit the venting of gases from the poly material.

NOTE: Encasement is required because many plastic materials, including flame- and fire-retardant materials, will burn with an intensity and energy production in the range similar to that of ordinary hydrocarbons. When burning, these materials produce heavy smoke that obscures visibility and can plug air filters, especially charcoal and HEPA filters. When burning, halogenated plastics also release free chloride and hydrogen chloride. These gases are toxic to humans and corrosive to equipment.

17-4 HAZARD CONTROL

17-4.1 Flammable and Combustible Liquids

17-4.1.1 Where oil-burning equipment, stationary combustion engines, or gas turbines are used, they will be installed and used in accordance with NFPA 31 or NFPA 37, as appropriate.

17-4.1.2 Flammable and combustible liquid and gas piping will be in accordance with ANSI B31.1 or the ASME *Boiler and Pressure Vessel Code*, Section III, as applicable.

17-4.2 Hydraulic Systems

Hydraulic systems must use only listed fire-resistant hydraulic fluids.

17-4.3 Solvents

Where a flammable or combustible solvent is used, it must be handled such that the uncontrolled release of vapors is not permitted.

17-4.4 Gases

Flammable and combustible gases will be stored and handled in accordance with NFPA 54, NFPA 55, and NFPA 58.

Bulk flammable gas storage, either compressed or cryogenic, will not be permitted inside structures capable of maintaining or storing nuclear weapons.

Storage of flammable gas, such as hydrogen, will be located outdoors or in separate detached buildings so a fire or explosion will not adversely affect any nuclear weapons maintenance and storage facility systems or equipment.

17-4.5 Automatic Sprinkler System

In addition to the requirements of Chapter 11 of this document, provide a conventional wet-pipe sprinkler system designed for Extra Hazard Group 1 occupancy (0.3 gpm/ft^2 over 2500 ft^2 [12.2 mm/min over 232 m^2]) for all areas subject to maintenance, fueling, transport, or storage for fueled weapons delivery vehicles/systems.

17-5 REFUELING AREAS

17-5.1 Automatic Foam Fire Suppression

An automatic, local application, foam fire suppression system will be provided. The system will protect the area from the hazards defined within the FHA and be designed in accordance with NFPA 11. Foam concentrate and water will be provided to permit continuous operation of the system for 30 minutes. Activation of the foam discharge will be accomplished by a fire detection system meeting the requirements of Chapter 11. A pressure proportioning-type foam concentrate tank must be utilized for the foam system. High-expansion foam (if used) will be discharged at a rate to cover the hazard by least 2 feet (0.6 meter) within two minutes, and air to the high-expansion foam generator may be supplied from either within or exterior to the refueling area.

17-5.2 Electrical Equipment

Electrical equipment will comply with NFPA 70, including Chapter 5, “Special Occupancies,” and other NFPA 70 requirements related to hazardous locations.

17-5.3 Fuel Transfer Pumps

Where pumps are used for liquid fuel transfer, means will be provided to shut down liquid transfer in the event of a spill or fire.

17-5.4 Fuel Holding Tanks

Fuel holding tanks (i.e., operationally required tanks) located within refueling areas must not exceed 200 gallons (757 liters) per tank, with a maximum of two fuel holding tanks per refueling area.

Fuel holding tanks will be equipped with overfill protection.

17-5.5 Fuel Line Shutoff

Fuel supply lines entering refueling rooms will be arranged with a spring-loaded automatic shutoff valve that is activated via a fusible link.

17-5.6 Containment in Refueling Rooms

Refueling rooms will be designed to capture the entire contents of the fuel within the refueling room and the discharge of automatic fire sprinkler and foam fire suppression systems for 30 minutes. Drainage to a separate location must be approved by the Cognizant Office of Responsibility.

17-5.7 Ventilation

17-5.7.1 General

Refueling rooms will be provided with either a gravity system or a continuous mechanical exhaust ventilation system.

17-5.7.2 Exhaust Location

Exhaust air will be taken from a point near a wall on one side of the room and within 12 inches (30.5 centimeters) of the floor, with one or more make-up inlets located on the opposite side of the room within 12 inches (30.5 centimeters) of the floor.

17-5.7.3 Air Openings

The location of both the exhaust and inlet air openings will be arranged to provide air movement across all portions of the floor to prevent the accumulation of vapors.

17-5.7.4 Recirculation

Exhaust from the room must be conducted directly to the exterior of the building and must not be recirculated.

17-5.7.5 Ducts

If ducts are used, they must not be used for any other purpose and will comply with NFPA 91.

17-5.7.6 Make-Up Air

If make-up air to a mechanical system is taken from within the building, the opening must be equipped with a fire door or damper as required in NFPA 91.

17-5.7.7 Gravity Systems

For gravity air systems, the make-up air must be supplied from outside of the building.

17-5.7.8 Capacity

Mechanical ventilation systems must provide at least 1 cubic foot per minute (28.3 liters per minute) of exhaust air for each square foot (0.09 square meter) of floor area, but not less than 150 cubic feet per minute (4,248 liters per minute).

17-5.7.9 Dispensing Areas

The mechanical ventilation system for dispensing areas will be equipped with an airflow switch or other equally reliable method that is interlocked to sound an audible alarm upon failure of the ventilation system.

17-5.7.10 Air Intake Height

The minimum height of air intakes in these areas will be in accordance with UFC 4-010-01.

17-5.8 Static Electricity

Means will be provided to minimize the generation of static electricity in the refueling area. See AFI 91-203, NFPA 77, and NFPA 407.

17-6 LIQUID RUN-OFF CONTROL

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC.

Drainage must be provided in all areas of the facility for the removal of all liquids directly to safe areas, or for containment in the area and without endangering other areas. (See paragraph 17-7.6.)

17-6.1 Methods

Drainage and the prevention of equipment water damage will be accomplished by one or more of these methods:

- Floor drains
- Floor trenches
- Open doorways or other wall openings
- Curbs for containing or directing drainage
- Equipment pedestals
- Pits, sumps, and sump pumps

17-6.2 Sump Pump Systems

Waste and drainage sump pump systems will be provided with 100 percent redundant pumps.

17-6.3 Drainage and Drainage Facility Size

Drainage and any associated drainage facilities for a given area will be sized to accommodate the volume of liquid produced by all of these sources:

- The spill of the largest single container of any flammable or combustible liquids in the area (see paragraph 17-6.6 for refueling rooms)
- The credible volume of discharge (as determined by the FHA) released by the automatic suppression system operating for a period of 30 minutes, unless the approved FHA authorizes a different flow rate and duration
- The contents of piping systems and containers that could fail in a fire
- The volume of water discharged based on a manual firefighting flow rate of 500 gallons per minute (1,890 liters per minute) for 30 minutes unless the approved FHA authorizes use of a different flow rate and duration
- For areas open to the outside, such as underground loading docks, credible environmental factors such as rain and snow

17-6.4 Staging Equipment

Necessary equipment must be staged to assist with routing water from the affected area. The use of the staging equipment will be addressed in the fire department pre-fire plan.

17-6.5 Floor Drainage

Floor drainage from areas containing flammable or combustible liquids must be trapped to prevent the spread of burning liquids beyond the fire area.

17-6.5.1 Areas with Radioactive Materials

Floor drainage from storage and maintenance areas capable of containing nuclear weapons components must be trapped to prevent the spread of radioactive materials beyond the facility's controlled boundaries.

Water drainage from areas that might contain radioactivity must be collected, sampled, and analyzed before discharge to the environment or outside the boundaries of the facility.

Water released during fire suppression operations in areas containing radioactivity must be drained to a location that would be acceptable for the containment of radioactive materials.

17-6.6 Criticality Hazards

NOTE: The Cognizant Office of Responsibility for this paragraph is AFSEC.

Nuclear weapons-capable storage and maintenance areas will be designed to be criticality safe if required by the Cognizant Office of Responsibility, including consideration of the operation of automatic sprinklers and other fire suppression systems. Floor drains must be provided. Appropriate drain lines, storage, and handling systems capable of handling potentially contaminated water must be provided.

17-7 THROUGH PENETRATION FIRE STOPS

17-7.1 Where Required

17-7.1.1 Penetrations

Fire stops for penetrations such as pipes, conduits, bus ducts, cables, wires, pneumatic tubes and ducts, and similar building service equipment that passes through fire barriers will be provided to prevent the spread of fire using listed or approved materials (caulking) or devices (sleeves).

17-7.1.2 Blast-Resistant Barrier

If the fire barriers coincide with or are also serving as a blast-resistant barrier, these penetrations will also require blast-resistant devices. If the blast-resistant device is sufficient to serve as protection from the spread of fire, no additional protection is necessary. If the blast-resistant penetration device is not listed or approved for fire penetrations, it can be evaluated by a qualified fire protection engineer and accepted as a fire barrier product by the Cognizant Office of Responsibility.

17-7.2 Annular Spaces

The annular space between the penetrating item and the through opening in the fire barrier must be filled with a qualified (listed or approved) fire-resistive penetration seal

assembly capable of maintaining the fire resistance of the fire barrier. The assembly must be qualified by tests in accordance with fire test protocols or be protected by a listed fire-rated device for the specified fire-resistive period. Penetration seals provided for electrical and mechanical openings must be listed as meeting the requirements of ASTM E814 or UL 1479.

17-7.3 Conduit Seals

Refer to Chapter 3.

17-7.4 Leak Testing

Open flame- or combustion-generated smoke will not be used for leak testing.

17-8 COMMUNICATIONS

NOTE: Cognizant Office of Responsibility for this paragraph is AFSEC.

Communication systems using a lossy antenna distribution system within the facility will be limited as much as possible and must be within the allowable EMR limits of the STS.

All electrical equipment and devices are either intentional or unintentional EMR emitters as defined in Chapter 8. All such equipment to be used in close proximity to critical equipment interior to the facility must not exceed the allowable EMR limits of the STS. Anticipated EMR emitters must be analyzed to evaluate anticipated EMRE levels. If the EMRE levels exceed allowable limits, facility design, equipment selection, or procedures must be adjusted to mitigate EMRE levels.

17-9 LIFE SAFETY AND MEANS OF EGRESS

NOTE: Cognizant Office of Responsibility for this paragraph is AFCEC.

17-9.1 Life Safety Performance Criteria

The following performance criteria will be met during all operational modes and facility configurations:

- Provide safe egress or areas of refuge for all occupants of the facility.
- Provide adequate protection, including emergency lighting and communication, for essential personnel to perform necessary weapons safety and security functions in case of a fire event.

17-9.2 Occupancy Classification

17-9.2.1 Industrial facilities involved in the inspection, testing, and maintenance of nuclear weapons and weapon delivery vehicles/systems will be considered limited-access special purpose industrial occupancies as defined in NFPA 101.

17-9.2.2 Those areas involved in the storage of nuclear weapons and weapons delivery vehicles/systems will be considered limited-access special purpose industrial occupancies as defined in NFPA 101.

17-9.2.3 Support and storage areas designated for the storage of materials other than nuclear weapons will conform to the ordinary hazard storage occupancy (refer to Chapters 6 and 42 of NFPA 101) and, if applicable, limited-access requirements in NFPA 101.

17-9.2.4 General office areas, break rooms, security control rooms, and training areas will conform to the business occupancy requirements, and, if applicable, limited-access requirements in NFPA 101.

17-9.3 Occupant Load

In determining the exiting requirements for a limited-access nuclear weapons-capable maintenance and storage facility, the actual number of assigned personnel and expected number of visitors during operations, maintenance, and testing with an added safety factor must be used to determine occupant load in lieu of other criteria within NFPA 101. The safety factor will be 30 percent for maintenance areas and 20 percent for storage areas.

17-9.4 Number of Means of Egress

17-9.4.1 Fire areas designated as not limited-access must have at least two means of egress.

17-9.4.2 A single means of egress will be permitted from any story or section of a non-restricted access/egress fire area, provided the exit can be reached within 100 feet (30 meters) and when the single means of egress is approved by the Cognizant Office of Responsibility.

17-9.4.3 Limited-access fire areas must have at least one means of egress. When nuclear security requirements prohibit the use of approved egress components (such as a listed fire door meeting the requirements of NFPA 101) for the means of egress, an area of refuge must also be provided within the fire area (see paragraph 17-10.6).

17-9.4.4 Refueling room must have not less than two means of egress.

17-9.5 Horizontal Exit

A horizontal exit will be considered to be any adjacent fire area separated by at least 3-hour fire-rated construction and accessible through listed fire doors meeting the requirements of NFPA 101 and NFPA 80.

17-9.6 Area of Refuge

An area of refuge will:

- Be separated from adjacent areas by at least 3-hour fire-rated construction
- Minimize the entrance of smoke
- Be protected throughout by automatic sprinklers
- Be provided with two-way communication (including instructions on the operation of the equipment)

An area of refuge must be provided with protective heat-resistant clothing, emergency drinking water, and sufficient breathing air to permit survival for at least 72 hours based on the expected occupant load. The occupant capacity for the area of refuge will be established in the FHA.

NOTE: When possible, the area of refuge within a fire area should be located near the nuclear security access doors into the fire area.

17-9.7 Travel Distances

For weapon maintenance and storage areas, travel distances to an exterior exit, horizontal exit, or area of refuge within the fire area must not exceed 400 feet (122 meters).

For refueling rooms, travel distances to an exit must not exceed 75 feet (23 meters).

For all other limited-access areas, travel distances to an exterior exit, horizontal exit, or area of refuge within the fire area must not exceed 300 feet (91 meters)

17-9.8 Common Path of Travel

For weapon storage areas, common path of travel distances are not limited. For all other limited-access areas, the common path of travel must not exceed 100 feet (30 meters).

17-9.9 Dead-End Corridors

For restricted access/egress areas, dead-end corridors distances are not limited, provided travel distances and common path of travel distances are not exceeded. For all other areas, dead-end corridors must not exceed 50 feet (15 meters).

17-9.10 Special Locking Devices

Special locking devices (such as dead bolts and slide bolts) may be installed and left engaged on exit doors during periods of occupancy in addition to the normal door locking devices, provided that the devices are required by security, are clearly visible to the building occupants, and the building occupants are advised of their presence.

NOTE: Such locking devices should be marked or painted with a bright contrasting color (e.g., orange, yellow, red) to be clearly visible to the occupants.

17-10 ELECTROEXPLOSIVE DEVICES (EED)

NOTE: Cognizant Offices of Responsibility for this paragraph are AFCEC and AFSEC.

17-10.1 Storage and Testing Area Criteria

Areas where EEDs are stored or tested will meet the following criteria:

17-10.1.1 Separation

EED areas will be designed to withstand the internal explosive hazard and will be separated from the remainder of the facility by not less than 3-hour-rated walls.

17-10.1.2 Seals

All permanent penetrations into and out of the room must be sealed by a listed or approved means (i.e., penetration seals, fire and smoke dampers).

Penetrations that are provided for use in remote testing or remote electrical testing may be covered with a movable steel door or “flap” that is configured with a small slit that allows temporary wiring needed for the testing to penetrate the wall.

17-10.1.3 Ventilation Ductwork

Ventilation ductwork that penetrates the room must be equipped with fire or combination fire and smoke dampers with at least a 3-hour fire rating. Alternate means of protection of the ductwork (i.e., without dampers) are not permitted.

17-10.1.4 Blast Doors

Blast doors will be designed to withstand the internal explosive hazard and be evaluated by a qualified fire protection engineer to determine if the door may be considered as equivalent to that of a 3-hour-rated fire door. Use of the blast doors for this purpose must be approved by the Cognizant Offices of Responsibility.

17-10.1.5 Fire Suppression

The room will be protected by an automatic sprinkler fire suppression system.

NOTE: The sprinklers should be supplied from above the ceiling and also provided with sprinkler guards. These features will help reduce damage to the sprinkler system due to explosion.

17-10.1.6 Grounding

Grounding or bonding to an earth ground must be provided (see Chapter 3).

17-10.2 Deflagration Venting

Areas where EEDs are stored or tested must be provided with deflagration venting in accordance with NFPA 68.

17-11 ARMORIES

17-11.1 Fire Rating

Armories must be separated from the remainder of the facility by a minimum of 2-hour fire-rated construction and 1.5-hour-rated fire doors.

17-11.2 Fire Stops

Penetrations into armories will be fire stopped (e.g., fire dampers, penetration seals) in addition to security requirements.

17-11.3 Automatic Sprinklers

Armories must be protected with automatic sprinklers. The sprinkler piping into an armory may be valved to permit isolation of the system in the event of an emergency when approved by the Cognizant Office of Responsibility.

17-11.4 Security Doors

Security doors into armories will be evaluated by a qualified fire protection engineer to determine if a door may be considered as equivalent to that of the required fire-rated door. Use of the security doors for this purpose must be approved by the Cognizant Office of Responsibility.

17-12 FIRE HYDRANTS FOR ENTRY/EXIT POINTS

Fire hydrants will be installed within approximately 50 feet (15 meters) of each entry/exit point for over-the-road vehicle loading dock.

17-13 SECURITY CONTROL ROOM COMPLEX

See Chapter 5 for security control room complex requirements.

17-14 COMMUNICATIONS

For all communication systems that are wireless or EMR emitting devices, the restrictions within Chapter 8 will be implemented as appropriate.

Prior to the introduction of wireless devices, the devices must be reviewed by the Host Wing, Weapons Safety Office.

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APPENDIX B BEST PRACTICES

B-1 GUIDELINES FOR POTENTIALLY SURVIVABLE FIRE PROTECTION SYSTEM ARCHITECTURES

B-1.1 INTRODUCTION

This document defines a spectrum of facility-related requirements for nuclear weapons-capable maintenance and storage facilities. These requirements include, but are not limited to, requirements for design, construction, and maintenance. There are relatively few of these facilities and, since they have unique design features, national consensus standards are either not available or are not applicable to these facilities.

The principles of fire safety required for nuclear weapons-capable maintenance and storage facilities documented herein were developed by collecting and refining criteria from the DoD, fire protection and munitions safety experts, and national consensus fire safety standards. The document requires that an approved fire detection system and suppression system (e.g., automatic sprinkler system, water mist system, or foam-water system) be installed in all areas of the facility unless shown to be unnecessary in the FHA. The automatic sprinkler system must be designed and installed in accordance with NFPA 13 and UFC 3-600-01.

Water-based fire suppression systems are required to be hardened against possible internal or external damage. This appendix describes different approaches to increase the survivability of a required suppression system and increase the capabilities of a suppression system in a damaged area. Less-conventional, alternative survivable systems for meeting the document's hardening requirements are also described.

B-1.2 OBJECTIVE

The objective of these guidelines is to identify potential approaches to increase the survivability of required water-based fire suppression systems and to identify other potentially more survivable systems for weapons storage facilities.

B-1.3 FACILITY TYPES AND DESCRIPTIONS

B-1.3.1 Facility Types

Several types of nuclear weapons-capable maintenance and storage facilities are discussed in this appendix: ECMs, industrial facilities, and underground facilities. ECMs and underground storage areas are used primarily for storing various munitions. These facilities typically consist of a large, open area with little, if any, floor-to-ceiling compartmentalization. Industrial facilities and portions of underground storage are used for such activities as inspection, maintenance, and testing of munitions. These facilities consist of separated use areas, including administration portions (office spaces), maintenance bays, and mechanical rooms.

B-1.3.2 Compartmented Areas

Facilities capable of storing nuclear weapons and components must be subdivided into separate fire areas to minimize the risk of fire spread and the resultant consequential damage from fire gases, smoke, heat, radioactive contamination, and to aid in firefighting activities. Fire area boundaries must be provided to separate contiguous buildings or portions thereof serving different purposes, such as storage, maintenance, service, administration, and other occupancy areas as dictated by the facility design.

B-1.3.3 Open Areas

ECMs and underground storage areas typically consist of a limited number of large weapon storage areas. These areas can potentially have relatively large footprints.

B-1.4 PERFORMANCE OBJECTIVES

The system can be designed to meet three performance objectives:

- Maintaining capabilities of the system in undamaged areas.
- Containing the fire to the damaged area.
- Controlling or suppressing the fire in the damaged area.

Paragraph B-1.5 identifies approaches and techniques to configure the system to meet some or all of these objectives.

B-1.5 SURVIVABLE ARCHITECTURES

The performance objectives of the system will dictate the required architecture. The systems with the greatest capabilities would be the most complex and expensive. Conversely, systems with reduced capabilities would be the simplest and most economical to design and install. The approaches addressed in this paragraph progress from simple to more complex (i.e., in the order of the performance objectives listed in paragraph B-1.4).

B-1.5.1 Architectures for Maintaining Capabilities in Undamaged Areas

To maintain the capabilities in the undamaged areas, the system must be segregated into fire zones (referred to in this appendix as fire areas). At a minimum, a reliable water supply must be provided. Also, rupture isolation for installed agent piping must be provided. This can be accomplished using flow control valves located within each fire zone boundary.

B-1.5.1.1 Simplest Approach

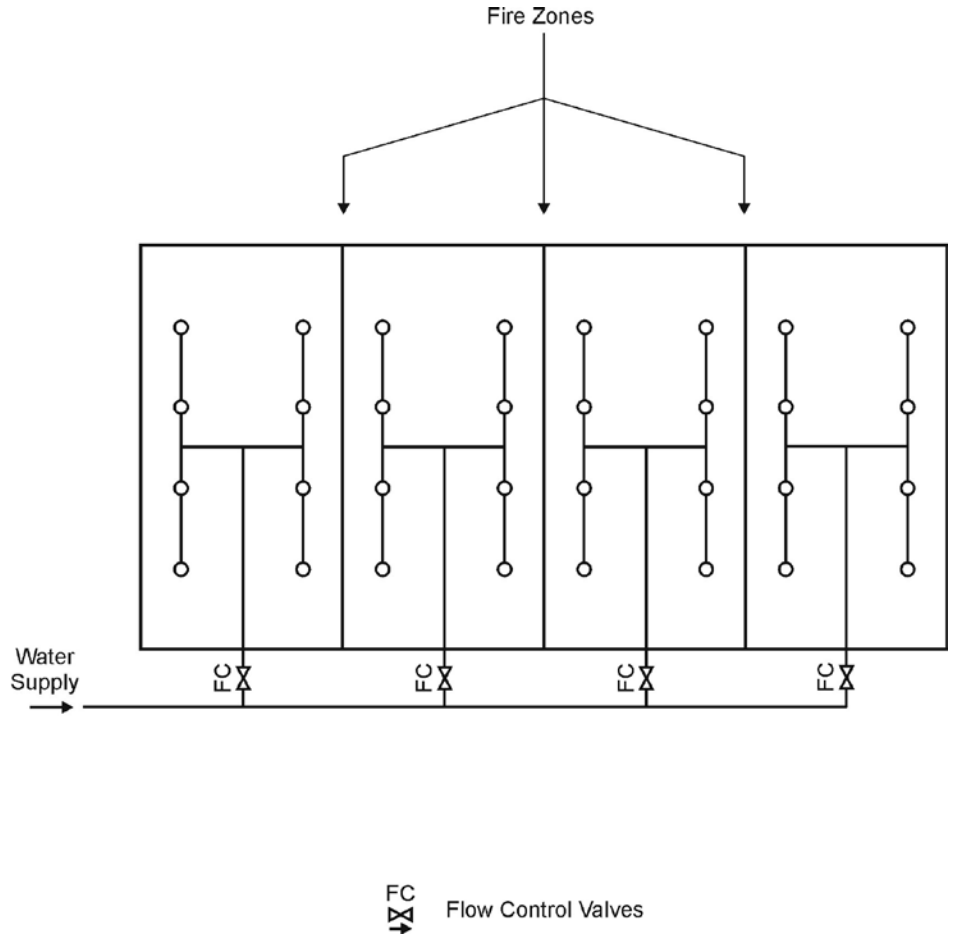
The simplest approach is to install the distribution main and control valves for each zone at a survivable location. These are potentially survivable locations:

- Low in the facility at the junction between the wall and the floor (baseboard)
- Any area that runs the length of the facility that is outside of the potential damage area from the initiating event

Installing the main in the concrete floor slab or even below grade just outside the building may also be options.

Figure B-1 shows a single survivable distribution main located outside of the facility supplied from one end with only a single control valve for each fire zone. Rupture isolation is provided by the control valves for each zone. This approach is adequate only if the distribution main and control valves are outside the damaged area.

Figure B-1 Survivable Distribution Main Architecture

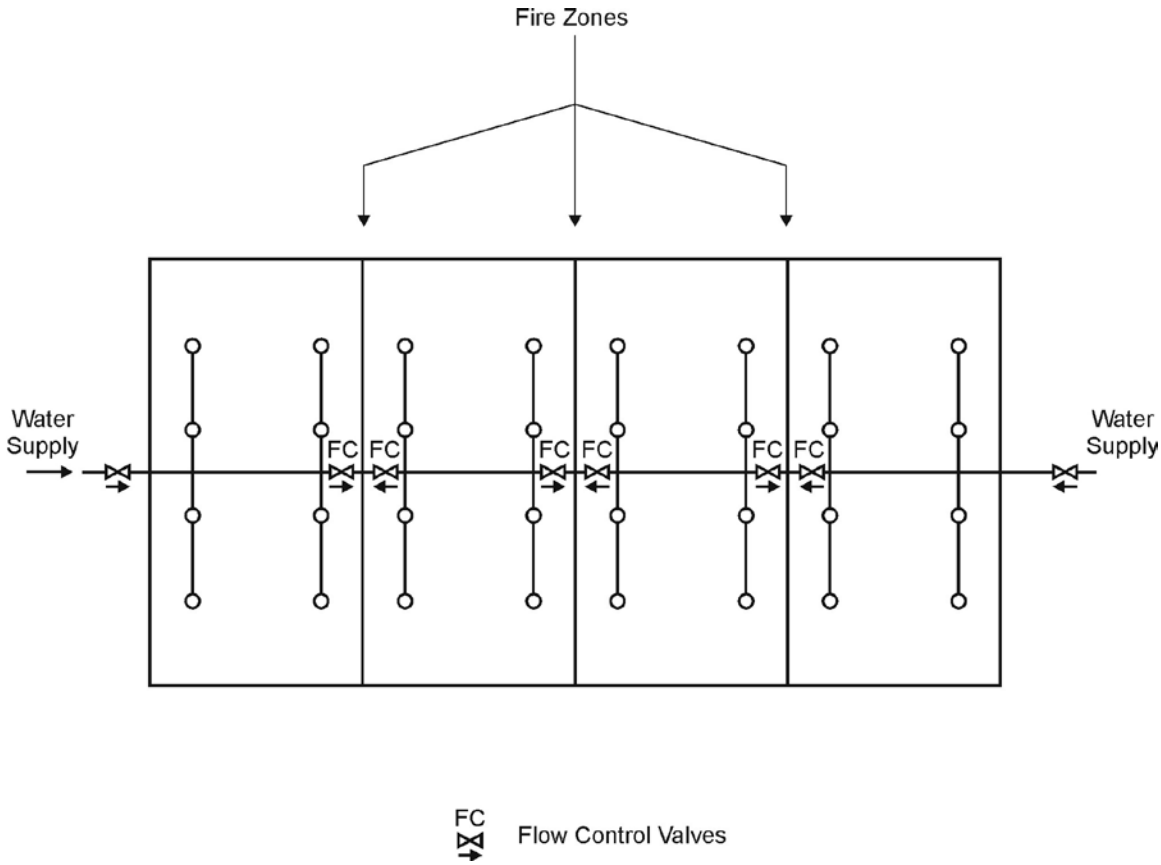


B-1.5.1.2 Alternate Approach

A second approach would be to provide redundant water supplies that enter from opposite ends of the facility. These supplies would feed into opposite ends of a distributed fire main supplying all of the fire suppression systems in the facility.

Figure B-2 shows a single distribution main supplied from opposite ends of the building, with control valves located on both sides of each fire zone boundary.

Figure B-2 Basic Survivable Architecture



B-1.5.1.2.1 Flow Control Valves

These flow control valves can be either manually operated or automatic. Manually operated flow control valves are the simplest and the easiest to install but require a manned response for the system to operate properly. Automatic valves have the advantage of not requiring a manned response but are more expensive. Automatic valves can be either self-contained mechanical or electrical valves (referred to as excess flow valves).

B-1.5.1.2.2 Excess Flow Valves

Excess flow valves automatically close if the flow through the system exceeds a preset value. The simplest type of excess flow valve is a mechanical valve (a spring-loaded piston or flapper) that is pushed closed by the friction produced by the higher flow rates. Electrical excess flow valves (sometimes referred to as smart valves) are equipped with either flow or pressure sensors that assess the flow condition through the valve and automatically secure the valve if the preset value is exceeded. These valves are

expensive and require power to be run to each valve. A backup power supply (i.e., battery) may also be required, depending on the reliability of the primary power supply. These valves are not standard fire protection system components and have been developed and tested by the U.S. Navy and the petroleum industry.

B-1.5.1.2.3 Fully Automated System

A fully automated system is the most complex and expensive. This system consists of electrical valves operated by a separate computerized control system. In addition to the control valves, the pipe network must be instrumented to provide information to the control system. An industrial flow control system used in processing-type facilities could be adapted for this application. In addition, many of the commercially available fire detection and alarm panels can be programmed to control a simple automated system.

B-1.5.2 Architectures for Containing and Combating Fire in the Damaged Area

Maintaining the capabilities of the system in the undamaged zones is the first step in containing the fire to the damaged area. The surviving parts of the system in the undamaged area may not prevent the fire from spreading into the undamaged areas. Specifically, the surviving adjacent zones may not activate until fire has spread into that area.

As currently designed, the adjacent zones have no capabilities against the fire in the damaged area. To obtain these capabilities (containment or suppression of the fire in the damaged area), the system would need to be modified to include additional nozzles, or a new or different system would need to be considered.

B-1.5.2.1 Detection and Control System

Modifying the existing sprinkler system or selecting a new system for this application would result in a more sophisticated and complex system than the conventional sprinkler systems commonly in use. Specifically, the modified or new systems would need to be controlled by a separate detection and control system. This is required since the added component or new system used to combat the fire in the damaged area must be located away from the damage. The fire detection system required in Chapter 11 of this document could be used to control this more sophisticated system, minimizing the cost to obtain these additional capabilities. All of the architectures and systems discussed in the following paragraphs would incorporate the required fire detection system to control the fire suppression system.

B-1.5.2.2 Applicability

The discussion in paragraphs B-1.5.2.3 through B-1.5.2.5 applies only to open areas within the facility. Compartmented areas (office-type spaces, shops, and services areas) are difficult to protect from adjacent zones. This is typically acceptable since the open storage areas are a primary hazard of concern.

As a final point, a conventional automatic sprinkler system may not be the best choice for protecting large, open spaces. Namely, larger fires are required to activate the automatic sprinkler system in open storage areas. This may justify the need for a more sensitive detection system that could be used to control the fire suppression system.

The following paragraphs identify two approaches that can be used to increase the capabilities of the required automatic sprinkler system against a damage scenario.

B-1.5.2.3 Approach 1: Switch to Deluge Sprinkling

Since larger fires are typically required to activate automatic sprinklers in large, open areas, deluge sprinkling may be a better option than thermally activated heads.

B-1.5.2.3.1 System Activation

The detection system installed in the space would activate the system. The activation criteria (for the undamaged system) can be selected based on the ambient conditions in the facility and the nature of the hazard. For example, a default can be to activate the system using 135 degrees F (57 degrees C) intrinsically safe heat detectors. If a more sensitive detection system is required, cross-zoned smoke detectors are an option.

B-1.5.2.3.2 Adjacent Zones

The system can be programmed to automatically discharge water in the zones adjacent to the damaged area. This will help prevent fire spread into these zones or areas by pre-wetting any combustible materials located in these areas.

B-1.5.2.3.3 Flow Rates

Electrical excess flow valves would need to be used for this application (controlled by the detection system) due to the higher flow rates associated with the deluge sprinkling zones. The flow rates of a deluge sprinkling zone may be similar to a damaged system in many scenarios.

B-1.5.2.4 Approach 2: Add Nozzles or Monitors to the Existing System

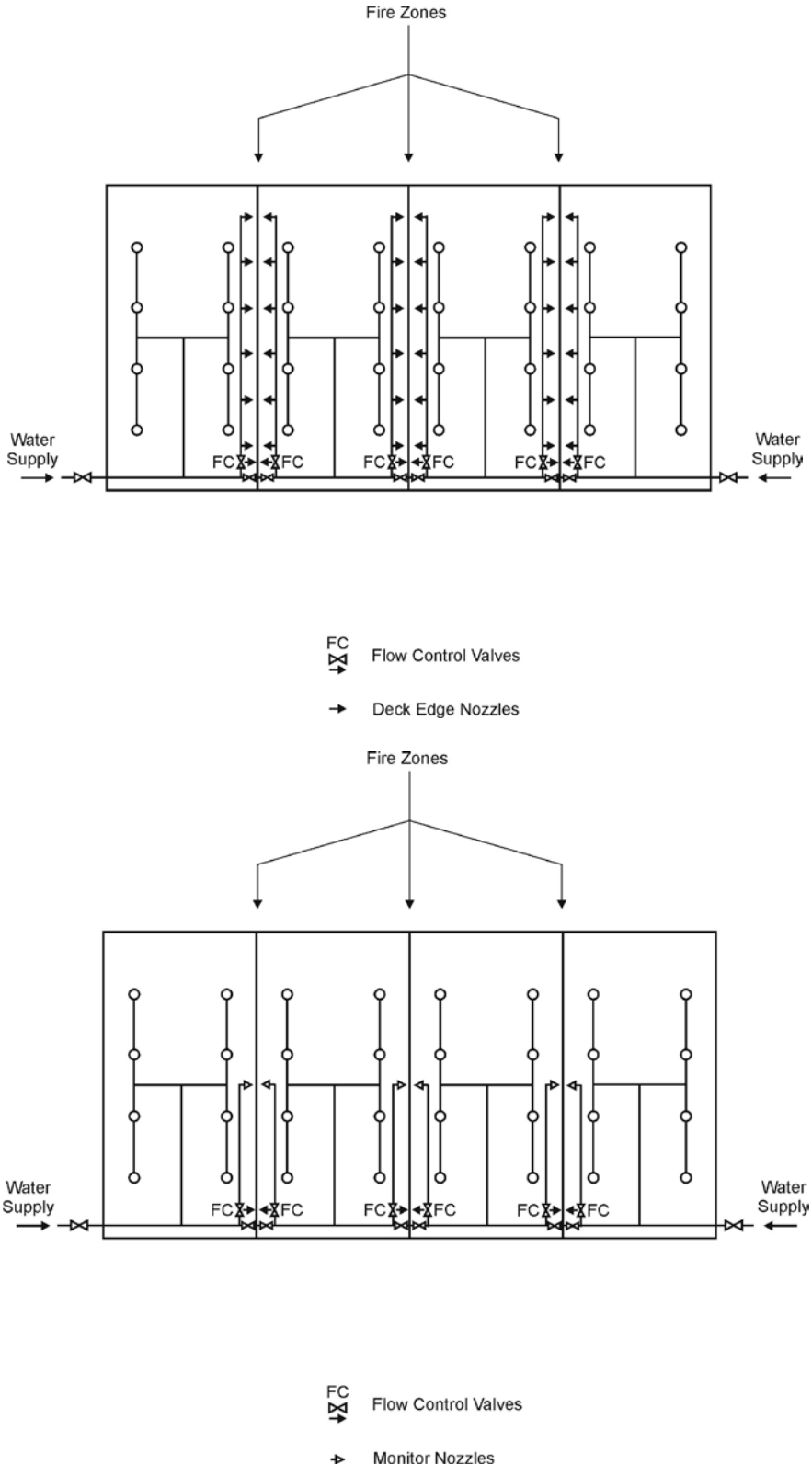
To combat the fire in the damaged area, additional nozzles or monitors would need to be added to the system. These nozzles or monitors would be installed high in the adjacent zones, spraying into the damaged area or zone. If the damaged area or zone is separated from the adjacent zone by a wall, the nozzles or monitors can be installed in the boundary to spray into the damaged area. Acceptability of penetrating the zone boundary must be considered since this is a violation of fundamental zone integrity criteria (i.e., zones are not typically penetrated).

The simplest approach would be to add a line of nozzles on both sides of each fire zone boundary, spraying into the adjacent zone. An approved “deck edge”-type system (the nozzle arrangements used to protect the flight decks of U.S. Navy surface

combatants but installed high in the space) is recommended for this application. Another approach would be to provide one or more 125-gallons-per-minute (473 liters per minute) monitors (depending on the size of the fire zone) on both sides of each fire zone boundary, spraying into the adjacent zone. The monitors must be located at a place that is least likely to be obstructed by the contents in the space. A drawing of the two approaches is provided in Figure B-3.

The branch line containing the supplemental nozzles or monitors would be equipped with an electrically operated valve controlled by the installed fire detection system. The system can be programmed to automatically discharge water into the damaged zone if any or all of the detectors in that zone are reported as damaged (each detector is in “FAULT”). This approach provides the potential to combat the fire in the damaged area.

Figure B-3 Systems That Discharge Water in the Damaged Area



B-1.5.2.5 Aqueous Film-Forming Foam (AFFF)

The default for the two systems (nozzles or monitors) would be to discharge water since they are basically add-ons to the automatic sprinkling system; however, water has only limited capabilities against a potential Class B fire. Specifically, the water would have some effect in controlling the fire but would not be able to suppress or extinguish the fire. To suppress or extinguish the fire, the system would need to discharge aqueous film-forming foam (AFFF).

To add the ability to discharge AFFF, proportioning systems would need to be added to both ends of the distributed fire main. The system would be designed to discharge water in the sprinkler mode but would switch to AFFF when the valves to the branch lines containing the additional nozzles or monitors are opened.

The previous two approaches can be used to supplement either the automatic (system with thermally activated heads) or deluge sprinkler systems.

B-1.5.3 Alternative Systems for Containing and Combating Fire in the Damaged Area

The two systems described in this paragraph could be installed as a substitute for the required automatic sprinkler system. Both systems would incorporate a supply main capable of rupture isolation as described in paragraph B-1.5.1. Both systems would also be controlled by the fire detection system installed in the space (required in Chapter 11 of this document or added to control the hardened system). The activation criteria (for the undamaged system) can be selected based on the ambient conditions in the facility and the nature of the hazard. The default can be to activate using 135 degrees F (57 degrees C) intrinsically safe heat detectors. If a more sensitive detection system is required, cross-zoned smoke detectors may be an option. The system would activate when one or a group of detectors are damaged (the detector is in “FAULT”).

B-1.5.3.1 Approach 1: Replace the Sprinkler System with Monitors

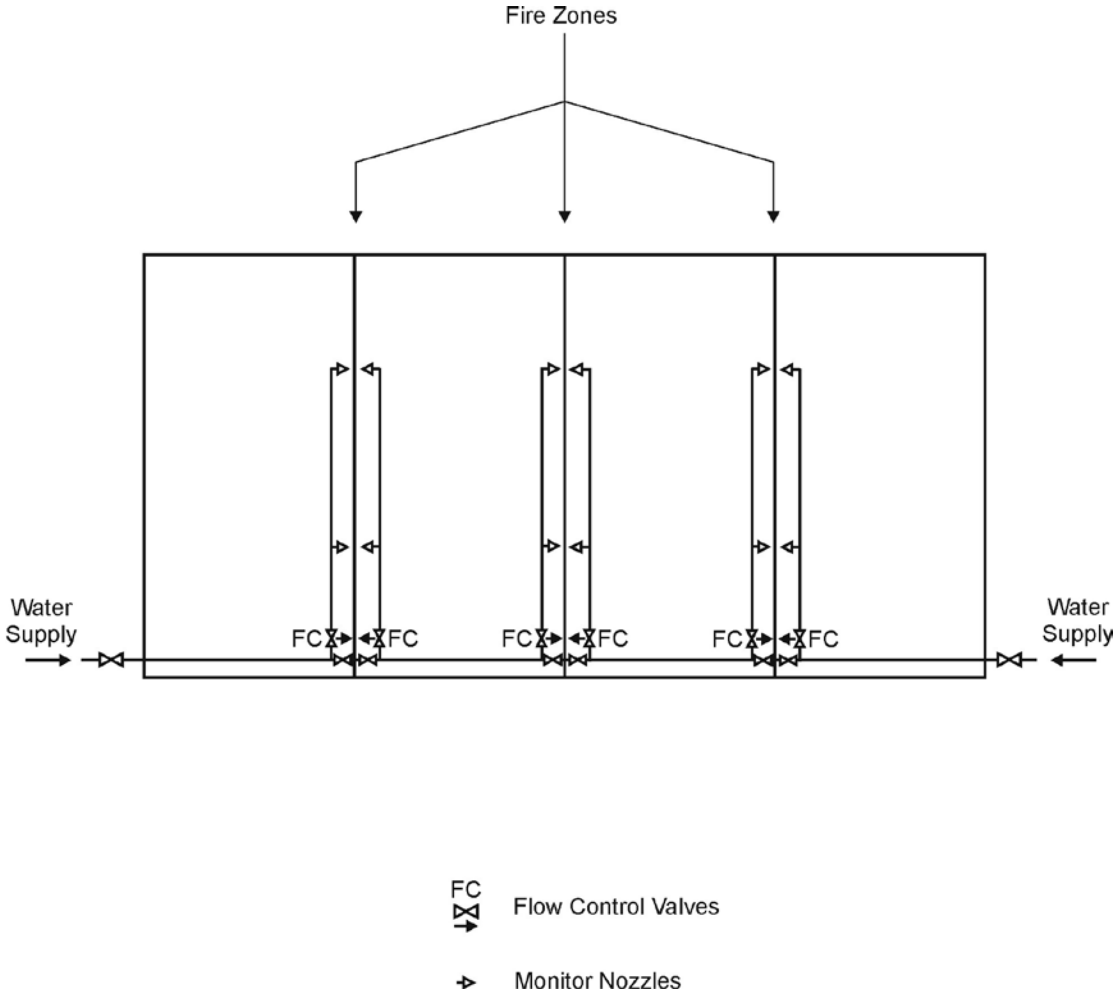
One approach would be to replace the required automatic sprinkler system with one consisting solely of monitors. A system produced using monitors has a better chance of being survivable due to the stream reach characteristics of the device (i.e., the monitor can be located away from the damage) and the reduced amount of piping (no overhead nozzle grid). The system will be designed to provide the same application density (water flow rate per unit area) as the automatic sprinkler system being replaced. In addition, the system would be sized for the simultaneous discharge of the two largest fire zones. An example of a system with monitors is shown in Figure B-4.

B-1.5.3.1.1 Configuration

As shown in Figure B-4, the monitors are located outside of the zone they are protecting. If the damaged area or zone is separated from the adjacent zone by a wall, the monitors would be installed in the boundary, spraying into the damaged area.

Each zone contains two monitors (or more, depending on the size of the zone) located adjacent to the protected area. This approach can work only if there is an uncluttered and unobstructed space for the monitors to be installed with direct coverage of the protected area. The branch line containing the monitors would be equipped with an electrically operated valve controlled by the installed fire detection system. The monitors would be set to automatically oscillate through the protected zone (bounded by limit switches).

Figure B-4 System Consisting of Monitors



B-1.5.3.1.2 AFFF Capability

Since water has only limited capabilities against a potential Class B fire, the system would also be capable of discharging AFFF. To add this capability, proportioning systems would need to be added to both ends of the distributed fire main. The system would be designed to discharge water when the detectors go into ALARM but would switch to AFFF when the detectors have been damaged (show a “FAULT”). This system

is a cost-effective option that provides protection against an incipient-type fire as well as more damaging incidents.

B-1.5.3.1.3 Disadvantages

The primary disadvantage of the system is that monitors require more maintenance than a fixed overhead nozzle grid. There is also a greater chance of “false positive” actuations, i.e., operation of the fire suppression system due to a false detection signal.

B-1.5.3.2 Approach 2: Replace the Sprinkler System with High-Expansion Foam

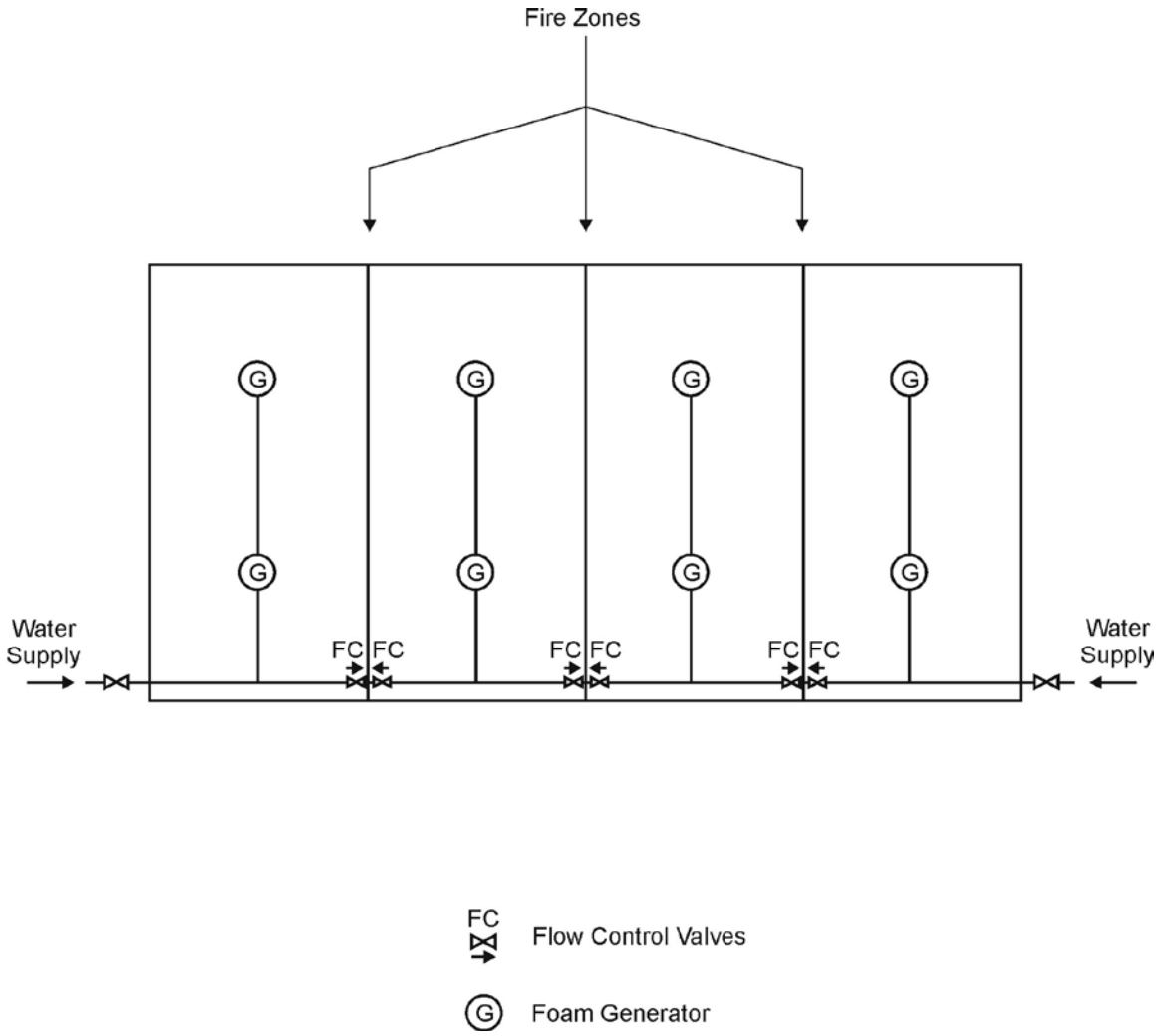
A significantly different approach would be to replace the automatic sprinkler system with a high-expansion foam system. A high-expansion foam system has potentially better capabilities in a damage scenario than an automatic sprinkler system. This is primarily due to the flow characteristics of the foam, i.e., foam would flow from adjacent zones through any penetrations into the damaged area. Another significant advantage of the system is that it has good capabilities against Class B fires. Automatic sprinkler systems have very limited capabilities against Class B fires. The disadvantage of high-expansion foam is that the system needs to be designed to fill the entire enclosure, i.e., high-expansion foam systems can be zoned properly only if the zones are separated by physical barriers to confine the foam in the protected area. Discharging foam throughout the entire area is a major disadvantage for the system during an inadvertent activation or during a smaller, incipient fire scenario (due to clean-up and potential collateral damage issues).

B-1.5.3.2.1 Requirements

The system would be designed to meet the requirements of NFPA 11. For large, open areas or facilities, the system would be designed to uniformly discharge foam throughout the entire area containing the ordnance; however, the system architecture would be designed with zones—but only for rupture isolation purposes because the rupture isolation would allow the undamaged generators in the space to operate properly. For facilities that have fire zones segregated by walls, the system would be designed similar to the system containing monitors, with the foam generators installed in the adjacent zone spraying through the fire zone boundary into the damaged area or zone.

NFPA 11 requires that the system fill the enclosure to a minimum depth of 10 percent above the height of the highest combustible material or 2 feet (0.6 meter) above the highest combustible, whichever is greater. This must occur in a specified maximum time period ranging from two to eight minutes, depending on the type of construction, the presence of an automatic sprinkler system, and the type of materials stored in the space. For this application, it is recommended that the system fill the space to the required depth in less than two minutes. The concentrate and water supplies should have a minimum capacity of 15 minutes. An example of a high-expansion foam system for a large, open area or facility is shown in Figure B-5.

Figure B-5 Example High-Expansion Foam System



B-1.5.3.2.2 Configuration

As shown in this figure, the system supply lines or mains are similar to the automatic sprinkler system described in paragraph B-1.5.1. As with the automatic sprinkler system, the system would be supplied from opposite ends of the facility. A bladder tank proportioning system would be required at both supply points (not shown in the drawing). Rupture isolation is accomplished using flow control valves located on both sides of each fire zone boundary. Mechanical excess flow valves are recommended for this application (most cost-effective and simplest to install).

Due to the simple architecture of the system, only two control valves are required (one at each end of the system). Both valves would be activated by the fire detection system in the event of a fire. Any damaged piping would automatically be isolated and foam would flow from the remaining generators in the space.

B-1.6 SUMMARY AND CONCLUSIONS

The performance objectives of the system will dictate the required architecture. The systems with the greatest capabilities would be the most complex and expensive. Conversely, systems with reduced capabilities would be the simplest and most economical to design and install.

B-1.6.1 Simplest Approach

Maintaining the capabilities of the water-based fire suppression system in the undamaged area is the first step in preventing significant fire spread to adjacent areas. The suppression system must be segregated into fire zones (referred to in this appendix as fire areas). A reliable water supply must be provided. The easiest approach is to supply the system with redundant water supplies at opposite ends of the facility. Rupture isolation must also be provided. Rupture isolation can be accomplished using flow control valves located on both sides of each fire zone boundary. Mechanical excess flow valves are recommended for this application because these valves are the most cost-effective and simplest to install.

In this design, the adjacent zones have no capabilities against the fire in the damaged area. To combat the fire in the damaged area, the suppression system would need to be modified to include additional nozzles, or a new or different system would need to be considered.

B-1.6.2 More Complex Approaches

Modifying the existing sprinkler system or selecting a new system for this application would result in a more sophisticated and complex system than the conventional automatic sprinkler systems commonly in use. Specifically, these modified or new systems would need to be controlled by a separate detection and control system. The fire detection system required in Chapter 11 of this document can be used to control this more sophisticated system, minimizing the cost to obtain these additional capabilities.

Alternative modifications, such as installing additional nozzles or monitors in the adjacent zones that project into the damaged area, would increase the capabilities of the existing system in the damaged area. A line of nozzles similar to a “deck edge”-type system but installed high in the space could be used for this application. Another approach would be to install monitors that automatically oscillate through the damaged area. The monitors would need to be located at a place that is least likely to be obstructed by the contents in the space for the system to be effective and reliable. For these two systems to be effective against a potential Class B fire, the systems would need to be capable of discharging AFFF.

Two less conventional systems have the capability to combat the ensuing fire in a damage scenario: a system consisting solely of monitors and a high-expansion foam system. Monitors can be located outside the zone they are protecting, allowing the system to maintain some capabilities in the damaged area. To be effective against a

potential Class B fire, the system consisting of monitors would need to be capable of discharging AFFF. High-expansion foam has good capabilities against Class B fires and would flow foam into the damaged areas from adjacent zones. High-expansion foam has the disadvantage of needing to fill the entire open area. (High-expansion foam can be zoned only if the protected area is bounded by physical barriers). Either system could be used as a substitute for an automatic sprinkler system.

APPENDIX C GLOSSARY

C-1 ACRONYMS

AE	ammunition and explosive
AF/A4SN	Headquarters Air Force Security Forces, Nuclear Security Division
AFCEC	Air Force Civil Engineer Center
AFCEC/COS	Air Force Civil Engineer Center, Engineer
AFFF	aqueous film-forming foam
AFGSC	Air Force Global Strike Command
AFI	Air Force instruction
AFMAN	Air Force manual
AFNWC	Air Force Nuclear Weapons Center
AFPD	Air Force policy directive
AFSEC	Air Force Safety Center
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATS	automatic transfer switch
Btu/lb	British thermal units per pound
C	Celsius
CB	chemical-biological
CBR	chemical-biological-radiological
DDESB	Department of Defense Explosives Safety Board
DoD	Department of Defense
DoDD	Department of Defense directive
DoDI	Department of Defense instruction
DoDM	Department of Defense manual

DOE	Department of Energy
ECM	earth-covered magazine
EED	electro-explosive device
EFS	essential facility systems
EIS	Engineering Installation Squadron
EMR	electromagnetic radiation
EMRE	electromagnetic radiation environment
ETL	Engineering Technical Letter
F	Fahrenheit
FC	Facilities Criteria
FHA	fire hazard analysis
ft^2	square foot
gpm/ft^2	gallons per minute per square foot
HEPA	high efficiency particulate air
HVAC	heating, ventilation, and air conditioning
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
kJ/kg	kilojoules per kilogram
LPS	lightning protection system
m^2	square meter
MCFL	maximum credible fire loss
MCE	maximum credible event
MIC	microbiologically induced corrosion
MIL-STD	Military Standard
mm/min	millimeters per minute

MNS	mass notification system
MPFL	maximum possible fire loss
NFPA	National Fire Protection Association
OS&Y	outside screw and yoke
P.E.	professional engineer
SCBA	self-contained breathing apparatus
SFPE	Society of Fire Protection Engineers
STS	stockpile-to-target sequence
UFC	Unified Facilities Criteria
UL	Underwriters Laboratories, Inc.
UPS	uninterruptable power supply

C-2 DEFINITION OF TERMS

Area of Refuge: A room or space that is designated, marked, and suitably equipped to provide a temporary place of safety for building occupants while awaiting rescue during a fire emergency.

Characterization: The process that includes the following: testing and analyzing a facility to determine the effectiveness of a Faraday shield (also known as low impedance testing); electrically bonding metallic penetrations to the Faraday shield; installing appropriate surge suppression; and establishing a reduced safe separation distance (SSD) based on specific test results and analyses.

Combustible: Capable of undergoing combustion.

Combustible Liquid: A liquid that has a closed-cup flash point at or above 100 degrees F (37.8 degrees C).

Criticality: The state of sustaining a chain reaction, as in a nuclear reactor.

Criticality Incident: An accidental, self-sustained nuclear fission chain reaction.

Defense in Depth: A principle aimed at providing a high degree of fire protection by achieving a balance of preventing fires from starting; detecting fires quickly and suppressing those fires that occur, thereby limiting damage; and designing a nuclear facility to limit the loss of life, property, and environment to fire and to ensure continuity of facility operation and safety.

Deflagration: Propagation of a combustible zone at a velocity that is less than the speed of sound in the unreacted medium.

Detonation: Propagation of a combustion zone at a velocity that is greater than the speed of sound in the unreacted medium.

Electromagnetic Radiation (EMR): EMR is a ubiquitous phenomenon that takes the form of self-propagating waves in a vacuum or in matter. It consists of electric and magnetic field components that oscillate in phase perpendicular to each other and perpendicular to the direction of energy propagation. Electromagnetic radiation is classified into several types according to the frequency of its wave; these types include (in order of increasing frequency and decreasing wavelength) radio waves, microwaves, terahertz radiation, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays.

Fire Area: An area that is physically separated from other areas by space, barriers, walls, or other means to contain fire within that area.

Fire Barrier: A continuous vertical or horizontal construction assembly designed and constructed to limit the spread of heat and fire and to restrict the movement of smoke.

Fire Door: A door assembly rated in accordance with NFPA 252 and installed in accordance with NFPA 80.

Fire Hazard Analysis (FHA): An analysis that evaluates potential fire hazards and appropriate fire protection systems and features to mitigate the effects of fire in any area.

Fire Model: Mathematical prediction of fire growth, environmental conditions, and potential effects on structures, systems, or components based on the conservation equations or empirical data.

Fire Prevention: Measures directed toward avoiding the inception of fire.

Fire Protection: Methods of providing fire detection, control, and extinguishment.

Fire-Rated Cables: Cables with an hourly fire resistance rating based on maintaining functionality when exposed to the fire tests in NFPA 251.

Fire-Rated Internal Seal: A conduit seal that is a tested and approved hourly rated fire seal in accordance with ASTM E814.

Fire-Rated Penetration Seal: An assembly provided in a fire barrier opening for the passage of pipes, cable trays, and so forth, to maintain the fire resistance rating of the fire barrier.

Fire-Resistant Hydraulic Fluid: A listed hydraulic fluid or lubricant that is difficult to ignite due to its high fire point and auto-ignition temperature and that does not sustain combustion due to its low heat of combustion.

Fire Resistance Rating: The time, in minutes or hours, that materials or assemblies have withstood a fire exposure as established in accordance with an approved test procedure appropriate for the component under consideration.

Flame Spread Rating: A relative measurement of the surface burning characteristics of building materials when tested in accordance with NFPA 255.

Flammable Liquid: A liquid that has a closed-cup flash point that is below 100 degrees F (37.8 degrees C) and a maximum vapor pressure of 40 pounds per square inch absolute (psia) (2,069 Torr) at 100 degrees F (37.8 degrees C).

Hot Work: Any temporary operation involving open flames or producing heat or sparks, including brazing, cutting, grinding, soldering, arc or gas welding, plasma welding, or torch-applied roofing. Cutting and grinding classified as hot work is limited to operations that produce significant sources of heat or spraying sparks such that they are considered ignition sources to surrounding combustible materials.

Hot Work Permit: A daily or weekly authorization document provided by the fire department for performing hot work outside of an established permissible welding area.

Limited Access Facility: A structure or portions of a structure lacking emergency openings (see NFPA 101).

Limited-Combustible: A building construction material not complying with the definition of noncombustible material that, in the form in which it is used, has a potential heat value not exceeding 3,500 Btu/lb (8,141 kJ/kg) where tested in accordance with NFPA 259 and complies with (a) or (b) below. Materials subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition will be considered combustible. (a) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8 inch (3.2 millimeters) that has a flame spread index not greater than 50. (b) Materials, in the form and thickness used, other than as described in (a), having neither a flame spread index greater than 25 nor evidence of continued progressive combustion and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame spread index greater than 25 nor evidence of continued progressive combustion.

Mass Notification System (MNS): A system that provides real-time information to all building occupants or personnel in the immediate vicinity of the building during emergency situations.

Maximum Credible Fire Loss (MCFL): A worst-case fire scenario in which all installed fire protection features operate as designed.

Maximum Possible Fire Loss (MPFL): A worst-case fire scenario in which all fire protection features are not operable and the fire is involved within the entire fire area that is bounded by not less than 3-hour fire barrier walls.

Noncombustible: Not capable of supporting combustion.

National Consensus Standards: Standards, such as those by NFPA, that are consensus by preparation and approval, based on a very specific set of regulations. Generally, these standards are only mandatory when adopted.

Nationally Recognized Testing Laboratory (NRTL): A laboratory that provides fire testing and labeling services to list or approve products. Generally, such laboratories are certified by a national laboratory certification agency.

Occupancy: The purpose for which a building or portion thereof is used or intended to be used.

Radiation: The emission and propagation of energy through matter or space by means of electromagnetic disturbances that display both wave-like and particle-like behavior.

Radioactivity: The spontaneous decay or disintegration of an unstable atomic nucleus accompanied by the emission of radiation.

Redundant Component, System, or Subsystem: A component, system, or subsystem that independently duplicates the essential function of another component, system, or subsystem.

Self-Contained Breathing Apparatus (SCBA): An approved device that provides the user with a safe supply of breathing air via a compressed air cylinder, positive pressure regulator, and full-face mask. The air supply is generally for 30 to 45 minutes.

Through-Penetration Firestop: A tested, fire-rated construction consisting of the materials that fill the openings through the wall or floor around penetrating items such as cables, cable trays, conduits, ducts, and pipes, and their means of support to prevent the spread of fire.

Underground Facility: A structure or portions of a structure in which the floor level is below the level of exit discharge (see NFPA 101).

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UNIFIED FACILITIES CRITERIA (UFC)

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Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**
1	April 1, 2019	1-4, ccr 4719, 1-5.5 ccr 5512, 2-3.4.1 ccr 4720,3-1.1 ccr 6625, 2-6 ccr 7378, 2-8 ccr 4721 and ccr 4722, 3-6.5 ccr 4723, Figure 3-13 ccr 4724, 3-15.1.2 ccr 4726, 4-2.1 ccr 4727, 4-3.1.5 ccr 4728,4-4.4 ccr 4729

This UFC supersedes UFC 4-440-01A, dated March 1, 2005 and UFC 4-442-01N, dated January 16, 2004.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site https://www.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

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UNIFIED FACILITIES CRITERIA (UFC)
NEW SUMMARY SHEET

Document: UFC 4-440-01, *WAREHOUSES AND STORAGE FACILITIES*

Superseding: UFC 4-440-01A *Storage Depots* and UFC 4-442-01N *Design; Covered Storage.*

Description: This new UFC, "*WAREHOUSES AND STORAGE FACILITIES*" replaces UFC 4-440-01A, *Storage Depots* (Army) and UFC 4-442-01N, *Design: Covered Storage* (Navy). These existing UFCs are not unified. The Army document is former TM 5-840-02 dated October 7, 1994. The Navy document is former Military Handbook 1032/2 dated September 30, 1987.

Reasons for Document:

- The new UFC will provide updated guidance for new warehouses and covered storage facilities.

Impact:

- The result of these changes is a document which can more practically be used as part of a construction contract and is more easily understood by the users, more relevant to current practice and is properly coordinated with other Government requirements documents.

Non-Unified Items:

- Differing policies for Navy and Marine Corps, Army, and Air Force appear in paragraphs entitled "*Controlled Humidity Warehouse", "Flammable / Hazardous Storage Within Other Storage Facilities",* and "*Flammable / Hazardous Materials Storage"*.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This Unified Facilities Criteria (UFC), UFC 4-440-01, contains criteria for planners, engineers, and architects on the planning, engineering, and design of Department of Defense (DoD) storage facilities. The information in this UFC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental Unites States (CONUS) and outside the continental US (OCONUS). Alteration and renovation projects must update existing facilities to meet the guidance and criteria contained in this UFC within budgetary constraints. This is supplementary guidance to be used in conjunction with Facility Requirements Documents (FRD), Facility Requirements Supplements (FRS), Intrusion Detection Systems Engineering Plans (IDSEP), Installation Appearance Plan (IAP), and other DoD material for the planning and construction of DoD storage facilities and to support the preparation of DD 1391 project documentation.

1-2 APPLICABILITY.

This UFC will be used for planning individual projects, preparing engineering documentation, and preparing contractual documents for construction. It is intended to present the basis for standardization of practices and identify a common baseline to be used during the planning of new facilities or the modification of existing facilities.

1-2.1 Conflicts in Criteria

Where conflicts appear between the general criteria contained in the Whole Building Design Guide (WBDG) website and the guidance in this document, the guidance in this UFC governs.

> **Exception:** Navy and Marine Corps planning criteria is governed by UFC 2-000-05N, *(P-80) Facility Planning Criteria for Navy/Marine Corps Shore Installations*. Conflicts must be brought to the attention of the UFC 2-000-05N program manager through a Criteria Change Request (CCR). To submit a CCR go to the following link: https://cms.wbdg.org/ccrs/new?ufc=2-000-05N

1-3 GENERAL BUILDING REQUIREMENTS

Comply with UFC 1-200-01*, General Building Requirements*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this FC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-4 TYPES OF STORAGE FACILITIES

The criteria in this UFC cover the design requirements for warehouse facilities; General Purpose Warehouse, Controlled Humidity Warehouse, \1\ Hazardous Materials Storage, /1/ and Shed Storage, or the combination of these storage facility types. These criteria address the factors which affect the functional effectiveness of warehouse facilities. Included in these factors are siting, system selection, facility layout, area, storage height, life-cycle costs, energy efficiency, and internal details. Since modern storage facilities are integrated operations in which the structure and materials handling/ storage equipment function as a system, coordination and integration of equipment and structure requirements is essential to proper operation of the system. The more common facility types following:

1-4.1 General Purpose Warehouse

General Purpose Warehouse includes, conditioned, semi-conditioned, and unconditioned types, with and without overhead crane capability. The general purpose warehouse provides space for bulk and bin storage, aisle space, receiving and shipping space, packing and crating space, and office and toilet space.

1-4.2 Humidity Controlled Warehouse

A humidity controlled warehouse is similar to a general purpose warehouse except that it is designed with enhanced features for humidity control, such as: humidity control equipment and enhanced building envelope design. This warehouse may be a separate building or contiguous with a general purpose warehouse. Requirements for controlled humidity space must be thoroughly justified. Such requirements must be considered a portion of the total space allowed for the facility type. Use DoD Real Property Classification System (RPCS); Category Codes 441-10 through 441-40 facility types. Planning for storage of material in controlled humidity space for varying periods of time is authorized when the use of such space performs the following:

a. Permits technical material and material highly sensitive to moisture to be stored in a state of readiness for immediate issue.

b. Permits a reduction in the cost in initial preservation or re-preservation of material.

c. Affords significant reduction in either the reactivation time or the reactivation cost of material, or both.

d. Maintains the condition of any material being held in temporary storage while awaiting repair, disposition, preservation or re-preservation, or assembly of components.

e. Affords the desired supplemental protection to material already subjected to preservation treatment

1-4.3 Shed Storage

A shed is a roofed structure without complete side or end walls. Sheds are typically used for storage of gas cylinders, drummed Petroleum/Oil/Lubricant (POL), vehicles, unfinished lumber, and other construction material. In areas where it is impractical to use shed space for the storage of materials because of weather conditions, storage requirements must be included as warehouse space and complete justification must be submitted. Sheds storing hazardous materials are subject to special design requirements and must comply with criteria in Chapter 4 of this UFC.

1-4.3.1 General Purpose Shed

Provide minimum utilities consisting of electricity for lighting and electrically operated equipment and tools. Provide fire protection in proportion to the type of material stored and the loss potential.

1-4.4 Hazardous Materials Storage within Other Storage Facilities

Hazardous materials warehouses differ significantly from general purpose warehouses due to the materials stored and the provisions made to prevent, and remove through proper ventilation, mists, gases, and vapors in accordance with National Fire Protection Association (NFPA) *Flammable and Combustible Liquids Code*, NFPA 30 and NFPA 430, *Code for the Storage of Liquid and Solid Oxidizers*. Materials considered for storage in this category facility include paints, certain packaged Petroleum/Oil/Lubricant (POL) materials, chemicals, acids, corrosive liquids, oxidizing materials, and other similar hazardous flammable materials. Space justified for hazardous materials storage must be considered a portion of the total space allowed for the facility type. Such space must not exceed 5 percent of the total space. Such flammable and combustible liquid storage area(s) must comply with the requirements of Chapter 4 of this UFC.

Use DoD Real Property Classification System (RPCS); Category Codes 441-10 through 441-40 facility types.

1-5 EXCLUSIONS

Design of the following types of storage facilities is not covered by this UFC:

1-5.1 Cold Storage

Cold storage warehousing is planned to satisfy the primary function of preservation of the quality of perishable foods and general supply materials that require refrigeration. The warehouse will include freeze and chill space, processing facilities, and mechanical areas. Cold Storage warehouses are not included. See Unified Guide Specification (UFGS) 11 41 11, *Refrigerated and Frozen Food Storage Equipment* for additional guidance.

1-5.2 Liquid Storage

Bulk tanks and associated equipment for liquid fuel storage and storage of liquids other than water, fuel tanks, and propellant tanks are not included. Refer to UFC 3-460-01, *Design: Petroleum Fuel Facilities*.

1-5.3 Ammunition Storage

Magazines, specialized warehouses, tanks, and open pads for storage of ammunition, inert ammunition components, liquid propellants, and weapon related batteries are not included.

1-5.4 Open Storage

Non-covered storage areas, paved or otherwise are not included.

1-5.5 Hazardous Waste Storage

Facilities which are used for storage of hazardous waste or are otherwise subjected to the requirements of 40 Code of Federal Regulations (CFR) *Protection of Environment*, Part 264 *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities* \1\/1/are not included.

1-6 APPENDICES

Appendix A contains a list of references used in this document. The publication date of the code or standard is not included in this document. In general, the latest available issuance of the reference is used.

Appendix B identifies background information and best practices for accomplishing design and engineering services.

Appendix C contains acronyms, abbreviations, and terms.

CHAPTER 2 PLANNING AND LAYOUT

2-1 PROJECT INITIATION AND PLANNING

This UFC provides information required for preparation of DD Form 1391, which initiates project development. This includes information about functions, space allowances, overall building size, site evaluation, and special factors to consider in developing overall scope and cost estimates. It provides data and criteria needed at each stage of planning, project engineering, and the design process.

2-1.1 Project Analysis and Engineering Phase

After a project is initiated, it is analyzed and defined. During the Project Analysis stage, the project team meets to define the project so as to have a clear understanding of the project goals and objectives. The Customer, Design Agent, and Architect / Engineer (A/E) team then develops the project documentation based on an analysis of unique customer needs, requirements, established criteria, and site and environmental constraints. Information gathered provides the basis for defining the preliminary design and supports the project engineering phase, parametric cost estimating (PCE), and programming process. Information required includes space planning, site design, selection of the appropriate plan, water supply, and building design, elements and concepts. Unique local requirements concerning building program and design criteria are included in the PCE.

Functional concept planning for new facilities or modernization of existing facilities must include guidance and information contained in this document and data from reference documents identified in this publication.

2-1.1.1 Antiterrorism

Antiterrorism requirements are established as part of the design program and are identified as a separate line item in the DD Form 1391 estimate.

2-1.1.2 Navy and Marine Corps

Navy and Marine Corps planning criteria is governed by UFC 2-000-05N, *(P-80) Facility Planning Criteria for Navy/Marine Corps Shore Installations*.

2-2 GEOGRAPHIC PLANNING

Planning and design of warehouse facilities must address the specific climatic and geographic conditions of the intended site. In all climate regions consider solar orientation to maximize energy efficiency, passive solar and daylighting potential of the building. Refer to UFC 1-200-02, *High Performance and Sustainable Building Requirements*.

2-3 STORAGE / HANDLING SYSTEM

New facilities or modernization of existing facilities must consider the evaluation of alternative materials handling systems, selection of handling and storage equipment, design of operations, and layout of the building.

2-3.1 Design Parameters

The following design parameters must be observed when collecting data and analyzing requirements associated with the material storage and handling requirements of a planned warehouse facility:

2-3.1.1 Load Size

Standard cargo load size (including pallet) is 40 inches x 48 inches x 36 inches high (1020 millimeters [mm] x 1220 mm x 915 mm), or 40 cubic feet (ft3) (1.13 cubic meters [mm3]) which is equal to 1 Measurement Ton (M/T). The average storage load is 0.8 M/Ts (32 ft3, 0.91 mm3) which equates to a pallet size 40 inches x 48 inches x 28.8 inches (1020 mm x 1220 mm x 730 mm). A 48-inch (1220 mm) vertical pallet rack beam spacing is provided by the standard pallet rack configuration for this average height load. Maximum DOD allowances for loaded pallets with overhanging loads are 43 inches x 52 inches (1090 mm x 1320 mm). Planning must accommodate such vertical dimensions or be adjusted where loads differ significantly from the average height. In special cases such as automated storage/retrieval system racks, it may be necessary to maintain the 40-inch x 48-inch (1020 mm x 1220 mm) dimensions due to equipment restrictions.

2-3.1.2 Cost Standards

Storage costs, handling costs, and handling times relative to actual performance of an activity must be evaluated before comparisons are made between proposed designs and current operations if applicable.

2-3.1.3 Storage Height

Economical storage height is dictated by safety requirements, site restrictions, foundation cost, aviation restrictions, materials handling equipment availability, and storage requirements. These characteristics must be considered when making system evaluations.

2-3.1.3.1 Hazardous Materials Warehouses Storage Height

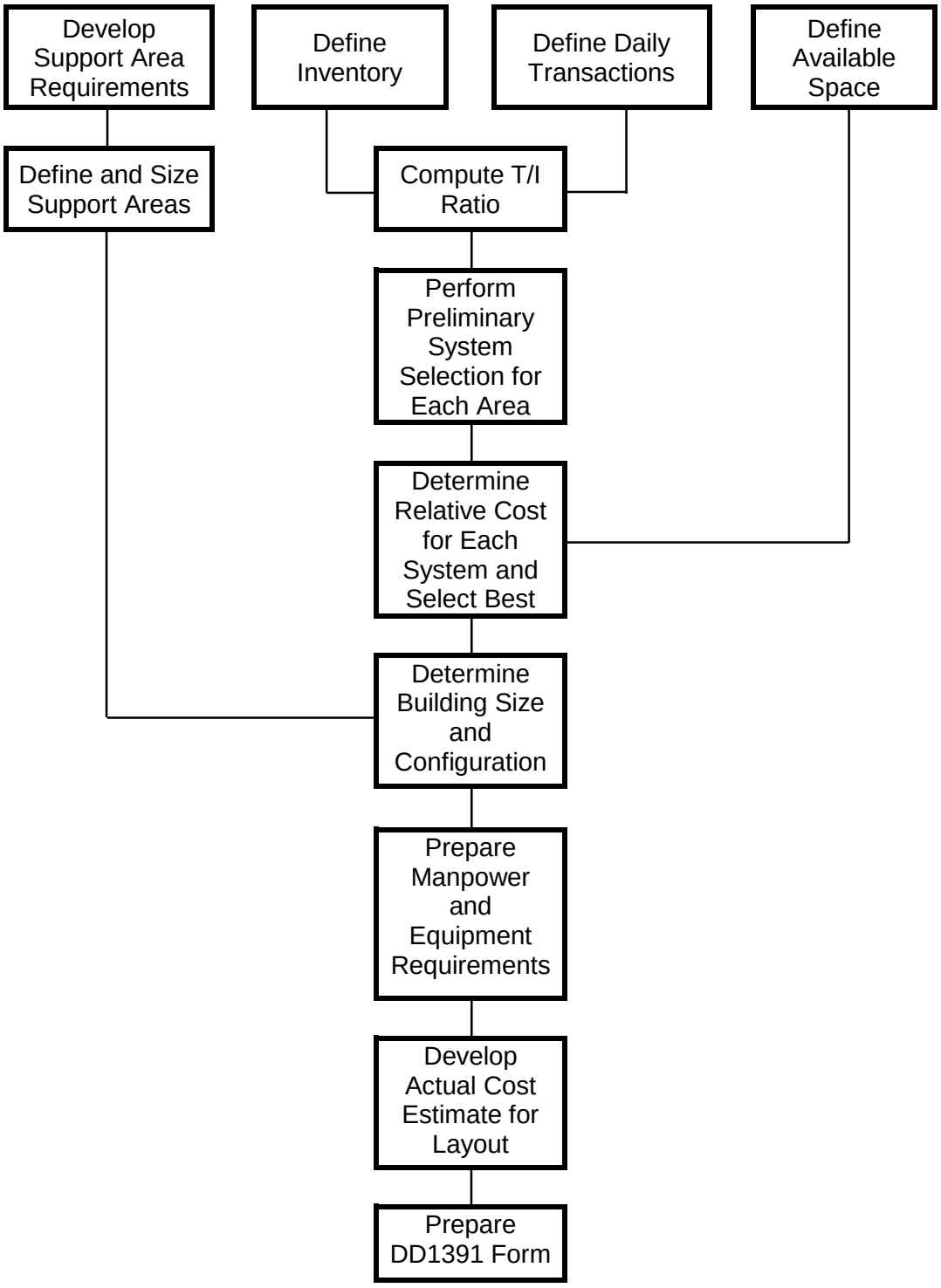
Hazardous materials warehouses are limited to a maximum storage height of 25 feet (7620 mm) or less. See the paragraph entitled “Material Handling Equipment”.

2-3.2 Procedures

The following steps should be followed in developing a facility concept. Figure 2-1 illustrates these steps in flowchart form. The Activity or Project Manager must

designate in the project scope the following factors, as well as any special requirements for storage or handling.

Figure 2-1 System Selection Flowchart



2-3.2.1 Define Inventory

State inventory levels in terms of 0.80 measurement ton (m/t) (32 ft3 or 0.91 mm3) pallet loads or 0.0095 m/t (0.38 cubic foot; 0.011 cu. M) shelf boxes. Separate inventory into groups with similar storage, handling, or transaction characteristics. The major inventory item attributes to be evaluated must include temperature sensitivity, hazardous characteristics, stackability, dimension, volume, and weight. Examples are pallet storage, bin storage, high and low activity material, pre-positioned war reserve stocks, etc. Establish maximum/minimum inventory levels per group.

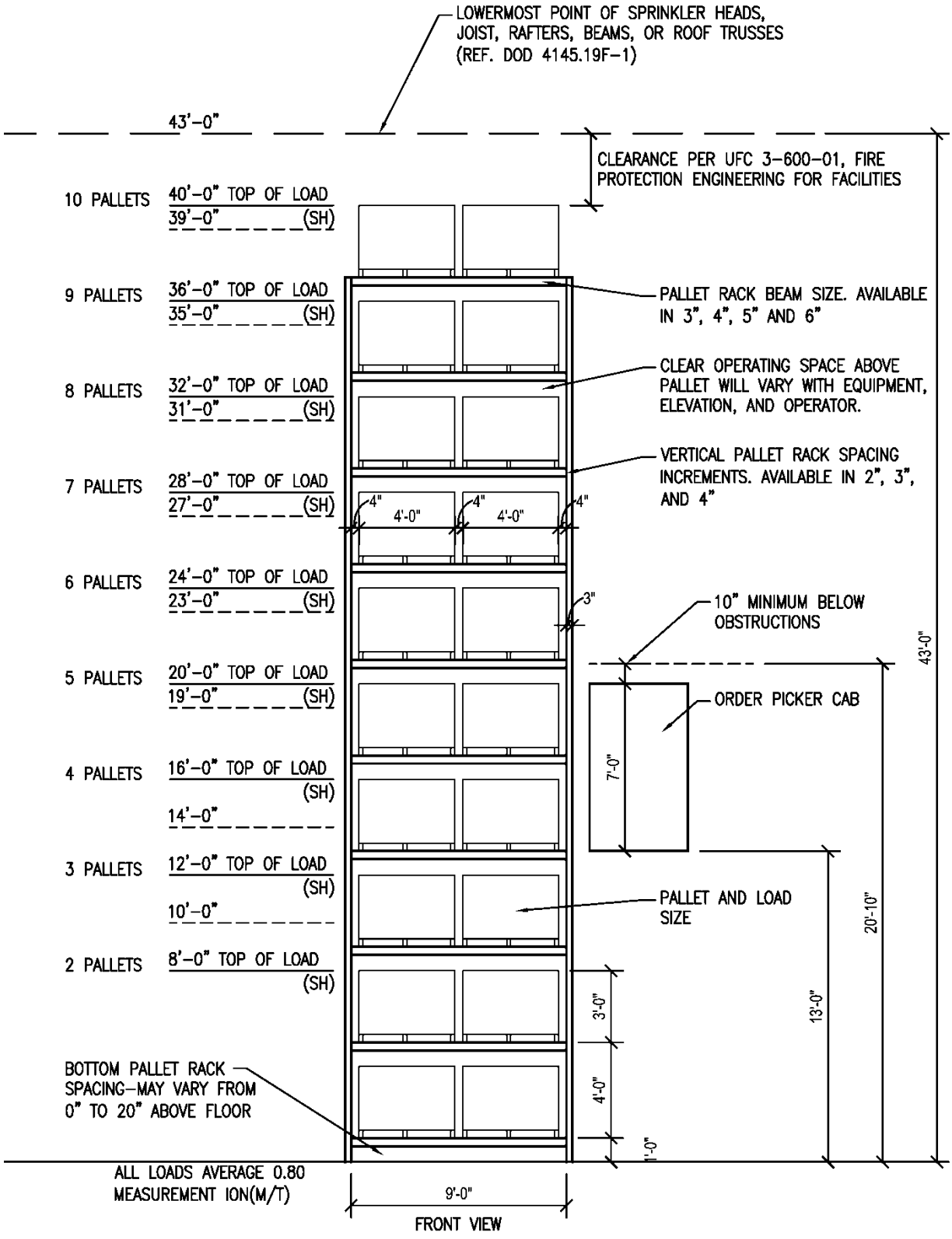
2-3.2.2 Define Daily Transactions

Define daily activity characteristics of each inventory group. For pallet systems activity levels must be defined in terms of daily quantities of pallets stored and retrieved. Define daily activity for binnables and rackables order picking systems in a line item (stock keeping unit) format.

2-3.2.3 Define Available Space

Define the space available for system installation for both new facility designs and conversion of existing facilities. Determine available Net Square Feet (NS) and allowable Stacking Height (SH) to define the available storage area in terms of Total Cubic Feet (TCF). When determining Stacking Height, the allowable stacking load, floor load capacity, and floor condition (surface condition, expansion joints, cracks, and flatness) must be considered. Figure 2-2 shows a typical height pattern for pallet racks up to the limit of the stacking capability of standard forklift equipment.

Figure 2-2 Standard Pallet Rack Elevation / Parameters



2-3.2.4 Compute Transaction/Inventory (T/I) Ratio

Compute the system T/I ratio based upon the defined inventory and transaction quantities. Develop separate T/I ratios for each inventory or handling group identified by the procedure in the paragraph entitled “Define Inventory”.

2-3.2.5 Select System

Taken together, physical characteristics of inventory and storage facility narrow the range of acceptable materials handling systems. Identify requirements or limitations which will affect system operations. Evaluate and perform preliminary system selections based on the computed T/I ratios for each area or inventory group. Evaluate and identify alternative systems for each area.

2-3.2.6 Determine Cost

Determine the relative cost for each system and select the most effective system for the funds available.

2-3.2.7 Determine Covered Storage Area

Determine the required building area for the selected system(s). Include cube and stacking height values as per UFC 2-000-05N (P-80) *Facility Planning Criteria for Navy and Marine Corps Shore Installations*.

2-3.2.8 Determine Support Area Requirements and Sizes

Evaluate and develop Support Area requirements. Support Areas consist of all other warehouse areas other than the Storage Area (SA). These include support functions such as supervisory offices, receiving, shipping, rest rooms, employee services, crating operations, packing/ packaging operations, battery charging rooms, inspection, identification, preservation, training rooms, mechanical equipment rooms, etc. Define and size Support Areas based on manpower and equipment requirements per each space and function.

2-3.2.9 Integrate Layout

Develop a composite building layout by integrating the various storage and support areas into a facility layout. Incorporate functional adjacency requirements of spaces. If the Storage Area includes hazardous materials storage the facility layout must take into account separation/safety considerations. Hazardous materials storage areas must be isolated in combination layouts. Combine the separate operations into a composite facility plan by adjusting column spacing to produce a common dimension while maintaining compatibility among the various systems. Explore 3 different layouts to ensure pre-construction system optimization.

2-3.3 Material Handling Equipment

The following materials handling equipment are essential components of warehouse facilities and their characteristics must be considered during the design phase.

2-3.3.1 Pallet Handling Equipment

This equipment may be either vehicular (truck-like) or specifically designed (i.e., storage/retrieval machine) for transporting and storing the standard pallet.

2-3.3.1.1 Fork Trucks

Propane, gas or diesel powered fork trucks can have a significant impact on ventilation requirements and indoor usage must be avoided where practical. Facilities are to be designed so that no gasoline, diesel or LPG/Propane fueled fork trucks are permitted to be used for prolonged periods of time. These types of fork trucks are to make quick drop-offs of material and electric fork trucks should move the stock within the warehouse facility.

When gasoline, diesel or LPG/Propane fueled fork trucks are required by the user activity the ventilation and/or climate control systems must be design to accommodate the expected quantity of fork trucks and duration of indoor use. Refueling for these types of fork trucks must be provided on the exterior of the building. Provide a spill containment dike for gasoline and diesel fork trucks in accordance the paragraph entitled "*Dikes"*.

2-3.3.1.2 Conveyer Systems

Conveyer Systems must be selected and designed to achieve energy conservation goals. They must include controls to automatically shut-down to conserve energy when not in use for a preset period of time. High efficiency, variable speed motors with "soft start" functions must be utilized to conserve energy and minimize maintenance.

2-3.3.2 Order Picking Equipment

This equipment is designed to aid a worker in the selection and transportation of supplies and may be vehicle based or designed as an application specific piece of equipment.

2-3.3.3 Transport Systems

These systems are designed for the movement of supplies between two or more locations within or outside of a facility. They may be designed to transport packaged loads (pallets or shelf boxes), loose loads, bulk liquids, or solids.

2-3.4 Storage Equipment

The following types of storage equipment are essential components of warehouse facilities and their characteristics must be considered during the design phase.

Storage equipment will be provided to store materials properly, off the floor. It will also be securely fastened to the slab and/or other structural supports designed to support the equipment per equipment manufacturer's installation requirements. Storage equipment will be protected by proper means from contact by material handling and operational equipment.

2-3.4.1 Pallet Rack

Pallet racks must be designed for safe storage of palletized loads based on the standard pallet as described in the paragraph entitled "Load Size". Designs for other size pallets may be used in conjunction with appropriately sized pallet racks and pallet handling fork lift equipment. These include double-deep racks, cantilever racks, drive-in and drive thru rack systems, side-loading fork lifts, and double-reach fork lifts. \1\Idle pallets must be stored in accordance with NFPA 230 and sprinkler protection provided in accordance with NFPA 13. /1/

2-3.4.2 Shelving/Bins

Shelving and bins are designed for storage of package type items in less than pallet load quantities. Industrial grade steel shelving and storage bins are modular in nature and are composed of front and rear upright posts, shelves, dividers. Bin storage units are a sub-group of industrial shelving in which the storage shelves are divided into smaller compartments. If a shelf is divided into two or more compartments, the compartments are classified as bins.

2-3.4.2.1 Shelving

Shelving is used for economical storage of small hand stackable items which are not suited to mechanized handling and storage due to their handling characteristics, activity, or quantity. Shelving is most often used for small parts storage in order picking systems and is suitable for either manual or mechanized operations.

Shelving is generally available in standard unit heights of 85 to 87 inches (2160mm to 2210mm) and a unit width of 36 inches (914mm). Typical depths are 12 inches (304mm), 18 inches (457mm), and 24 inches (609mm). The range of widths varies from 24 to 48 (609mm to 1220mm) inches while the depth ranges from 9 to 36 inches (228mm to 914mm). Shelf uprights are available in either beaded post or angle post configurations. Shelving is available in either open or closed design. Closed design includes solid back and side panels which provide load containment and minimize possible accumulation of unwanted dust and dirt. Open shelving is less expensive and utilizes sway braces to provide rigidity.

2-3.4.2.2 Bins

Bin storage is, in most instances, identical in application to shelf storage but is generally applied to smaller items which do not need the entire width of a conventional shelf module. Bin storage represents a small part of the total storage system in terms of physical space although it may represent a significant portion of the total storage in terms of item positions.

2-3.4.3 Special

Special storage equipment consists of devices designed for specific purposes such as cantilever rack, vertical sheet storage rack, pallet stacking frames, rigid and collapsible metal bins, etc.

2-3.4.4 Installation and Operation Tolerances

Observe the following tolerances for installation and operation of storage equipment. These tolerances apply in the absence of more stringent manufacturer tolerances.

a. Plumbness of pallet racks and high rise shelving +/- 1/16 inch (+-1.6 mm) over total height.

b. Pallet rack beam elevation +-1/4 inch (+-6.4 mm) between adjacent beams.

c. Rail guide position +1/4, -0 inches (+6.4 mm, -0 mm) from specified rail spacing.

d. Wire guide position +-1/4 inch (+-6.4 mm) from specified centerline.

e. Pallet rack aisle spacing +-1/4 inch (+-6.4 mm) from design aisle width.

f. Down-aisle rack offset +-1/4 inch (+-6.4 mm) from aisle centerline.

2-4 MATERIAL HANDLING SYSTEMS CONSIDERATIONS

2-4.1 Receiving Shipping Operations

Review vehicle and material flow characteristics, including:

a. Types of vehicles to be serviced.

b. Location of rail and road access.

c. Location with respect to other facility operations.

d. Support area requirements, such as staging areas and offices.

2-4.2 Order Picking Operations

Review load and documentation requirements, including:

a. Type of product being processed.

b. Documentation requirements.

c. Packing/packaging requirements.

2-5 SUPPORT AREAS

Separate support areas from hazardous materials storage areas with a 2-hour fire wall and from combustible or flammable storage areas with a 4-hour fire wall. Direct access between support areas and hazardous materials storage areas is not permitted. Refer to table 2-1 for space estimating criteria for administrative and supervisory offices. Refer to UFC 2-000-05N (P80), *Facilities Planning Criteria for Navy and Marine Corps Shore Installations* for criteria relating to other warehouse support functions.

Table 2-1 Administrative and Supervisory Offices and Support Area Space Requirements

LOCATION	LENGTH		WIDTH		AREA	
	m	ft	m	ft	m	ft
Private Offices						
Warehouses Manager	6.1	20	4.9	16	29.7	320
Personnel Manager	4.3	14	3.7	12	15.6	168
Open Office Dividers						
Managers	3.7	12	3.7	12	13.4	144
Assistants	3.0	10	2.4	8	7.4	80
Secretaries	2.4	8	2.4	8	5.9	64
Accounts Payable	1.5	5	2.1	7	3.3	35
Inventory Control	1.5	5	2.1	7	3.3	35
Procurement	1.8	6	2.4	8	4.5	48
Operations	1.8	6	1.8	6	3.3	36
Meeting Area	3.0	10	3.0	10	9.3	100
Interview Area	2.4	8	2.4	8	5.9	64
Programmers	2.4	8	2.4	8	5.9	64
Open Support Services						
Files	0.3	1	1.5	5	0.5	5
Reception/Lobby Area	9.1	30	6.1	20	55.7	600
Main Aisles (1)	--	--	--	--	--	--
Secondary Aisles (2)	--	--	--	--	--	--
Photocopy Machine	1.8	6	1.2	4	2.2	24
Closed Support Services						
Mail Room	7.6	25	3.7	12	27.9	300
Restrooms	7.3	24	2.4	8	17.8	192
Janitorial Closet	1.8	6	1.2	4	2.2	24
Clothes Closet	3.0	10	0.6	2	1.8	20
Supply Room	5.5	18	3.7	12	20.1	216
Computer Room	7.6	25	6.1	20	46.5	500
Conference Room	7.6	25	6.1	20	46.5	500
Lunch/Break Room (3)	18.3	60	6.1	20	111.5	1200
First-Aid Room	4.9	16	3.7	12	17.8	192

Areas considered for support of a storage facility include the following:

2-5.1 Supervisory Offices

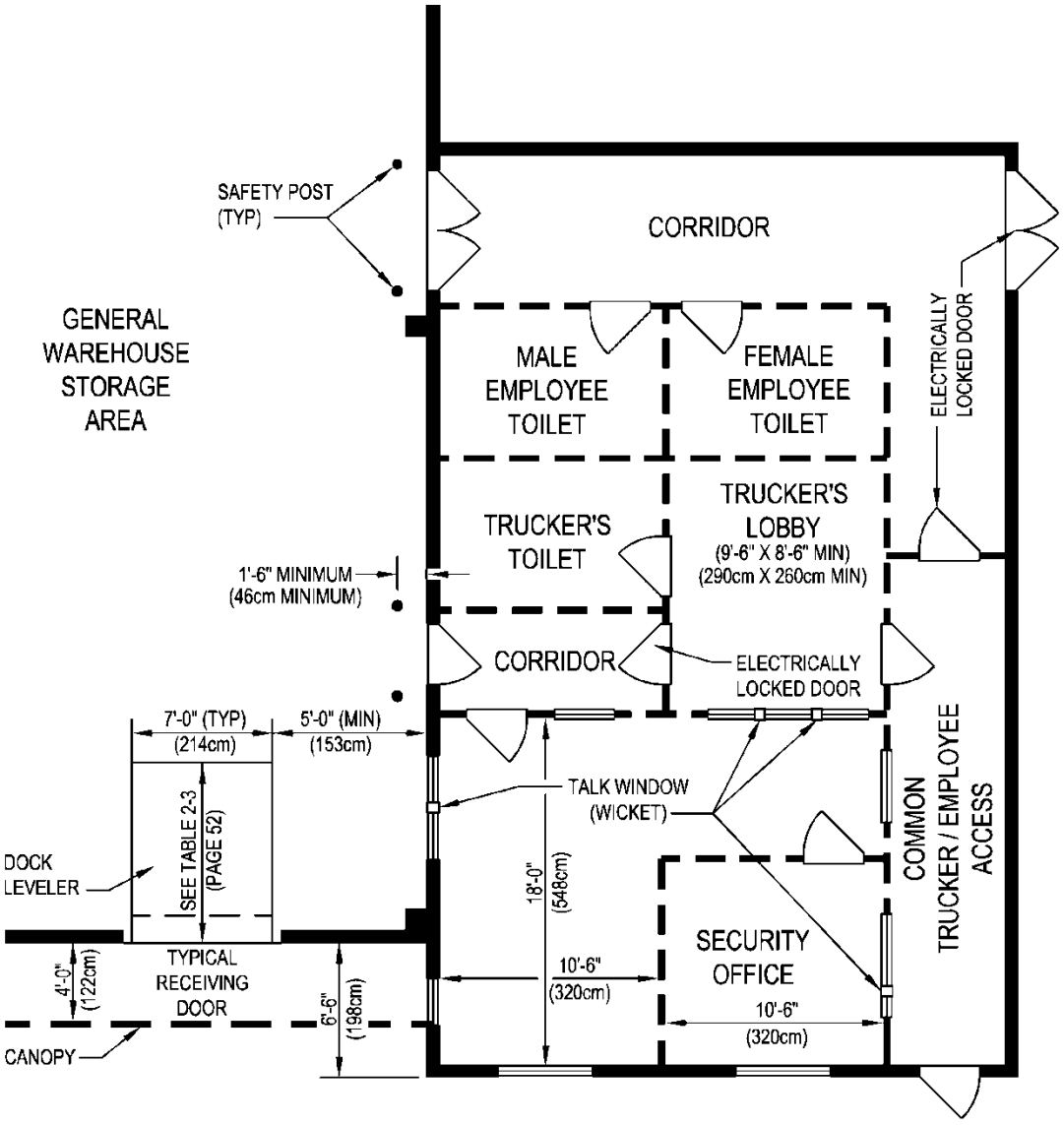
Provide offices for supervisory personnel such as foremen, crew leaders, etc. Offices must accommodate two people and provide filing space, one desk, and two chairs per person. Offices must be located near their associated activity areas. Offices may consist of prefabricated partition-type enclosures or more permanent forms of construction such as concrete block.

Separate shipping and receiving office areas may be required in larger facilities and combined hazardous materials and general storage facilities for safe operation and to expedite the flow of paperwork associated with the increased activity. A facility with few employees may use a single multipurpose office located away from any hazardous materials storage area. Office location and arrangement must provide separation of work functions and maintain security by controlling access to the facility. Offices must permit an unobstructed view of the inside and outside dock areas. Rest room facilities for both truck drivers and employees may be integrated into the office design.

2-5.2 Receiving Office

The typical functional area relationships for the Administration and Warehouse Facilities provide space for a building and site security system and office space for receiving personnel. The secured entrance, lobby and rest room for truck drivers provides controlled entry into the facility. Separate rest rooms are provided for supervisory and warehouse personnel. See figure 2-3.

Figure 2-3 Typical Receiving Office Layout - Functional Dimensions

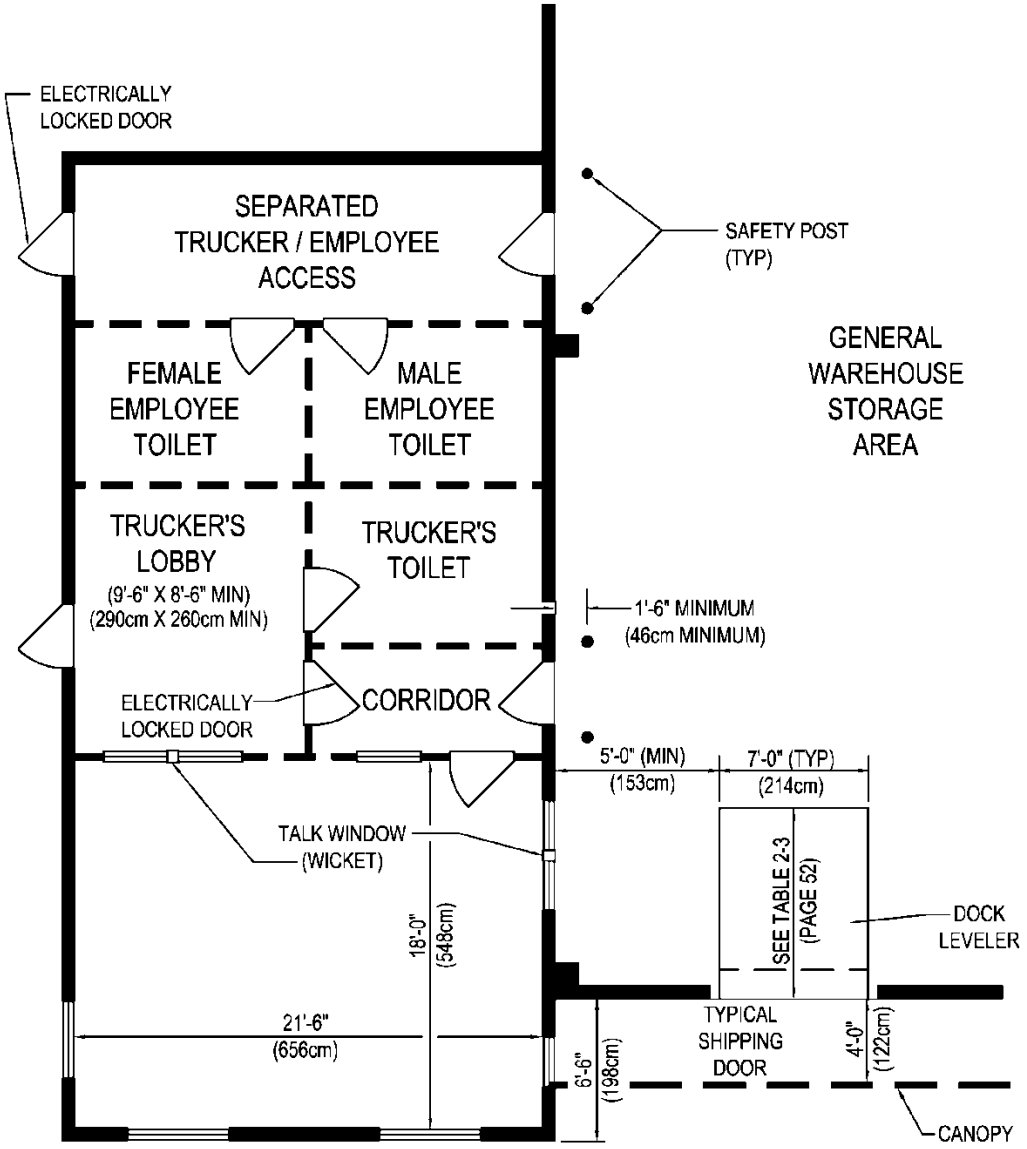


NOTE: LAYOUT SHOWN FOR ADJACENCIES AND CRITICAL DIMENSIONS ONLY

2-5.3 Shipping Office

The typical shipping office provides a separate entrance, lobby, and rest room for truck drivers. A central office area and separate rest room facilities are provided for shipping department and supervisory personnel. See figure 2-4.

Figure 2-4 Typical Shipping Office Layout - Functional Dimensions



NOTE: LAYOUT SHOWN FOR ADJACENCIES AND CRITICAL DIMENSIONS ONLY

2-5.4 Rest Rooms

Separate rest room facilities may be provided for supervisory and general warehouse personnel.

2-5.5 Employee Services

Employee service areas consist of break rooms, canteen and vending machine facilities, and locker rooms. Size these areas to accommodate the expected number of employees. Multiple installations may be required to place these facilities within required distances from employee activity areas. Refer to UFC 3-101-01, *Architecture* for Space Planning and Criteria and UFC 3-420-01, *Plumbing Systems* for specific requirements.

2-5.6 Crating Operations

General purpose storage facilities may require crating of large or odd shaped items prior to storage or shipment. Variability in requirements for materials, product size, and tools necessitates individual design of crating areas. Refer to DoD 4140.1-R, *Supply Chain Material Management Regulation*, title 49 CFR *Transportation* for criteria.

2-5.7 Packing/Packaging Operations

Requirements for small item packaging may be met through use of multipurpose packing table work stations. Small item packaging must support a supply of cartons, filler material, tape, glue, labels, and scales. The design of small item packing operations must be approached on an individual facility basis.

2-5.7.1 Design

The design of small package packing station depends upon the relationship between package characteristics and throughput patterns. If the movement through the packing operation is homogeneous in terms of product characteristics and packing requirements, it is possible to install conveyor type equipment. If the packing operations must accommodate a heterogeneous mixture, a customized work station must be provided.

Refer to DoD 4140.1-R, Supply Chain Material Management Regulation, title 49 CFR Transportation for criteria. Repackaging of damaged hazardous materials packages must be performed in a designated safe area.

2-5.8 Battery Charging Area

Provide an equipped and ventilated room or area for the charging of materials handling vehicle batteries. For additional requirements see section titled “Battery Charging and Handling Operations”.

2-6 PARKING

Provide parking space for \1\/1/facility employees. Parking areas must be separated from truck docks and other activity areas. Site security must be enforced by separating the storage facility from the remainder of the activity and further isolating parking from receiving and shipping functions. Refer to UFC 3-201-01, *Civil Engineering* for parking requirements.

2-7 TRAFFIC FLOW

Arrangement of the facility on the site and internal arrangement of the material handling systems must be evaluated to reduce or eliminate areas of conflicting traffic. Consider interaction with installation traffic flow.

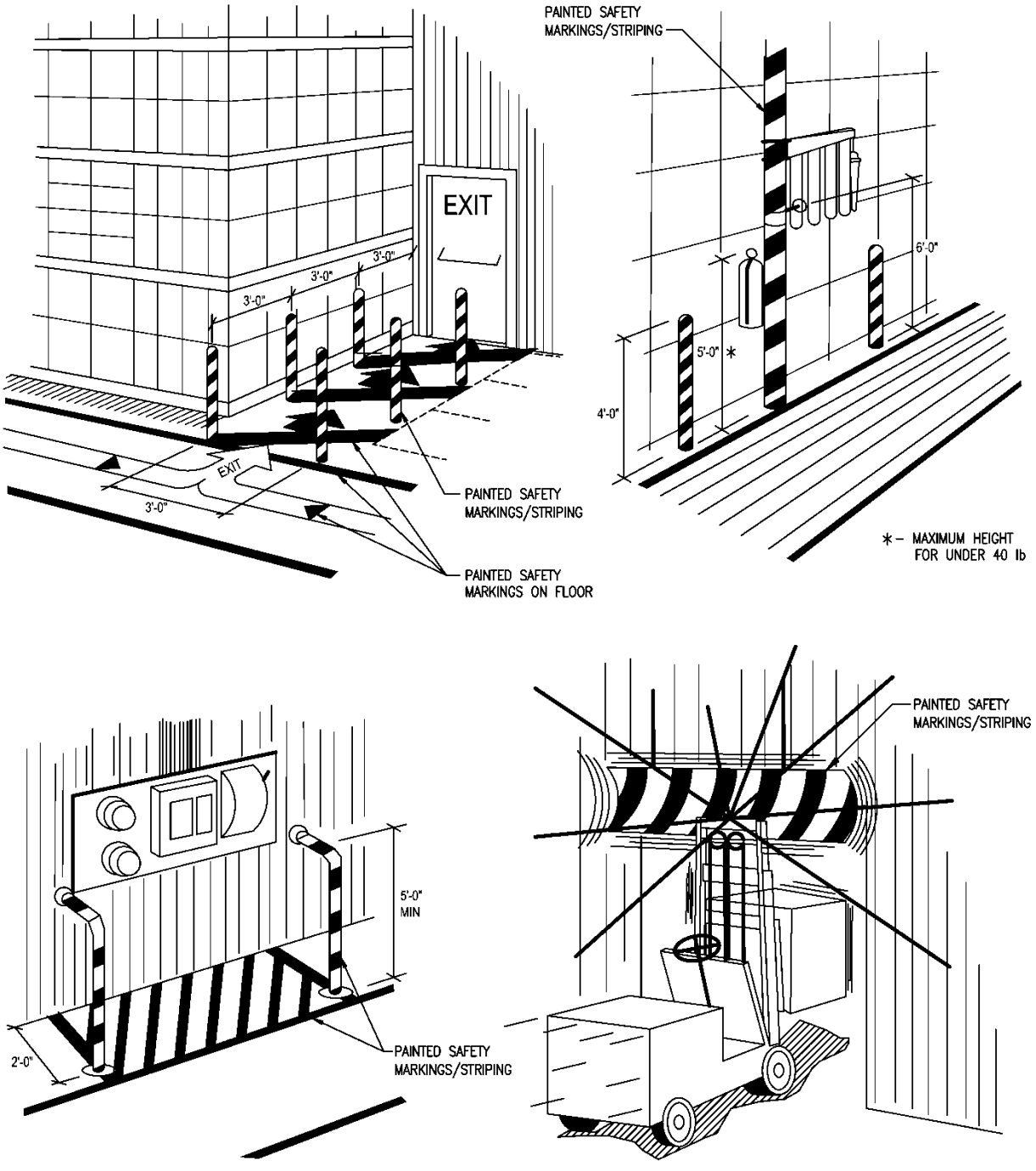
2-8 SAFETY

All DoD facilities must comply with DoD Instruction 6055.1 and host services' Occupational Safety and Health Requirements.\1\This includes but is not limited to the following:/1/

- Provide safety markings on walls and floors in accordance with title 29 CFR 1910.22, General Requirements and title 29 CFR 1910.144, Safety Color Code for Marking Physical Hazards (Reference Figure 2-5 Typical Safety Markings). Define areas for fork-truck battery charging. Provide fire protection equipment. \1\./1/ Provide specialized safety equipment (eye wash/shower, spill lockers, etc.) in hazardous materials areas. Provide all additional safety features required by the Occupational Safety and Health Administration (OSHA), in accordance with Title 29 Code of Federal Regulations (CFR) Part 1910, Occupational Safety and Health Standards.
- Provide exterior safety markings for fork truck refueling and vehicular operations.
- Provide all additional site safety features required by UFC 3-201-01, *Civil Engineering.*

Figure 2-5 Typical Safety Markings

Perspective Views



CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL DESIGN FACTORS

Providing easy and rapid materials handling and adequate clear storage space are the prime considerations in warehouse design.

3-1.1 Material Movement

Transport paths and building layout must avoid discontinuities and elevation changes which impede material movement. \1\ The transport path must be clear of structural columns or beams. /1/

Locate warehouse facilities on a site to take advantage of highway and rail facilities. Evaluate location of the facility on the site to reduce or eliminate areas of conflicting traffic.

3-1.2 Expansion Capability

Consider present and future requirements in building construction and site location to permit future expansion of facilities in an orderly, safe, and cost-efficient manner.

3-1.3 Flexible Design

Where facility usage is uncertain or subject to change, building design must use the universal bay dimension of 33 feet x 64 feet (10,060 mm x 19,510 mm).

3-1.4 Requirements of Specific Buildings

Building requirements are dictated by the function of the facility. Refer to table 3-1 for general requirements for specific types of buildings.

Table 3-1 Special Requirements for Warehouse Types

BUILDING TYPE	FUNCTIONS	SPECIAL REQUIREMENTS
General Purpose Warehouse	All-purpose structure for storing and handling supplies not requiring special considerations.	Fire protection separation between buildings; Refer to UFC 3-600-01, *Fire Protection Engineering for Facilities*, for required building separation based upon construction and exposure.
Heavy Materials Warehouse	Storing and handling heavy and bulky supplies incapable of being handled by forklift trucks, but which may be handled more economically by overhead traveling cranes.	Overhead electrical traveling cranes to handle loads too heavy or bulky to be handled by forklift trucks. Fire walls must be designed and constructed to avoid interference with operation traveling crane(s). Railroad service tracks within building. Flooring elevations at same level as top of inside railroad tracks. Door for truck entry into building and truck entrances at floor level. Ventilation: continuous ridge ventilators in unheated and non-humidified buildings only. Heating: storage areas are not heated.
Aeronautical Materials Warehouse	Storage of spare parts and component assemblies of aircraft.	Truck and rail access. High, clear storage space and large doors. Overhead traveling cranes. Heating and cooling required only for personnel comfort. Dehumidification required. Bins or storage shelves.
Hazardous Materials Warehouse	Storage and handling of hazardous chemicals and highly combustible materials.	Floor: 6 in. (150 mm) below the floor elevation of outside platforms or provide floor trenches for spill control. Flat floor with no drains or slope. Chemical resistant floor coating. Outside drainage with valve. Corrosive materials storage areas with external access doors. Ventilation: continuous mechanical from floor and roof; minimum of 1.5 air changes per hour (where all containers are sealed).
Humidity Controlled Warehouse	Preserving of stores at maximum relative humidity of 40 percent.	Proper equipment for dehumidifying. Additional electrical requirements. Measures to effectively seal openings.
Medical Warehouse	Storage of medical supplies: 1. Small auxiliary facility for hospital or dispensary. 2. Large medical supply warehouse.	Diversified functional elements include: Refrigeration, dehumidification, narcotics vaults, and heated spaces. Small facility is located and designed to best fit in local needs and support the parent structure. Large supply warehouse is a large building designed to meet present and foreseeable needs over wide areas for specified periods and situations.
Receiving, Shipping and Issue Buildings	Receiving: central point for receipt of shipments. Shipping: central point for outloading. Issue: standard storage buildings arranged for issuing supplies.	Based on the needs for receipt, unpackaging, inspecting, sorting, assembling, storage, repackaging, issue, reshipment, and other necessary handling. Special interior arrangements to carry out its mission and possibly special outloading facilities and techniques. Provisions for local issue are met by special interior layout, such as in packaging and sorting space, assembly space, inspection, bins, counters, enclosures, space for item accounting, and provisions for personnel traffic. Requirements are determined largely by the characteristics of the using agency.
Miscellaneous Facilities	Bulk Storage bias: storage of large lots of loose, solid materials. Warehouse bins: provide additional storage space in warehouse buildings.	Varying depending on the needs of the installations and materials to be contained. Materials, shape, and size determined by local needs. Arrange in double rows, back to back, and at right angles in main aisles: single rows may be arranged against walls. Passageways between open faces of bins must be a minimum of 36 in. (915 mm) wide. Metal Units: width, 36 in. (915 mm); height, 7 ft. 3 in. (2.51 m); depth, 18 in. (460 mm).
Boxing and Crating Buildings	Boxing and crating material.	One portion of building outfitted for necessary industrial operations; another portion for processing depot supplies; and the remainder devoted to storage of manufacturing stocks and assembled units.
Preservation Buildings	Special operations for preserving supplies.	Special equipment and facilities for preserving supplies before being placed in storage.
Cold Storage	Preserving stores in controlled climate ranging from -5° F (-21° C) to 50° F (10° C).	Proper equipment for cooling. Additional electrical requirements. Measures to effectively seal openings. Additional insulation requirements. Maximum utilization for storage space.

3-2 BUILDING SHAPE AND PROPORTIONS

Observe the following cautions relating to building size and shape:

3-2.1 Travel Distance

Arrange buildings or increments of buildings for minimum distance between high activity operations. Square buildings minimize perimeter wall area for a given floor area. Aspect ratios (ratio of length to width) of 1.25 or less are considered square. If possible, avoid aspect ratios exceeding 3.00 for conventional warehousing operations.

3-2.2 Irregular Shapes

Avoid irregular shapes, such as U or L.

3-2.3 Height

High-rise storage is preferred over low height buildings on a life-cycle cost basis since storage costs per unit stored, over the life of the project, decrease as height is increased. Coordinate building height parameters with storage system characteristics, as illustrated in figure 2-2.

3-2.4 Area

Limit building size based on restrictions due to loss potential and fire and hazardous chemicals safety and site restrictions. Fire protection separation between buildings; Refer to UFC 3-600-01, *Fire Protection Engineering for Facilities*, for required building separation based upon construction and exposure.

3-3 BUILDING SPACING

Required spacing between buildings to facilitate operations and aid in fire prevention, protection, and hazardous chemical spills (liquid/gas) control, will vary according to the type of construction and exposure classification. Refer to UFC 1-200-01, *General Building Requirements and* UFC 3-600-01, *Fire Protection Engineering for Facilities* for fire protection engineering requirements. Otherwise, observe the following:

3-3.1 Rail Side

Allow 120 feet (36.6 m) between faces of walls.

3-3.2 Truck Side

Allow 175 feet (53.3 m) between faces of walls.

3-3.3 Warehouses In-Line

Where a Warehouse or series of Warehouses are to be provided on a single site in a row or series of rows, in-line, allow 30 feet to 150 feet (9.1 m to 45.7 m) between faces of walls.

3-3.4 Hazardous Materials Facilities

Provide a buffer zone between the facility or portion of facility containing Hazardous Materials and the nearest inhabited area, stream, or body of water in accordance with UFC 1-200-01, *General Building Requirements* and UFC 3-600-01, *Fire Protection Engineering for Facilities*.

3-4 DOCKING FACILITIES

Provide maneuvering space to facilitate loading and unloading operations at warehouse rail and truck docks (see figure 3-1). Protect building corners and dock areas from vehicle impact by using concrete-filled steel pipes (see figure 3-2). Provide safety equipment and fall protection per OSHA and applicable codes and regulations.

Figure 3-1 Truck Apron Criteria (Functional Dimensions)

Plan View

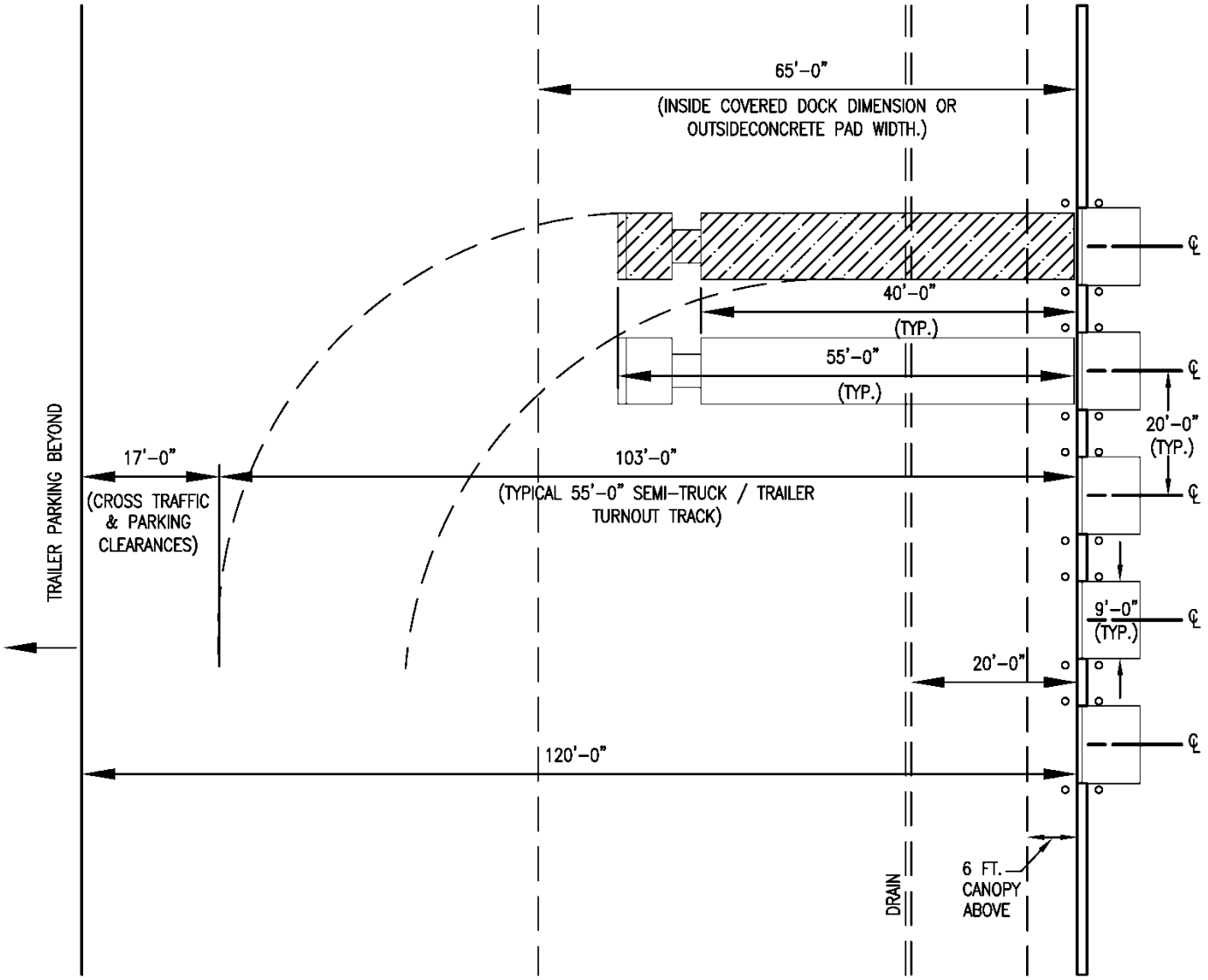
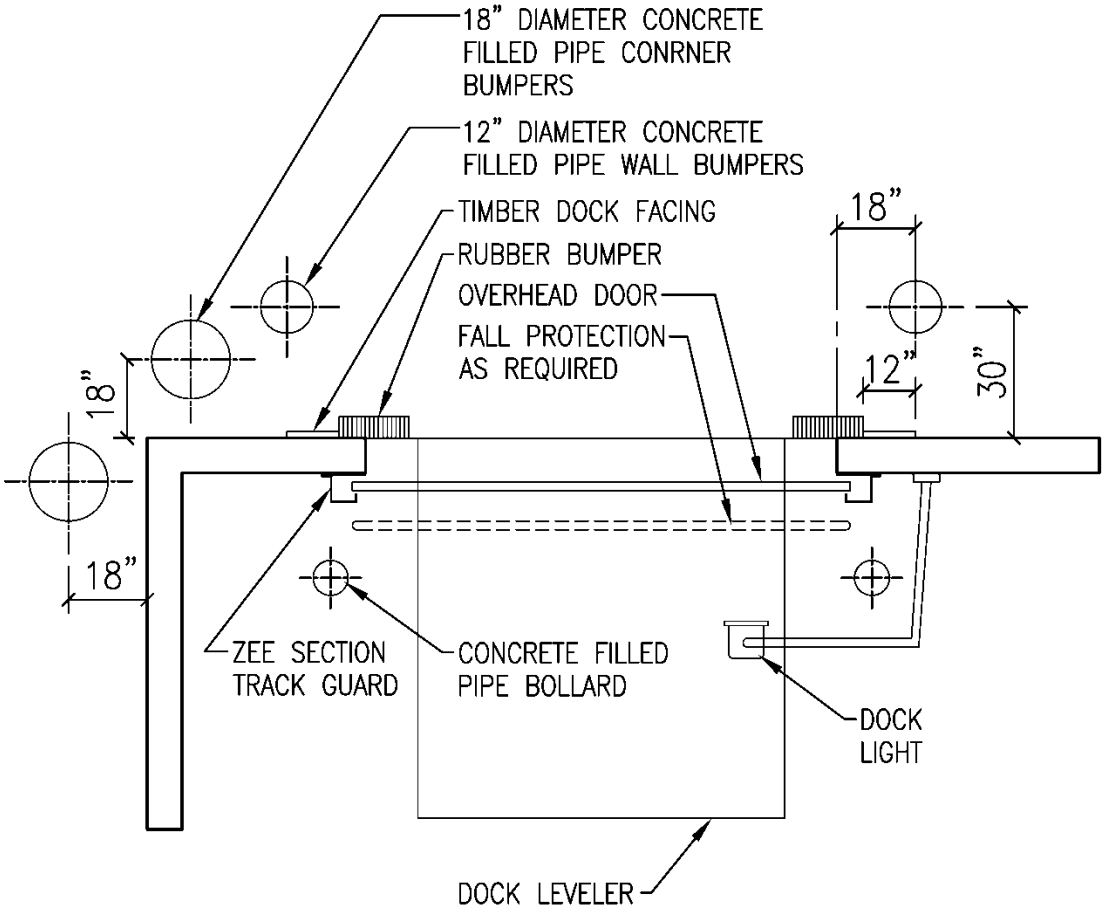


Figure 3-2 Building Protection Devices

Plan View



3-4.1 Truck Dock

Truck dock height will vary between 44 and 52 inches (1120 mm and 1320 mm) depending on the class of trucks served (see table 3-2). Use a 48-inch (1220 mm) height for general highway tractor-trailer service. Configure truck docks to conform to building, site, and traffic flow requirements (see figure 3-3). Figure 3-4 shows a typical dock section. Slope dock apron areas away from the building, as illustrated in figure 3-5. Provide doors of a size consistent with truck characteristics, as shown in figure 3-6. Open uncovered exterior truck dock platforms are not recommended. Provide space to load and unload flatbed and low-boy trucks and to move material in and out of the warehouse using a rolling A-Frame hoist or similar material handling equipment. A dock adjacent to the ramp of the building may be equipped with a 5-ton (4500 kilogram [kg]) monorail, interrupted at the door with a moveable (swing) section. A 12 x 12 foot (3660 mm x 3660 mm) door must be specified with this option. All outside supports must have protective barriers.

Table 3-2 Truck and Rail Vehicle and Dock Heights

TYPE OF TRUCK	BED HEIGHT				OVERALL HEIGHT		DOCK HEIGHT		DOCK LEVELER LENGTH (Minimum)	
	Minimum		Maximum		Minimum ft-in (mm)	Maximum ft-in (mm)				
	In	mm	in	mm			in	mm	ft	m
Container	56	1420	62	1570	12’-2” (3710)	13’-6” (4110)	52	1320	6’ – 10’	1.8 – 3.0
Reefer	50	1270	60	1520	12’-6” (3810)	13’-6” (4110)	52	1320	6’ – 8’	1.8 – 2.4
Flatbed (1)	48	1220	60	1520	---	---	48	1320	6’ – 12’	1.8 – 3.7
Double Axle Semi (2)	46	1170	56	1420	12’-0” (3660)	13’-6” (4110)	48	1220	6’ – 8’	1.8 – 2.4
Straight Semi (2)	44	1120	52	1320	12’-0” (3660)	13’-6” (4110)	48	1220	8’	2.4
City Delivery	42	1070	48	1220	11’-0” (3350)	12’-6” (3810)	48	1220	6’ – 8’	1.8 – 2.4
Stake Body	42	1070	48	1220	---	---	48	1220	6’ – 8’	1.8 – 2.4
High Cube Van	32	810	38	960	13’-0” (3960)	13’-6” (4110)	43	1220	8’ – 12’	2.4 – 3.7
Furniture Van (3)	24	610	36	910	13’-0” (3960)	13’-6” (4110)	30	1090	8’	2.4
Step Van (3)	20	510	30	760	8’-6” (2590)	10’-0” (3050)	30	760	6’ – 10’	1.8 – 3.0
Panel Truck (3)	20	510	24	610	8’-0” (2440)	9’-0” (2740)	30	760	8’ – 10’	2.4 – 3.0
Low Boy (3)	20	510	24	610	---	---	30	760	8’ – 10’	2.4 – 3.0
Box Car (4)	41	1040	44	1120	---	---	44	760	6’	1.8
Reefer Rail Car (4)	46	1170	52	1320	---	---	48	1120	5’ – 6’	1.5 – 1.8

Notes:

(1) Dock height range of 48”- 52” (1220-1320 mm).
(2) Dock height of 50” (1270 mm) if serving semis only.
(3) Dock height of 48”-50” (1220-1270 mm) recommended with exterior ramp to elevate truck to provide nominal 30” (760 mm) dock height.
(4) Minimum dock leveler length determined by required clearance between rail car and dock.

Figure 3-3 Truck Dock Configurations

Plan Views and Section

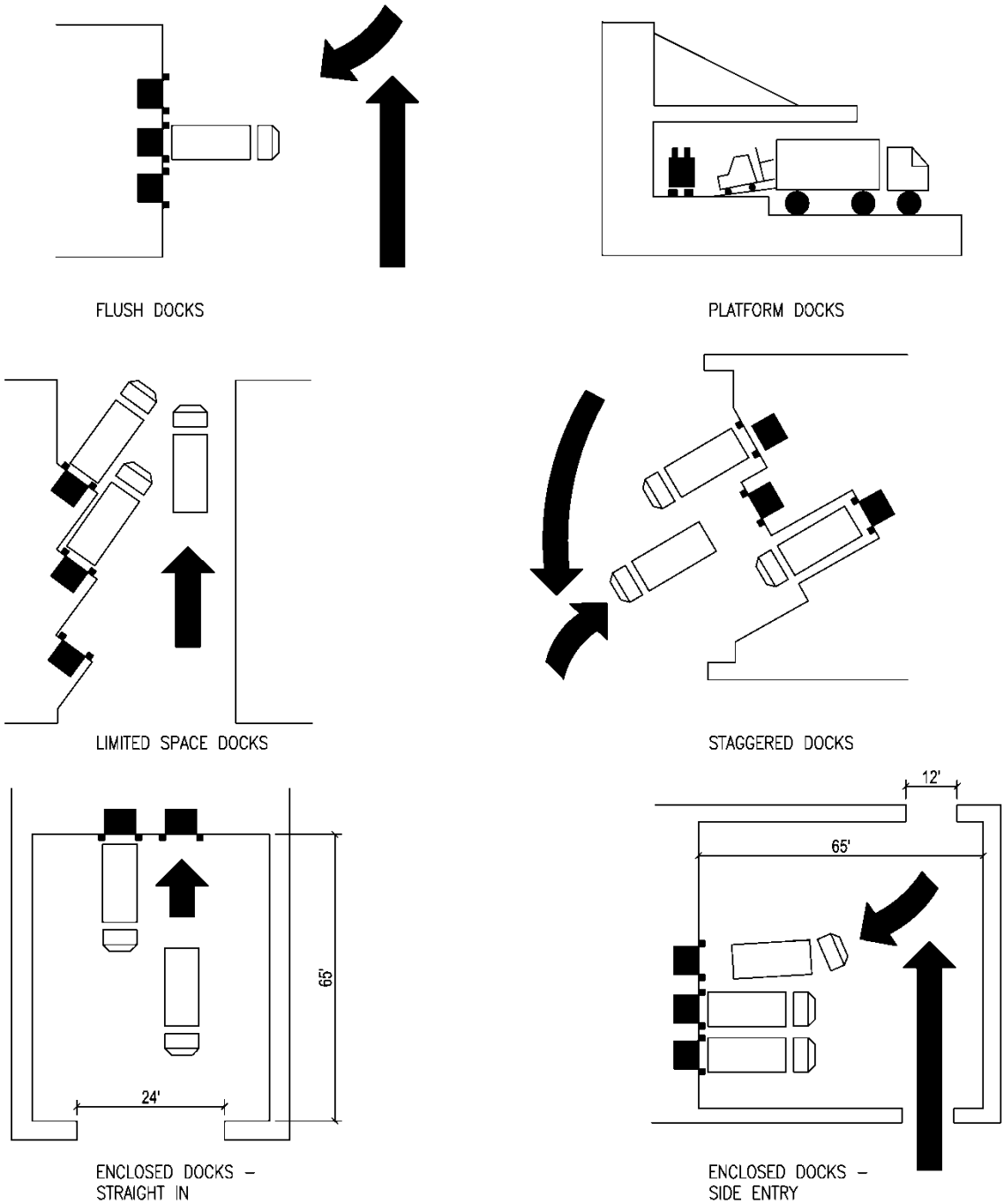


Figure 3-4 Typical Truck Dock

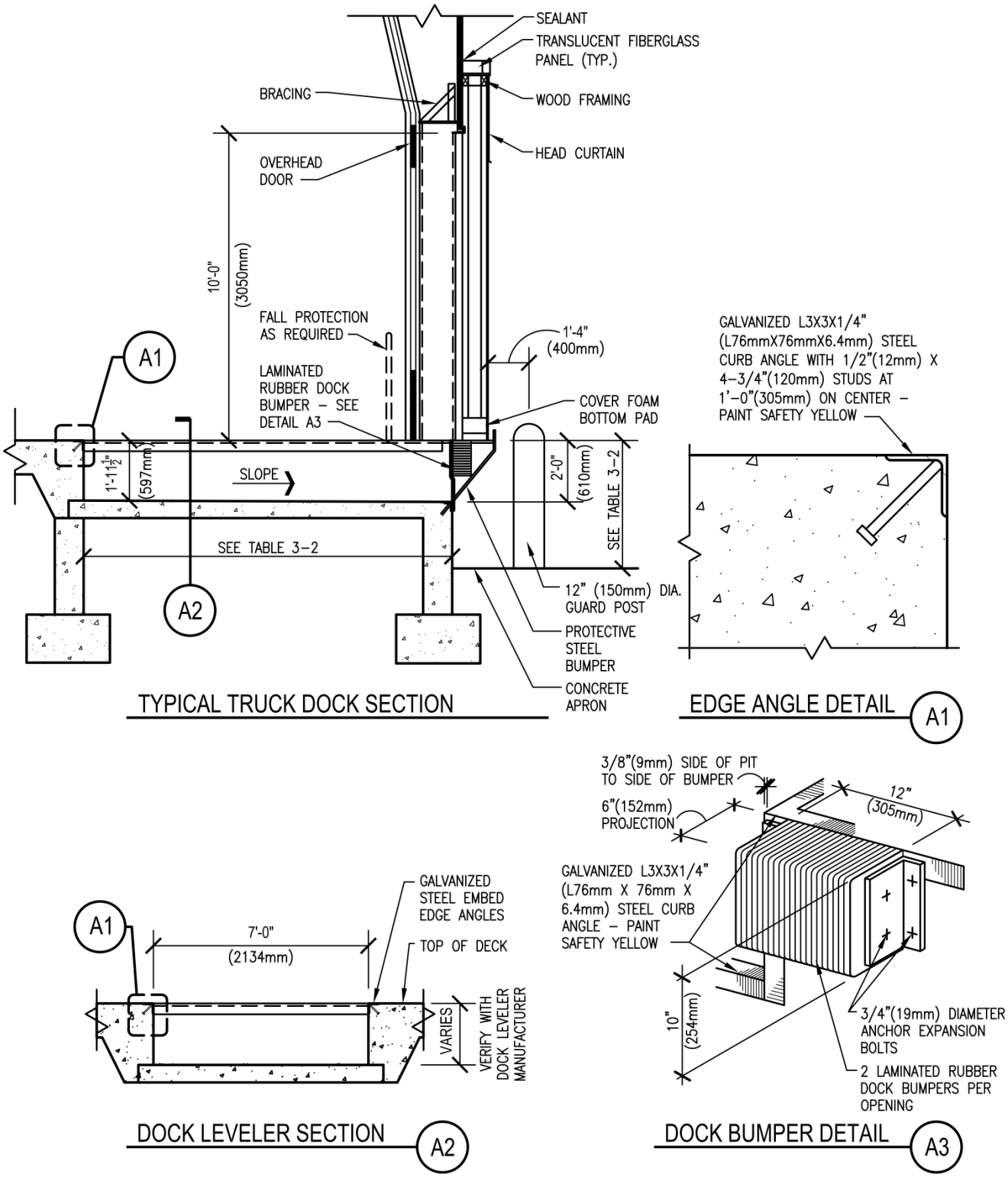
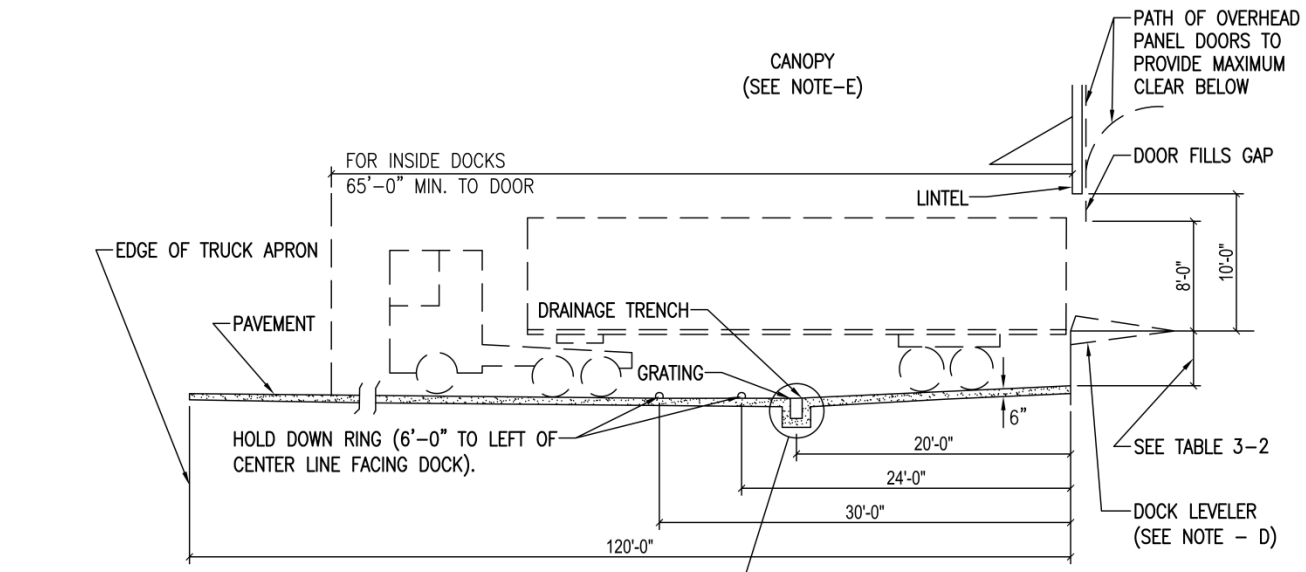


Figure 3-5 Truck Apron Section



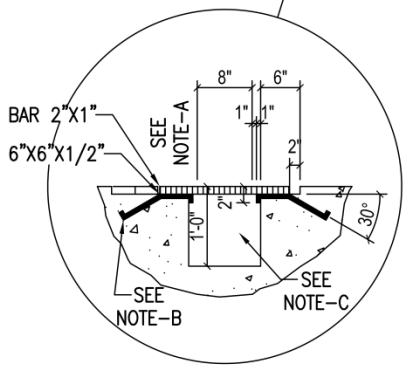
NOTE A: CAST IRON DRAIN PLATE AS DRAWN OR SIMILAR COMMERCIAL CASTINGS AS AVAILABLE.

NOTE B: BAR 2x1/4x1'3" LONG ON 2'–0" CENTERS.

NOTE C: TRENCH SLOPES 1/4" PER FOOT. PROVIDE DRAIN VALVE FOR CONTAINMENT IN HAZARDOUS/ FLAMMABLE FACILITIES.

NOTE D: 7'–0" WIDE DOCK LEVELER WITH CROSS TRAVEL LOCK OPERATING RANGE – 12" UP 9" DOWN.

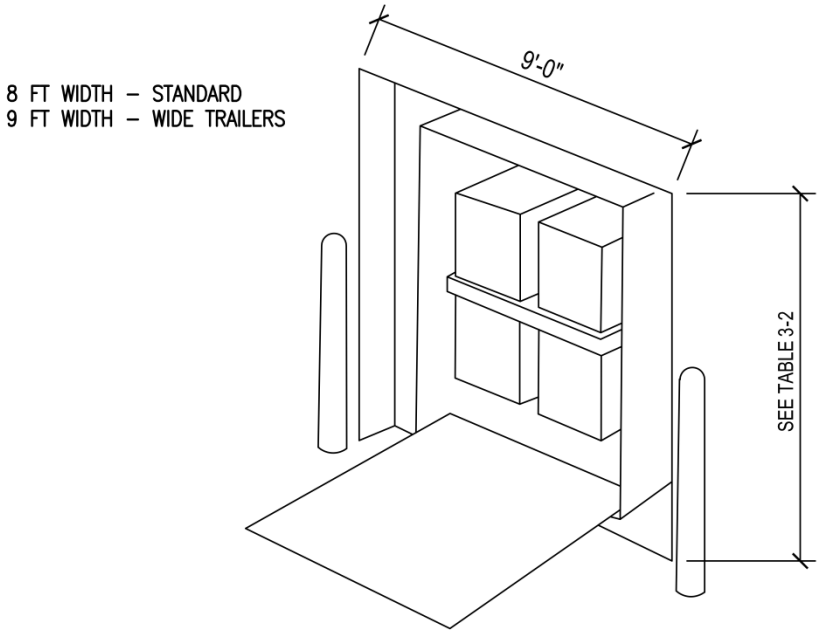
NOTE E: CANOPY FOR OUTSIDE DOCKS. ROOF OVER 65'–0". APRON FOR INSIDE DOCKS.

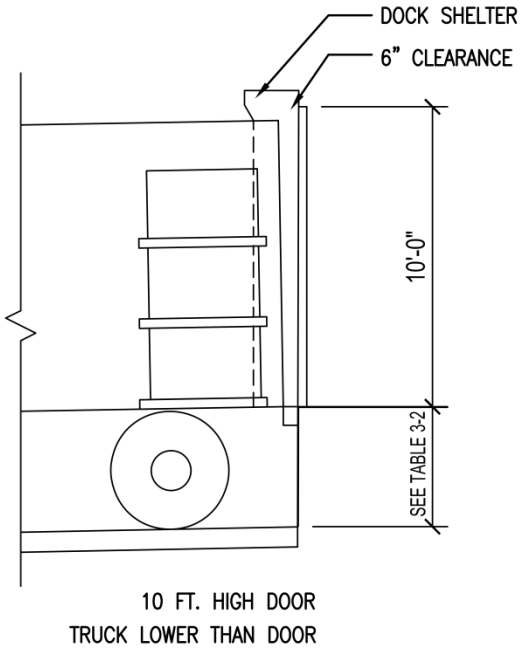


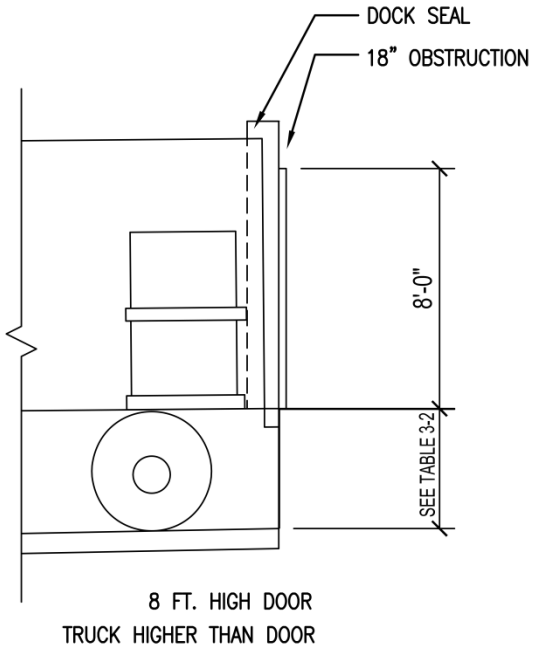
SECTION THROUGH TRUCK APRON DRAINAGE TRENCH

Figure 3-6 Door Size Characteristics

Perspective View and Sections





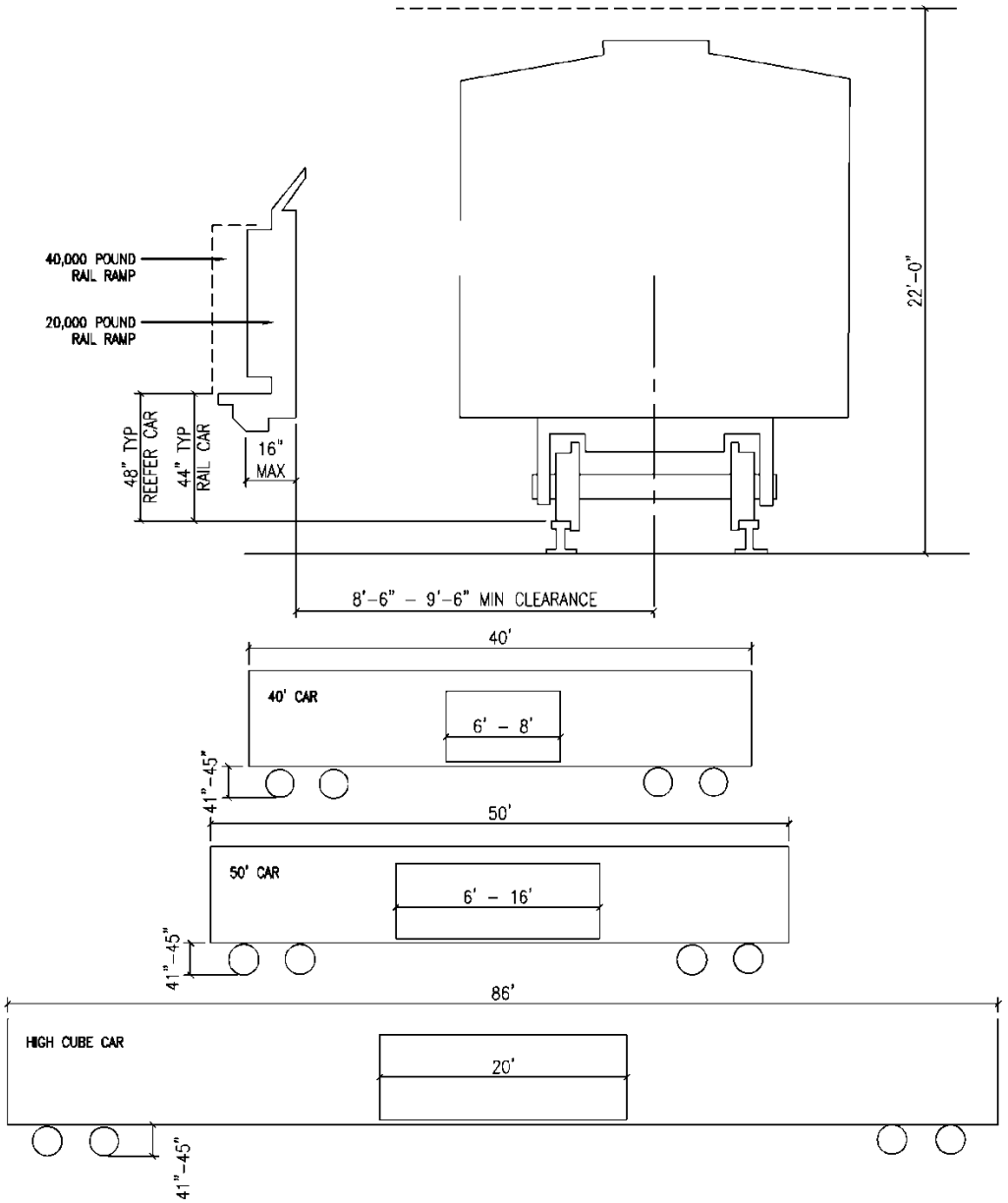


3-4.2 Rail Docks

If rail access is available include provisions for rail docks (see figure 3-7) as an option in the design of all storage facilities exceeding 40,000 square feet (3716 sq. m). There are three primary types of rail dock:

Figure 3-7 Rail Car Characteristics

Section and Elevations



3-4.2.1 Outside Docks

Outside rail docks use through-the-wall access to rail cars without using an outside platform. Use inflatable seals to seal the space between the rail car and the warehouse. Include a wall-mounted dock board to provide access to the rail car.

3-4.2.2 Inside Docks

Inside rail docks may place the tracks inside the building in a pit constructed to place the car floor at the same level as the warehouse floor or on a floor level track. Pit type installations must include track-mounted dock boards. Because of the large amount of warehouse storage space occupied by this type of dock, inside docks are not recommended except under extreme circumstances in which sheltering of the car or additional security is required.

3-4.2.3 Platforms

Platforms for rail service must extend the full length of the building and be 15 feet (4570 mm) wide. Platform height above rails must be 3 feet 8 inches (1118 mm) for general use. Equip platforms with track-mounted dock boards. See the paragraph entitled, “Dock and Platform Weather Protection”.

3-4.3 Ramp Access

Provide ramps at the end of rail platforms and at one warehouse truck dock door for vehicle access. Ramp slope must not exceed 10 percent.

For occupant accessibility requirements see the paragraph entitled, “Accessibility for the Disabled”.

3-4.4 Dock Levelers

Provide dock levelers at all truck and rail dock positions. Dock leveler life is directly affected by load weight, fork truck weight, and frequency of use. Specify dock leveler capacity to provide a minimum 20 year life (see table 3-3).

Interior Dock levelers must be equipped with dock leveler seals.

Table 3-3 Dock Leveler Life (Years) Based on Impact Loading

`RATED CAPACITY	WORKING SHIFTS	MAXIMUM GROSS LOAD (Including weight of fork truck and load)				
		5,000 lb. (2,270 kg)	10,000 lb. (4,540 kg)	15,000 lb. (6,800 kg)	20,000 lb. (9,070 kg)	25,000 lb. (11,340 kg)
20,000 lb (9,070 kg)	1	+	13	-	-	-
	2	19	7	-	-	-
	3	9	-	-	-	-
30,000 lb (13,600 kg)	1	+	+	13	-	-
	2	+	13	6	-	-
	3	18	5	-	-	-
40,000 lb (18,140 kg)	1	+	+	20	8	-
	2	+	+	9	-	-
	3	+	+	5	-	-
50,000 lb (22,680 kg)	1	+	+	+	16	11
	2	+	+	15	8	-
	3	+	18	9	-	-
60,000 lb (27,220 kg)	1	+	+	+	18	12
	2	+	+	+	8	-
	3	+	+	15	-	-

Notes:

+ Estimated life in excess of 20 years.

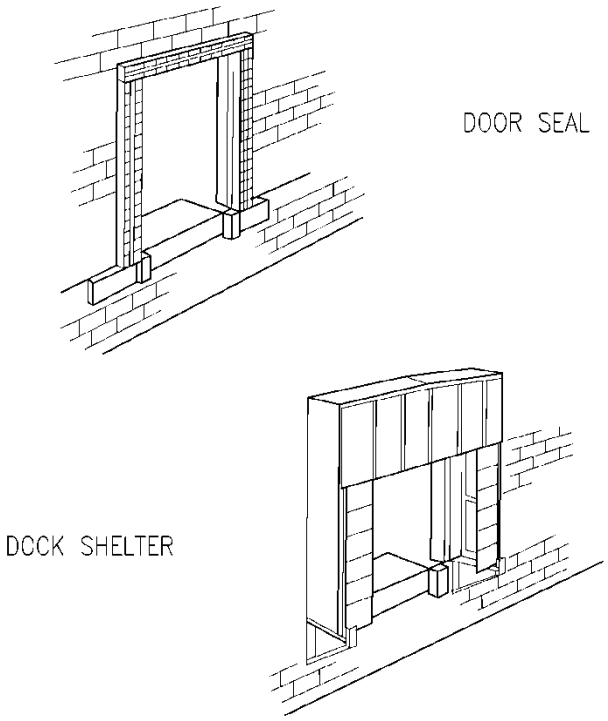
- Estimated life less than 5 years

3-4.5 Dock and Platform Weather Protection

Provide dock shelters or door seals in heated, air conditioned, and dehumidified warehouses, to seal the space between the truck or railcar and the building (see figure 3-8). Full width canopies must be used to shield all docks and rail service platforms from precipitation. Provide gutters and downspouts and connect to underground stormwater drainage system.

Figure 3-8 Truck Dock Weather Seals

Perspective Views



3-4.5.1 Dock Shelters

Use dock shelters in applications where truck size cannot be controlled. Sealing action is achieved through the wiping action of the shelter on the trailer when a truck backs into and through the shelter to the dock. Use shelters when the dock wall is not capable of resisting the compressive forces exerted by a door seal.

3-4.5.2 Door Seals

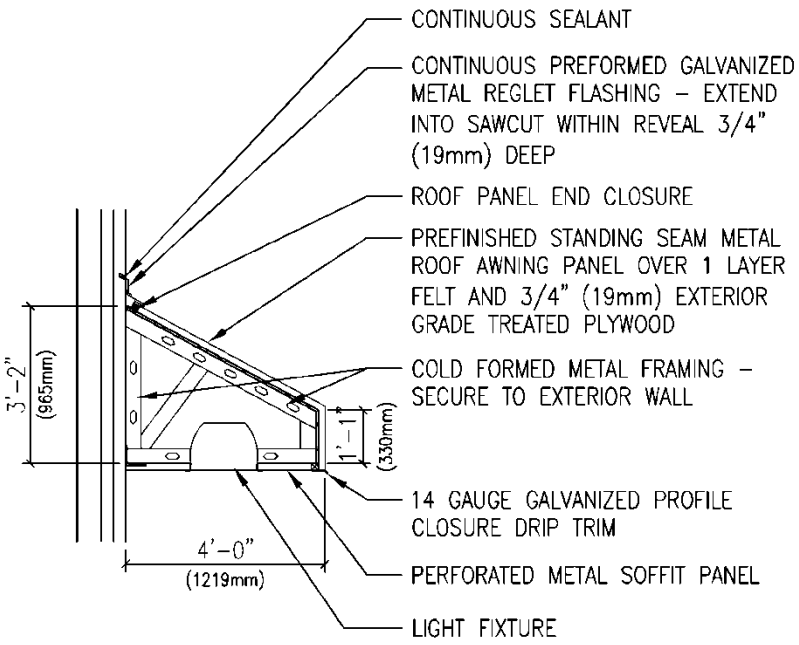
Door seals achieve a seal by compressing between the building wall and the trailer. Door seals provide greater sealing efficiency than dock shelters but require a structural wall capable of resisting compressive forces. Use of door seals requires close coordination of door opening size and trailer size. Excessive size incompatibility will require use of a dock shelter. Provide fire retardant door seals.

3-4.5.3 Canopy

Provide a minimum 4 foot (1830 mm) full length canopy (figure 3-9) over outside docks to protect the trailer and door interface and dock shelter or door seal from excessive weather exposure. This requirement must be evaluated with the site solar angle to alleviate solar loading in the cooling season and optimize solar gain in the heating season.

Figure 3-9 Truck Dock Canopy

Section



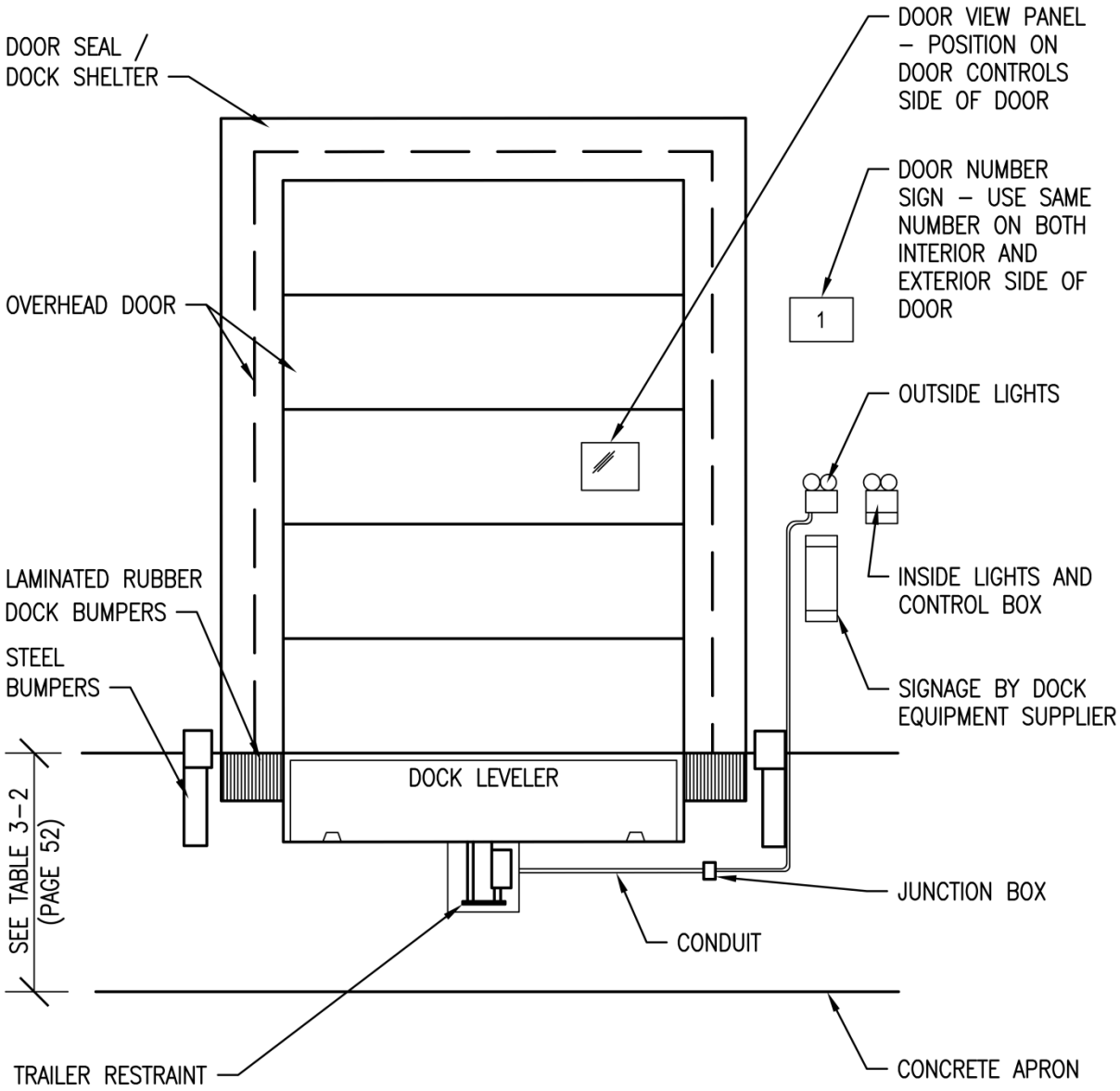
Storm drainage from canopies is prohibited to drain on grade at docks/platforms. Provide exterior downspouts connected to an underground storm water system.

3-4.6 Safety Equipment

Equip each truck dock with safety equipment consisting of wheel chocks and door-mounted lights to illuminate the trailer interior. Dock levelers must be equipped with manually or electrically operated trailer restraints with wheel chocks as a secondary safety measure. Figure 3-10 illustrates a typical installation of a dock shelter, dock leveler, and trailer restraint device.

Figure 3-10 Trailer Restraint System

Elevation View



Provide fall protection per requirements of 29 CFR 1910.23, *Guarding Floor and Wall Openings and Holes*.

Provide two safety posts for each personnel door on the warehouse storage side of the door. See figure 2-3 and figure 2-4 for examples of safety posts applications.

3-5 STRUCTURAL

Refer to UFC 1-200-01, *General Building Requirements*; UFC 3-301-01, *Structural Engineering*; and UFC 3-310-04, *Seismic Design for Buildings* for structural engineering and seismic design requirements.

3-5.1 Ground Floors

Slab-on-grade systems for the offices and shop spaces of the facility must be designed in accordance with UFC 3-301-01, *Structural Engineering*. Fiber reinforced concrete systems must not be used inside the building. Slab-on-grade must have adequate thickness to support wall line loads. For slab-on-grade subject to forklift traffic, the minimum compressive strength for the concrete must be 4,000 psi (27580 kPa).

3-5.1.1 Reinforcement

Provide crack control using reinforcement consisting of minimum number 6 welded wire fabric in a 6- by 6-inch (150 mm x 150 mm) mesh or alternative non-reinforced methods.

3-5.1.2 Thickness

Floor thickness will be determined by a combination of live load, dead load, strength of concrete, and subgrade conditions. Refer to UFC 1-200-01, *General Building Requirements*, UFC 3-301-01, *Structural Engineering* and UFC 3-220-01, *Geotechnical Engineering,* for structural engineering and geotechnical engineering procedures for foundation design. Floors in warehouse facilities must be no less than 6 inches (150 mm) thick.

3-5.1.3 Static Load

Floors must be designed to support the estimated static load of stored material and storage equipment.

3-5.1.4 Impact Load

Floor design must incorporate the effects of Impact loads caused by operation of materials handling equipment. Consult equipment manufacturers for characteristics of specific vehicle impact loads

3-5.2 Superstructure

The superstructure of the warehouse must be a steel frame unless alternate structural frame systems are determined to be better suited for the facility.

The superstructure must be designed to accommodate structure supported shelving and equipment.

3-5.2.1 Structural Bracing

Structural bracing must be located so as not to impair functionality of storage areas. Exposed structural bracing must not be permitted in any administrative spaces.

3-5.2.2 Selection Factors

Determination of a structural frame system other than steel must show careful study of the advantages and disadvantages of alternative systems, as well as the reasons for using the system considered most suitable. Before selecting structural systems, determine if the building will be wall-bearing or framed construction.

Investigate the following during selection of the structural system:

a. Availability of materials.

b. Speed of erection.

c. Local labor and construction practices.

d. Quality of local materials.

e. Limitations on materials by Department of Defense, Bureau of the Budget, or other mandatory standards.

f. Mandatory standard drawings and specifications for certain types of buildings, such as ammunition magazines.

g. Criteria for design of structures in typhoon, hurricane, and other high wind areas. Refer to UFC 3-301-01, *Structural Engineering*.

3-5.2.3 Conventional Construction

Conventional column/beam/truss construction or pre-engineered designs may be used for buildings up to 44 feet (13 410 mm) in height.

3-5.2.4 Rack Supported Construction

Rack supported construction, in which the storage (pallet rack) system provides the building support in the storage area, must be evaluated for all structures over 44 feet (13 410 mm) in height. For lower buildings, this method of construction must be reviewed for economic suitability.

3-5.2.5 Main Structural Framing Materials

3-5.2.5.1 Weathering Steel

Weathering steel must not be used.

3-5.2.5.2 Hollow Structural Sections

HSS members must be sealed to keep water from entering the section and animals from nesting inside. 1/4 inch (6.35 mm) diameter weep holes are allowed as necessary to release any thermal pressure built-up from within the members.

3-5.2.5.3 Exposed Structural Steel

Exposed steel shapes must be selected to minimize their surface area. All exposed steel connections must be designed to shed water. Exposed steel must be designed to permit the complete inspection of all fasteners and welds.

All exposed structural steel must be coated with a high performance coating system consisting of an epoxy primer, a high solids polyurethane intermediate coat and a high solids polyurethane top coat. Refer to UFC 3-190-06, *Protective Coatings and Paints*.

3-5.2.5.4 Corrosive Environments

Refer to UFC 3-301-01, *Structural Engineering* for requirements of steel structures in corrosive environments.

3-5.2.6 Secondary Structural System

The walls and partitions of the warehouse must be non-load bearing and must not be considered as elements of the lateral load resisting system. The walls of the office and shop portion(s) of the facility may be designed as load bearing if structurally isolated from the warehouse structure.

3-5.2.7 Strength and serviceability requirements

In addition to the loads described in or incorporated by reference by UFC 1-200-01, *General Building Requirements,* the design must account for all loads imposed by bridge cranes or other specialty equipment supported by the structure. Cold-Formed steel framing systems must be designed for vibration serviceability.

The structural frame must be designed to accommodate 125% of the loading from overhead bridge cranes. The designer must consider the effect of pattern loads resulting from multiple loaded hooks. All crane hardware and lifted loads must be treated as live loads in the load combinations defined in chapter 16 of the IBC, except for patented tracks, tracks, supports, sway braces and similar elements which are immobile and may be defined as dead loads.

3-5.2.7.1 Gravity loads

In determining design load combinations for structures in which the dead load of one portion of the building serves as stability enhancing function for another portion of the building (i.e. Cantilevered construction), the following cases must be considered in addition to the basic load cases.

3-5.2.7.2 Factored Load Combinations

If the dead load of any portion of the facility, including a structurally isolated administration and shop structure sharing a common foundation, is used to resist uplift forces, it must be factored by 0.9 in strength design analysis and by 0.6 in stress design analysis if it favorably contributes to the performance of the system.

3-5.2.7.3 Wind and Snow Loads

Refer to UFC 3-301-01, *Structural Engineering.*

3-5.2.7.4 Seismic Loads

Refer to UFC 1-200-01, *General Building Requirements*; UFC 3-301-01, Structural Engineering; and UFC 3-310-04, *Seismic Design for Buildings*, for structural engineering and seismic design requirements.

3-5.2.7.5 Thermal Loads

In addition to the thermal loads of the IBC, the designer must account for anticipated differential thermal effects from solar heating (e.g., on long sun-exposed exterior steel compared to shaded steel such as roof trusses, joists or decking) or inside/outside differences (particularly a “stratification” effect in the warehouse storage bay). Consider the local climate conditions when selecting the final differential temperature range, as a minimum, a temperature differential of 50°f (28°c) must be used for design. The deflections caused by differential thermal effects must be investigated by the engineer of record. Some architectural fascia elements and weather seals around large overhead doors are particularly vulnerable to detrimental deflections. The differential thermal effects are a serviceability concern and must be investigated using unfactored loads.

The design must also control deflections to within the limits imposed by section 1604 of the IBC in compliance with UFC 3-301-01, *Structural Engineering* unless stricter control is necessary to support equipment, fascia or other appurtenances. The warehouse roof must meet the requirements of a structure “supporting a non-plaster ceiling” and the walls must meet the requirements of a “partition with flexible finishes.” The administrative area must meet the deflection requirements appropriate to finish type. If the warehouse and administrative area framing is constructed as a single frame, the combined structure must meet the most stringent requirements described above.

3-5.2.7.6 Deflection and Drift

The deflection of structural elements, evaluated under service level loads, must provide for the serviceability of the structure and all of its components, including but not limited to exterior walls and cladding, partition walls, hangar doors, bridge cranes, utilities and other appurtenances. However, in no instance must the deflection of any structural element exceed the limits of the IBC. The lateral drift (sideways) of the structure as a whole, evaluated under service level loads, must provide for the serviceability of the structure and all of its components, including but not limited to exterior walls and

cladding, partition walls, overhead doors, bridge cranes, utilities and other appurtenances. However, in no instance must the drift of the structure exceed the mean roof height divided by 320. If the structure has multiple roof elevations, this requirement must be independently met at each roof level.

3-6 EXTERIOR DESIGN

Exterior walls of the warehouse must be of a construction suitable to the building type, be compatible with the design of the existing building / adjacent buildings with regards to building form, height, materials selection, color and architectural detailing and be protected from abuse, both interior and exterior. Exterior walls and building signage must be compatible with the Installation Appearance Plan (IAP) or other written documents. For Design/Build projects, coordinate any specific requirements for materials prior to issuing the RFP.

Exterior design and architecture must comply with UFC 1-200-01, *General Building Requirements,* UFC 3-101-01, *Architecture* and UFC 1-200-02, *High Performance and Sustainable Building Requirements.*

3-6.1 Surface Treatment

The chemical properties of materials and finishes for exterior surfaces must have the highest possible resistance to the effects of weather and salt-corrosive atmosphere.

Where metal panels are used for exterior wall and roof surfaces, provide a factory applied finish system to resist corrosive climatic effects.

3-6.2 Roofing Systems

Low-slope roofs must be used to minimize potentially unusable space caused by the roof rise associated with sloped roofs. Sloped roofs having a pitch exceeding 1 inch per foot (83 mm per meter) must be avoided for warehouse facilities unless available roofing materials require a greater pitch. When the roof slope exceeds 2 inch per foot (166 mm per meter) the sprinkler operating area and sequence will be impacted. Sheds may have a roof pitch of 2 inches per foot (166 mm per meter) or greater.

Refer to UFC 1-200-01, *General Building Requirements* and UFC 3-110-03, *Roofing*.

The following criteria apply:

a. Combustible roofing is permitted only in emergency construction.

b. Roofing construction may consist of steel decking, reinforced concrete, or precast concrete panels.

c. Gutters and downspouts must be used. Positive measures must be taken to prevent accumulations of mud, snow, or ice. Where downspouts are to

outlet on-grade splash blocks of adequate size for downspout capacity must be provided.

d. Refer to UFC 3-110-03, *Roofing*, for standards concerning materials and installation for built-up roofing.

e. Provide a drop ceiling in the warehouse when the roof slope is greater than 2 inch per foot (166 mm per meter).

3-6.2.1 Low-Slope

Low-slope roofs must have a minimum pitch of 1/2 inch per foot (42 mm per meter).

3-6.2.2 Steep Slope

Sloped roofs having a pitch of 3-4 inches per foot (250-333 mm per meter) may be used in small spans where roof rise can be limited to 5 feet (1525 mm) or less.

3-6.3 Exterior Walls

Exterior walls may be of insulated metal siding, brick or concrete masonry, or tilt up precast or cast-in-place concrete panels. When metal walls are used, the first 4 feet (1220 mm) of wall above the floor must be of reinforced masonry construction to protect the structure from fork truck impact and provide additional security. Walls located on sides designated for future expansion must be removable.

3-6.4 Dock Doors

Size dock doors consistent with the types of delivery vehicles expected to operate around the facility.

See table 3-4 for recommended door sizes.

Table 3-4 Recommended Door and Portal Sizes

Description	Width		Height	
	inches	mm	inches	mm
Standard Truck Door	9’-0”	2,743.2 mm	10’-0”	3,048.0 mm
Air Lines of Communication (ALOC) Door	10’-0”	2,743.2 mm	10’-0”	3,048.0 mm
Transporter Door	10’-0”	3,048.0 mm	10’-0”	3,048.0 mm
Firewall Door (interior between bays)	15’-0”	4,572.0 mm	15’-0”	4,572.0 mm
Oversized Door	12’-0”	3,657.6 mm	10’-0”	3,048.0 mm
Forklift Ramp Door	15’-0”	4,572.0 mm	15’-0”	4,572.0 mm
Truck Well Door	12’-0”	3,657.6 mm	15’-0”	4,572.0 mm

3-6.4.1 Dock Door Height

Truck dock doors must be at least 9 feet (2745 mm) high.

3-6.4.2 Dock Door Width

Truck dock doors must be at least 9 feet (2745 mm) wide.

3-6.4.3 Dock Door Safety Hardware

Provide safety hardware meeting the requirements of UL 325, *Door, Drapery, Gate, Louver, and Window Operators and Systems* and ANSI B11.19, *Performance Requirements for Safeguarding*.

3-6.5 Fire Doors

In heater rooms and transformer vaults, doors must be metal-covered or industrial-type metal fire doors, as required. \1\/1/Refer to UFC 3-600-01, *Fire Protection Engineering for Facilities*.

3-6.6 Windows

All fenestration must conform to the recommendations of the Threat / Vulnerability Assessment and Risk Analysis. Place windows to prevent illicit entry accomplished by reaching adjacent entry door hardware.

Use windows meeting American Architectural Manufacturers Association (AAMA) type HC60 window specifications (AAMA WSG-11, *Window Selection Guide*). Windows must be thermally broken pre-finished aluminum with tinted, low–e glass. Use laminated glazing and comply with UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings* in portions of the building that qualify as “inhabited”, including “inside” windows exposed by the warehouse bay. Both panes must have laminated glazing. Specify commercial grade windows with heavy-duty insect screen for operating section. Solar glazing with low “e” glass is required in regions with plentiful sunlight.

3-6.7 Doors and Hardware

Exterior doors with closers must be Level 4, physical performance Level A doors complying with ANSI/SDI A250.8, *Standard Steel Doors and Frames*. Frames must match door level. Exterior door frames must be welded type.

Provide Grade 1 hardware typical. Locksets must be mortise type, Series 1000 as defined by ANSI/BHMA - A156.13, *Mortise Locks and Latches* for shop and maintenance level doors. Hinges for doors with closers must be full mortise butt hinges except where special types are required. Closers must be the best and highest grade available from each manufacturer. Exterior doors must have overhead rain drips and door drips.

3-6.8 Signage

Provide exterior signage in accordance with UFC 3-120-01, *Design: Sign Standards*.

3-7 INTERIOR DESIGN

Durability is extremely important when specifying materials for interior construction and finishes. Warehouses regularly handle heavy equipment throughout the facility. All finishes and components must be selected based on the operations performed in the warehouse, and shop spaces. These conditions will lead to greater interior damage being incurred compared to many other facility types.

Refer to UFC 1-200-01, *General Building Requirements* and UFC 3-120-10, *Interior Design.*

3-7.1 Interior Walls

Interior wall construction will vary depending upon use, finish, and required fire and corrosion resistance. Refer to UFC 1-200-01, *General Building Requirements*.

3-7.2 Doors and Windows

Windows must be provided for office and service structures when located on an exterior wall. A continuous narrow band of high windows may be justified in large warehouses by savings in electric lighting costs as determined by energy modeling.

3-7.2.1 Doors

Provide interior door openings and portals of sufficient height and width to permit passage of materials handling equipment. Size doors and portals consistent with the types of trucks expected to operate in the facility. These requirements do not apply to personnel type exit doors.

See table 3-4 for standard door and portal sizes.

3-7.2.1.1 Door Height

Doors must provide a minimum of 6 inches (150 mm) clearance for the highest loads or vehicles expected to operate in the facility.

3-7.2.1.2 Door Width

Doors must provide a minimum of 12 inches (300 mm) clearance on each side of passing materials handling equipment.

3-7.2.1.3 Hardware

Provide Grade 1 hardware typical. Locksets must be mortise type, Series 1000 as defined by ANSI/BHMA - A156.13, *Mortise Locks and Latches*. Locksets for administrative spaces may be Series 4000 as defined by ANSI/BHMA - A156.2, *Bored and Preassembled Locks and Latches*. Hinges for doors with closers must be full mortise butt hinges.

Metal overhead doors must be chain hoist operated, except when frequent use demands motorized operation.

3-7.3 Signage

Provide safety markings on walls and floors (figure 2-5.) Refer to Title 29 Code of Federal Regulations (CFR) Part 1910, *Occupational Safety and Health Standards*.

Provide interior signage in accordance with the requirements of UFC 3-120-01, *Design: Sign Standards*.

3-7.3.1 Identification

Provide identification signage to inform personnel of area identification, function, services, safety, and storage locations.

3-7.3.2 Warning

Identify all hazards, hazardous equipment, and restricted areas with suitable warning signage.

3-7.4 Warehouse Storage Area

The warehouse must be provided with durable finishes. The exterior walls must have as a minimum, a protective panel along the exterior walls that will prevent damage to the exterior finish system. The minimum protection can be provided by a metal panel attached to the wall panel girts. The protective panel must extend to at least 7 feet (2.13 meters) above the warehouse floor. Alternatively, masonry may be provided.

3-7.4.1 Floors

Critical attention to floor design and construction is essential to proper operation of narrow aisle high-rise storage systems. Provide a Class 5 floor in accordance with American Concrete Institute (ACI) *Guide for Concrete Floor Slab Construction*, AC1 302.1R-04 and UFC 1-200-01, *General Building Requirements*, for areas not otherwise specified.

3-7.4.1.1 Finishes

Floor hardeners, dressings, or toppings are required for durability in areas of exceptionally high activity such as main aisles, towline paths, or industrial shop areas. Sealers are required for dust control.

3-7.4.2 Superflat Floors

High rise, narrow aisle storage systems with aisles less than 96 Inches (2440 mm) wide and storage heights exceeding 20 feet (6100 mm) require extremely smooth and flat floors to control operating tolerances. Superflat floors must be designed and specified for vehicles such as turret trucks and man-up order picking trucks. Provide superflat, class 9 floors in accordance with ACI 302.1R-04, *Guide for Concrete Floor and Slab Construction*.

3-7.4.2.1 Construction Guidelines

In order to assure that superflat tolerances can be achieved, the following design and construction guidelines must be followed:

a. Clearly identify on the design drawings those areas of the warehouse floor which must meet superflat tolerances.

b. Incorporate a requirement in the construction contract for test slabs to assure that the superflat floor tolerances can be achieved with the contractor's proposed operations.

c. All longitudinal construction joints must be located outside of the aisles in which the trucks operate. Space transverse weakened plane joints to control random cracking and potential slab warping. A transverse joint spacing of 20 feet (6100 mm) will generally be satisfactory. Transverse joints must be sawed and sealed.

d. Locate floor drains, cleanouts, conduits, and other floor discontinuities outside of the aisles and where appropriate to allow for access by maintenance personnel to perform routine maintenance.

e. Specify a concrete mix having a low water-cement ratio and low shrinkage characteristics. Achieve concrete workability through use of plasticizers in lieu of additional water.

f. During construction, pour concrete between rigid forms in lanes less than 20 feet (6100 mm) wide. Strike off concrete with a vibrating screed.

g. After initial floating, use a 10 foot (3050 mm) long transverse scraping straightedge (highway straightedge) to remove high spots.

h. Check the surface of the plastic concrete frequently with a 10 foot (3050 mm) long straightedge placed both parallel and transverse to the

centerline. Correct any high spots and fill any low spots using the highway straightedge.

i. Use of a boom operated laser leveling screed is greatly encouraged to achieve superflat floor tolerances.

3-7.4.2.2 Measurement

Refer to ACI 302.1R-04, *Guide for Concrete Floor and Slab Construction* for measurement requirements for class 9 superflat floors and the following requirements:

a. In specifying floor flatness for turret truck and order-picking truck operations, require a complete (100%) profile analysis of the wheel path portion of the concrete floor in the storage aisles and a statistical profile analysis of other portions of the concrete floor on which turret trucks and order-picking trucks will operate.

b. For measurement of floor flatness, require use of special floor flatness profile measurement equipment such as the "Profilograph" or an equivalent measuring equipment technique. Measurements must be taken at 20 ft. (6 m) intervals in each of two perpendicular directions.

c. Require in the specifications that the general contractor provide certification to be prepared by the measuring equipment operator. Certification states that the "wheel path" and other portions of the concrete floor to be used for turret truck and order-picking truck operations must completely meet maximum rated productivity floor flatness requirements of the Headquarters Office of the truck manufacturer(s). Floors which fail to meet the required tolerances will be corrected as directed by the Contracting Officer.

d. All noncritical floor slabs must be specified to be an ACI Class Bx floor. See ACI 302.1 R-04, *Guide for Concrete Floor and Slab Construction* for Class Bx criteria.

3-7.4.3 Wire Guide Requirements

When electronic wire guide vehicle controls are used, observe the following floor design criteria:

3-7.4.3.1 Conduits

Avoid installing conduits in the floor.

3-7.4.3.2 Reinforcing

Reinforcing steel must be located at least 2 inches (50 mm) below the concrete surface. Wire mesh must be tack-welded together wherever possible. Rebar and wire mesh must be grounded.

3-7.4.3.3 Expansion Joints

Where possible, expansion joints must not be located under storage racks. When expansion joints are located in the storage aisle, they must run parallel to the aisle and not be within 3 inches (75 mm) of the centerline of the storage aisle or within materials handling equipment wheel tracks. Expansion joint material used in hazardous materials storage areas must be compatible with the contents of the materials being stored.

3-7.4.4 Walls

All unfinished items must be painted.

Paint wall surfaces a light color(s) to reduce lighting demands.

3-7.4.5 Ceilings

Paint all structural steel, deck and other non-prefinished items.

3-7.5 Shops and Storage Rooms

3-7.5.1 Walls and Partitions

Walls must be painted concrete masonry units or concrete around shop spaces. Partitions separating shops may be impact resistant gypsum wall board on metal studs. For shops without ceilings, partitions must extend to structure above.

3-7.5.2 Floors

Floor finish must be an epoxy floor coating compliant with Master Painter's Institute - MPI 212, *Floor Coating, Thin Film, for Aircraft Maintenance Facilities* or sealed concrete.

3-7.5.3 Ceilings

Shops must not have suspended ceilings. All exposed piping, structure, deck, ductwork, etc. must be painted.

3-7.6 Administration and Office Spaces

3-7.6.1 Partitions

Partitions separating administration spaces from the warehouse space must be concrete masonry construction. Partitions separating administrative spaces may be gypsum board construction. Partitions are not required to extend to above the ceiling for similar office types and spaces where noise between offices is not an acoustical issue or required for personnel counseling. Paint all unfinished materials.

3-7.6.2 Floors

Floor finishes must be standard type finishes based on the expected usage of the spaces. Provide a wall base in all spaces.

3-7.6.3 Ceilings

Provide suspended acoustical ceilings in all administrative spaces.

3-7.7 Toilet and Locker Rooms

3-7.7.1 Partitions

Provide CMU partitions around toilet and locker rooms. Partitions around perimeter of space must extend to floor or roof construction above. Provide ceramic tile wainscot and ceramic base. Provide ceramic tile wall finishes to the ceiling on all walls in showers.

3-7.7.2 Floors

Floor finishes must be ceramic tile.

3-7.7.3 Ceilings

Ceilings in toilets must be gypsum wall board. Ceilings in locker rooms must be suspended acoustical ceilings with a water resistant membrane. Ceilings in showers must be water resistant gypsum board. Plaster is not allowed.

3-7.7.4 Lockers

Provide personnel lockers in dedicated locker rooms. The number of personnel lockers must be identified in the RFP. Lockers are provided for personnel to keep personal items or clothing during their work shift. Provide lockers with solid sides and louvered doors.

Lockers must be 9” x 21” x 72” (229mm x 533mm x 1829mm) high and must be single tier type. All lockers must be metal and must have capability to receive padlocks.

3-7.8 Corridors and Stairs

3-7.8.1 Partitions

Partitions in corridors and stairs must be painted masonry or painted gypsum board. Gypsum board must be impact resistant type to 8 feet (2.44 meters) above the floor or stair level. Corridor partitions and rooms without ceilings must extend to the deck above.

3-7.8.2 Floors

Floor finishes for these spaces must be as determined by the designer but minimum finish must be a resilient flooring system.

3-7.8.3 Ceilings

Corridors must have suspended acoustical ceilings, typical.

3-7.9 Support Spaces

Support spaces such as mechanical, pump rooms, and electrical rooms must be provided as required. These spaces must be as determined by the requirements of the project.

Partitions in corridors, around mechanical, electrical, and similar type spaces must be painted masonry. Corridor partitions and rooms without ceilings must extend to the deck above. All exposed piping, structure, deck, ductwork, etc. must be painted.

3-7.10 Battery Charging and Handling Operations

Provide an equipped and ventilated area for the charging of materials handling vehicle batteries. Figures 3-11, 3-12 and 3-13 illustrate typical battery charging layouts. Hydrogen detectors must be provided at Battery Charging Areas.

Figure 3-11 Battery Charging Area (Open Locations)

Plan Views

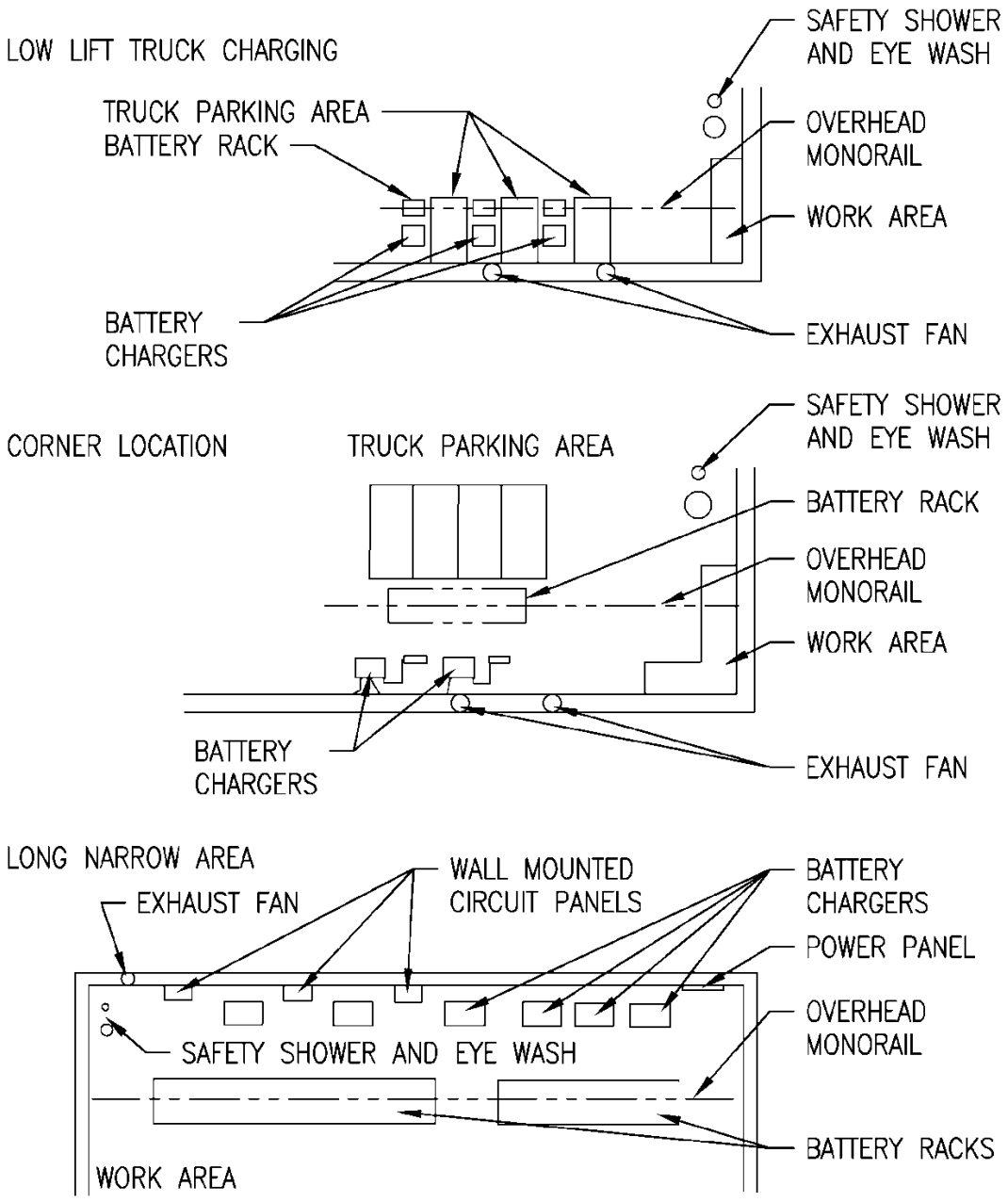
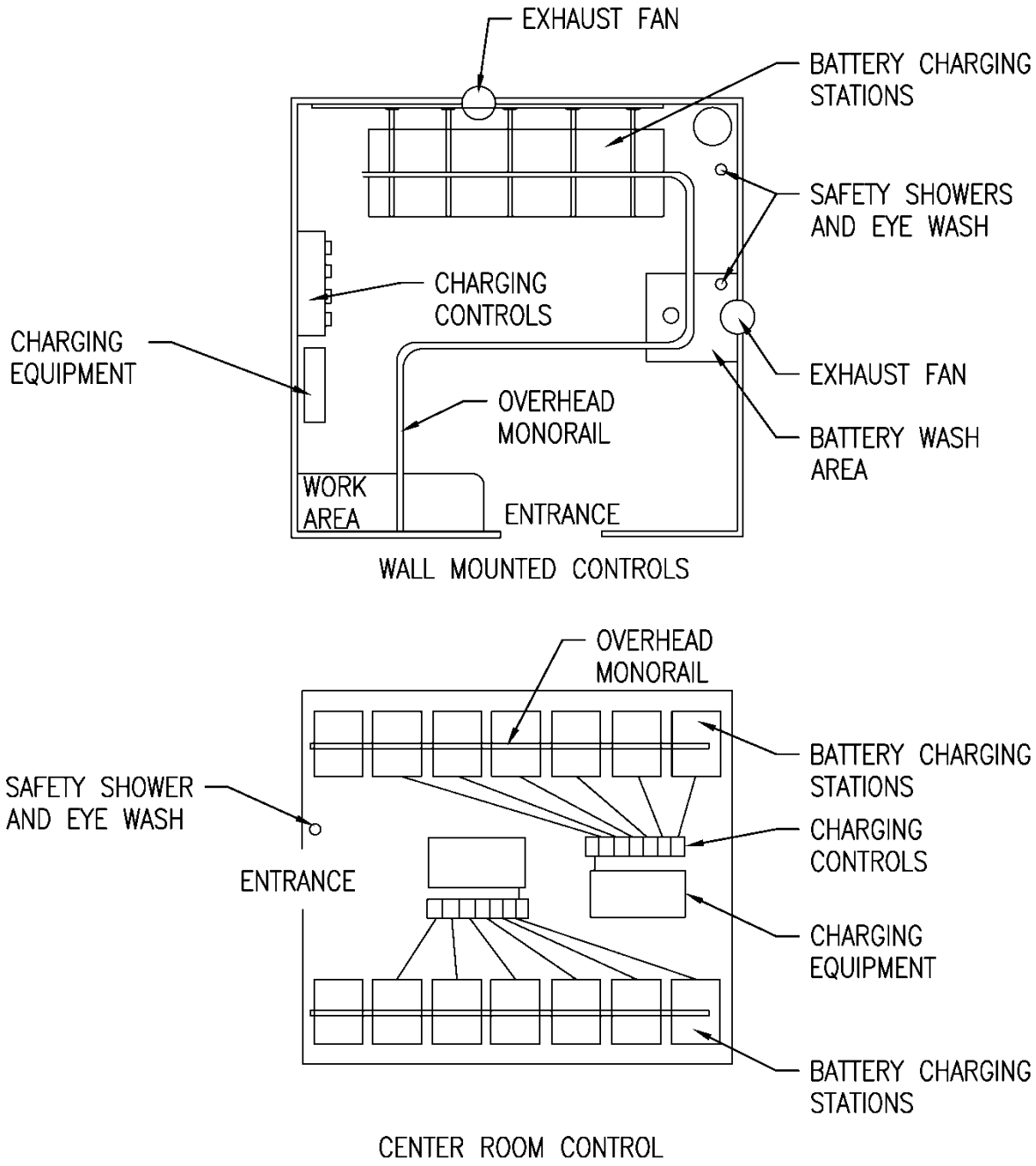


Figure 3-12 Battery Charging Area (One-Entrance Room)

Plan Views



3-7.10.1 Containment Pit

Contact the local environmental office for regulations about handling contaminated water.

Provide a spill containment pit with a floor grate to capture water and contaminants from the safety shower/eyewash and accidental battery discharge. The pit must be equipped with a shut off valve to allow for proper neutralization of contaminated water before discharging. The pit must be large enough to hold the entire contents of the largest battery serviced in the area as well as all the water from a 15 minute shower.

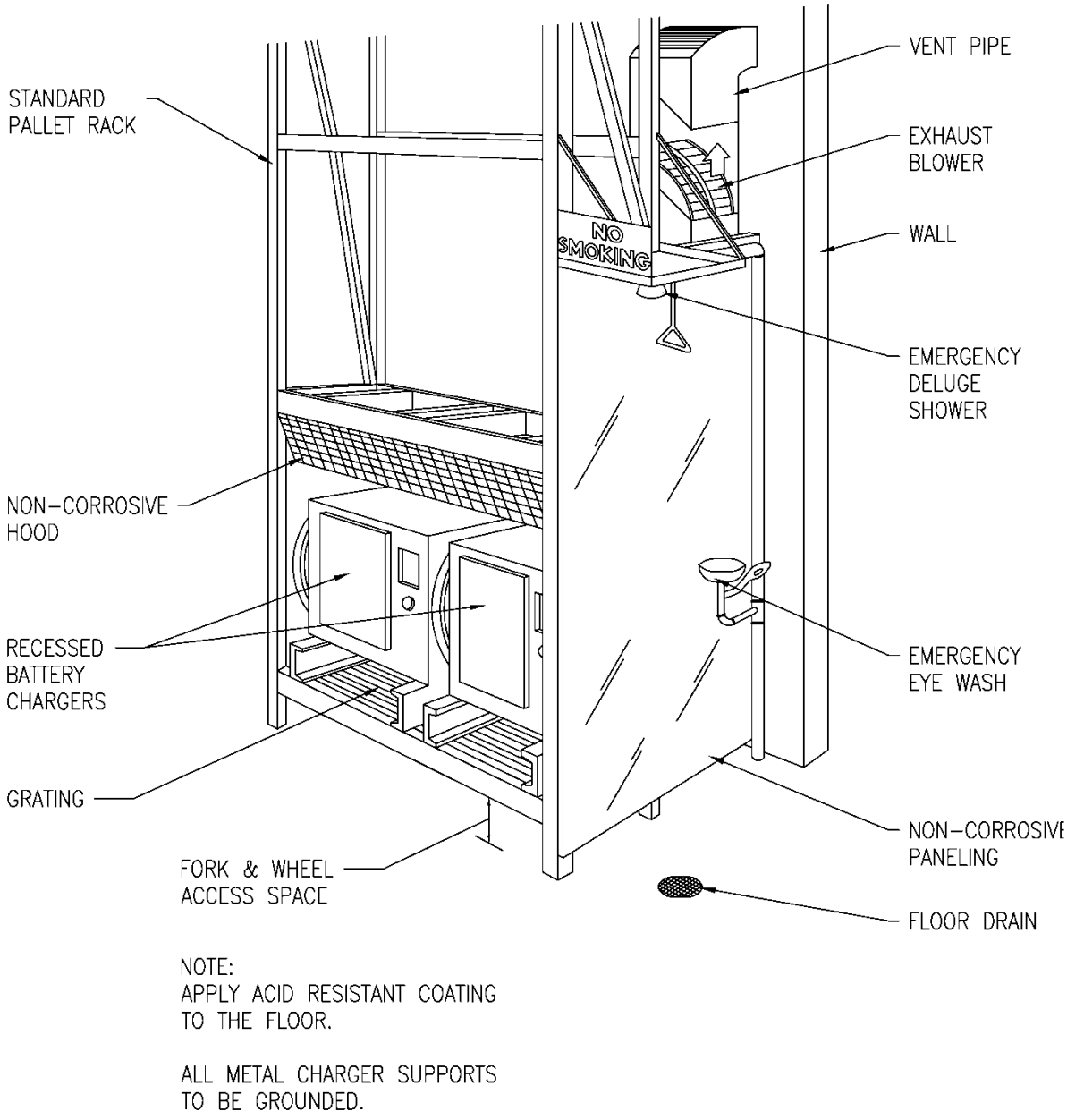
3-7.10.2 Safety Showers / Spill Control

Provide facilities for the emergency drenching of the eyes and body, flushing and neutralizing spilled electrolyte, and protecting charging apparatus from damage (figure 3-13) in accordance with UFC 3-420-01, *Plumbing Systems*. Battery charging areas must be equipped with neutralizing chemicals. Floors must be treated with an acid resistant coating. Install permanent eyewash and shower facilities wherever permanent charging or servicing areas are constructed.

Figure 3-13 Typical Battery Charger Installation

(With Eye Wash/Shower using Standard Pallet Rack)

Perspective View



\1\Note: Refer to paragraph *Containment Pit* for spill containment requirement. /1/.

3-7.10.3 Battery Handling Equipment

Provide specialized battery handling equipment in battery charging and work areas. Equipment used must be selected based on the characteristics of the vehicle and battery being serviced, the activity of the charging station, and the maintenance work performed on the battery. Devices include handling beams, jib hoists, special charging stations, and battery transporters.

3-7.10.4 Ventilation

Provide ventilation in accordance with UFC 3-410-04N, *Industrial Ventilation*.

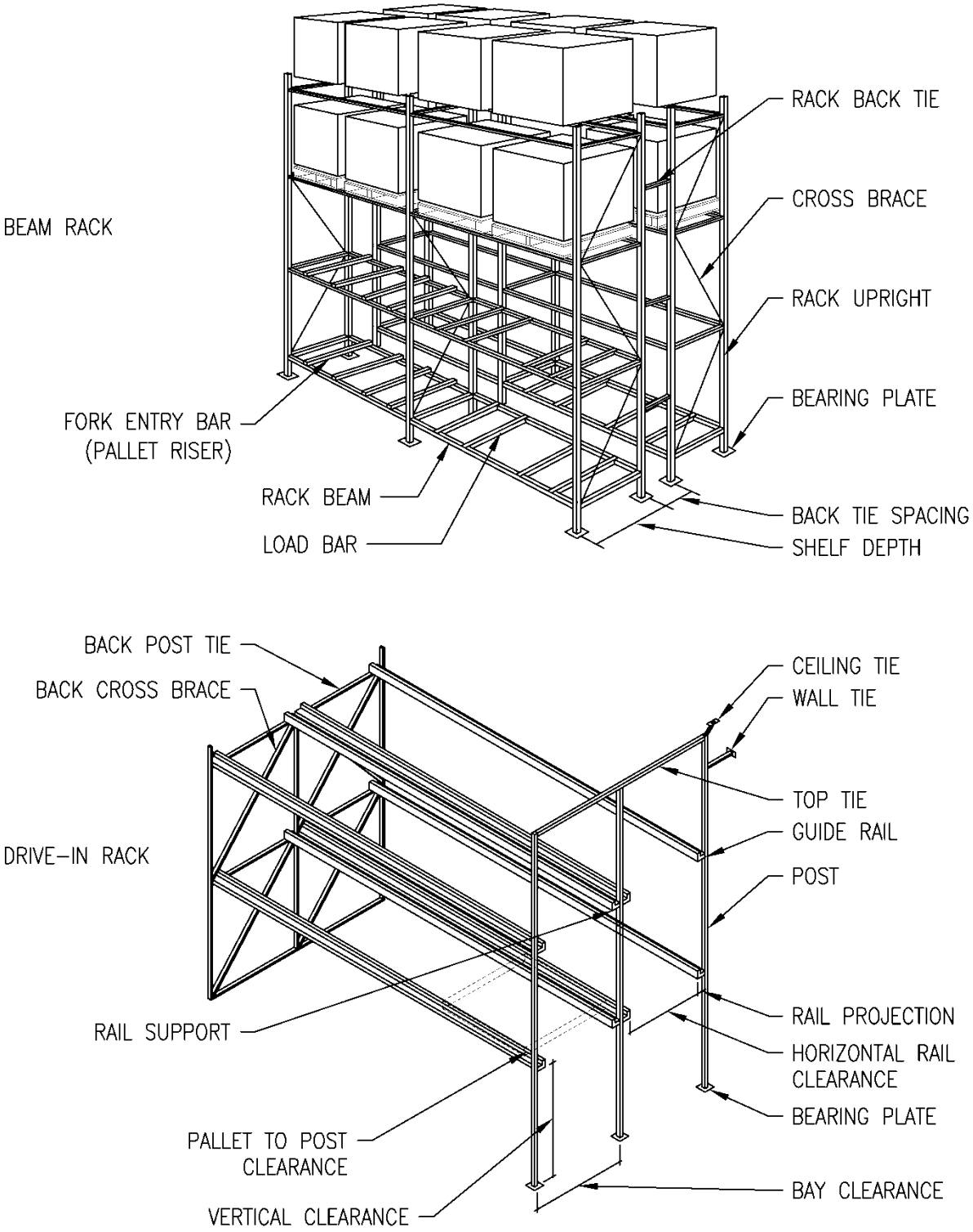
Provide natural and mechanical exhaust ventilation to ensure diffusion of the gases from the battery and to prevent the accumulation of an explosive mixture. Provide ventilation to limit hydrogen gas buildup to no more than 1 percent by volume in room air. If battery charging room air is air conditioned as part of a general building air conditioning system, exhaust air directly to the outdoors and do not return it to the air distribution system. Required air changes must be based on the expected activity in the charging room, but must be no less than six air changes per hour. Activity must consider the number of cells being charged at a given time and the charging current being used. Provide an air velocity rate across battery charging shelves of at least 125 feet per minute (0.64 meters per second). Interlock the ventilation system with the chargers to prevent charger operation unless the ventilation system is operating.

3-7.11 Pallet Racks

Selective pallet racks (see figure 3-14) consist of uprights, pallet beams, bracing, and miscellaneous accessories. Minimum design load must be 3,000 pounds (1360 kg) per pallet.

Figure 3-14 Pallet Rack Terminology

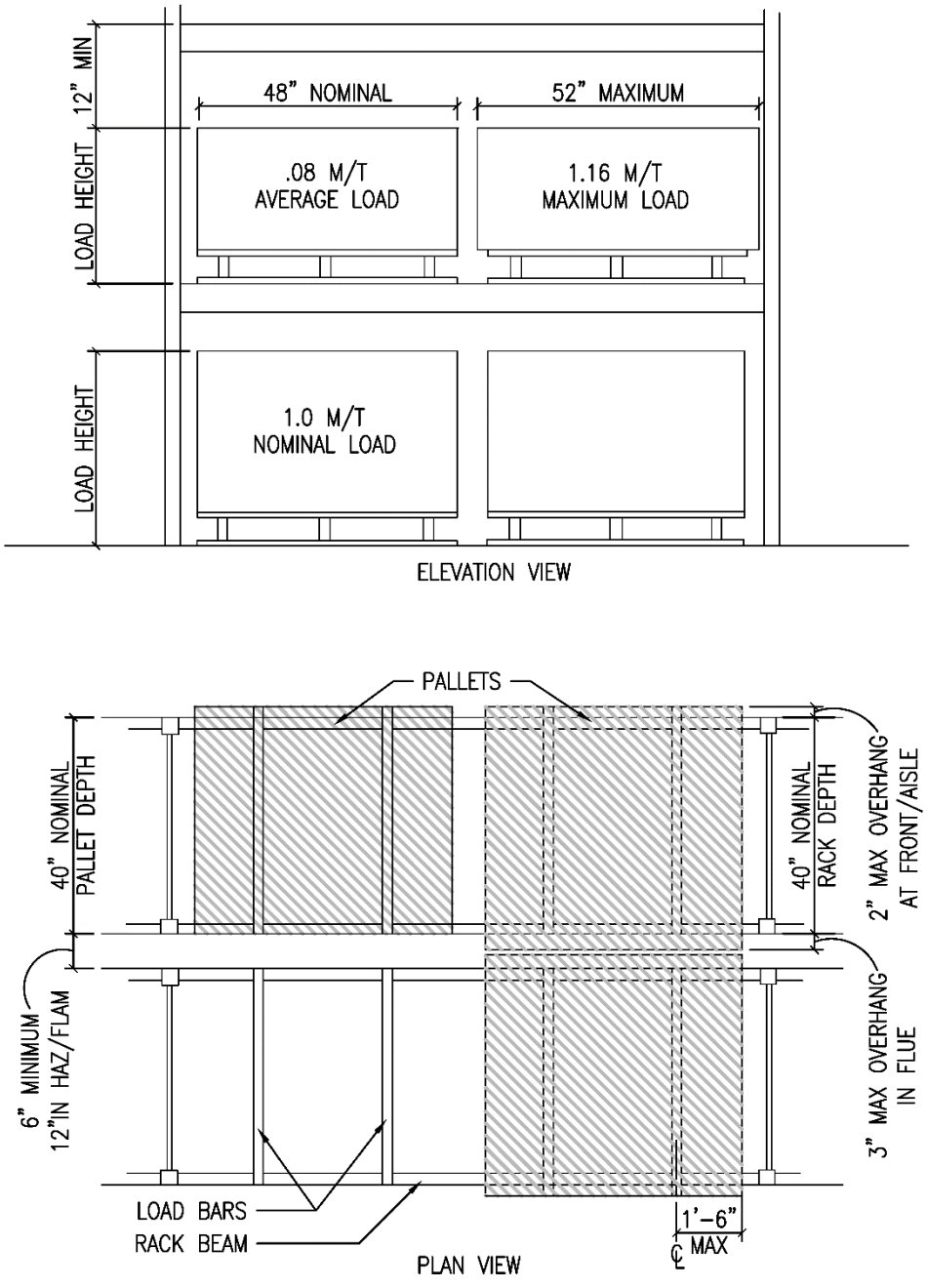
Perspective Views



3-7.11.1 Dimensions

Pallet racks must have a 40-inch (1020 mm) depth and accommodate standard 40- x 48-inch (1020 mm x 1220 mm) pallets without front or rear pallet overhang (see figure 3-15). Use of other sizes of pallet racks or pallets must be documented and justified. Beam to beam vertical spacing averages 48 inches (1220 mm) (see figure 2-2).

Figure 3-15 DoD Pallet Arrangement



3-7.11.2 Stability

Rack stability is influenced by loading conditions, attachment, and rack assembly. Racks exceeding a 6:1 height to depth ratio must be securely anchored or braced externally. For standard racks, this applies to racks exceeding 20 feet (6096 mm) in height.

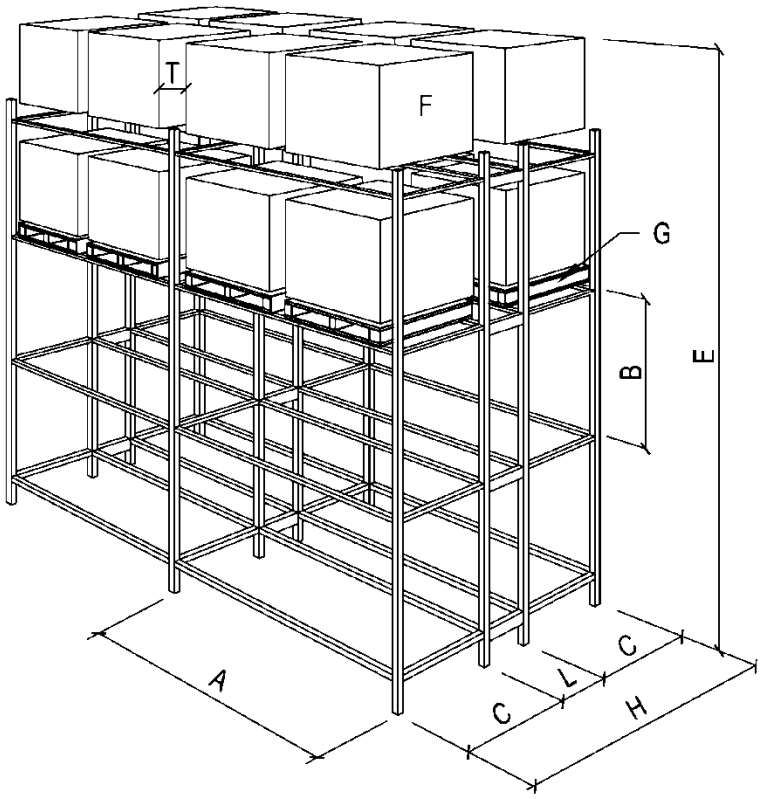
3-7.11.3 Flue Space

Flue space must comply with National Fire Protection Association (NFPA).

- Fire protection requirements dictate a minimum longitudinal flue space (figure 3-16) of 6 inches (150 mm).
- Flues must be 12 inches (300 mm) deep in refrigerated areas.
- In hazardous materials storage areas, provide 12-inch (300 mm) flues between back-to-back racks. Flues of 8-12 inches (200-300 mm) must be provided between backs of racks and walls.
- Standard pallet racks provide a minimum 4-inch (100 mm) transverse flue space.

Figure 3-16 Pallet Rack Fire Protection Terminology

Perspective View



LEGEND
A – SHELF WIDTH
B – SHELF HEIGHT
C – SHELF DEPTH
T – TRANSVERSE FLUE SPACE
L – LONGITUDINAL FLUE SPACE
E – STORAGE HEIGHT
F – COMMODITY
G – PALLET
H – RACK DEPTH

3-7.11.4 Attachment

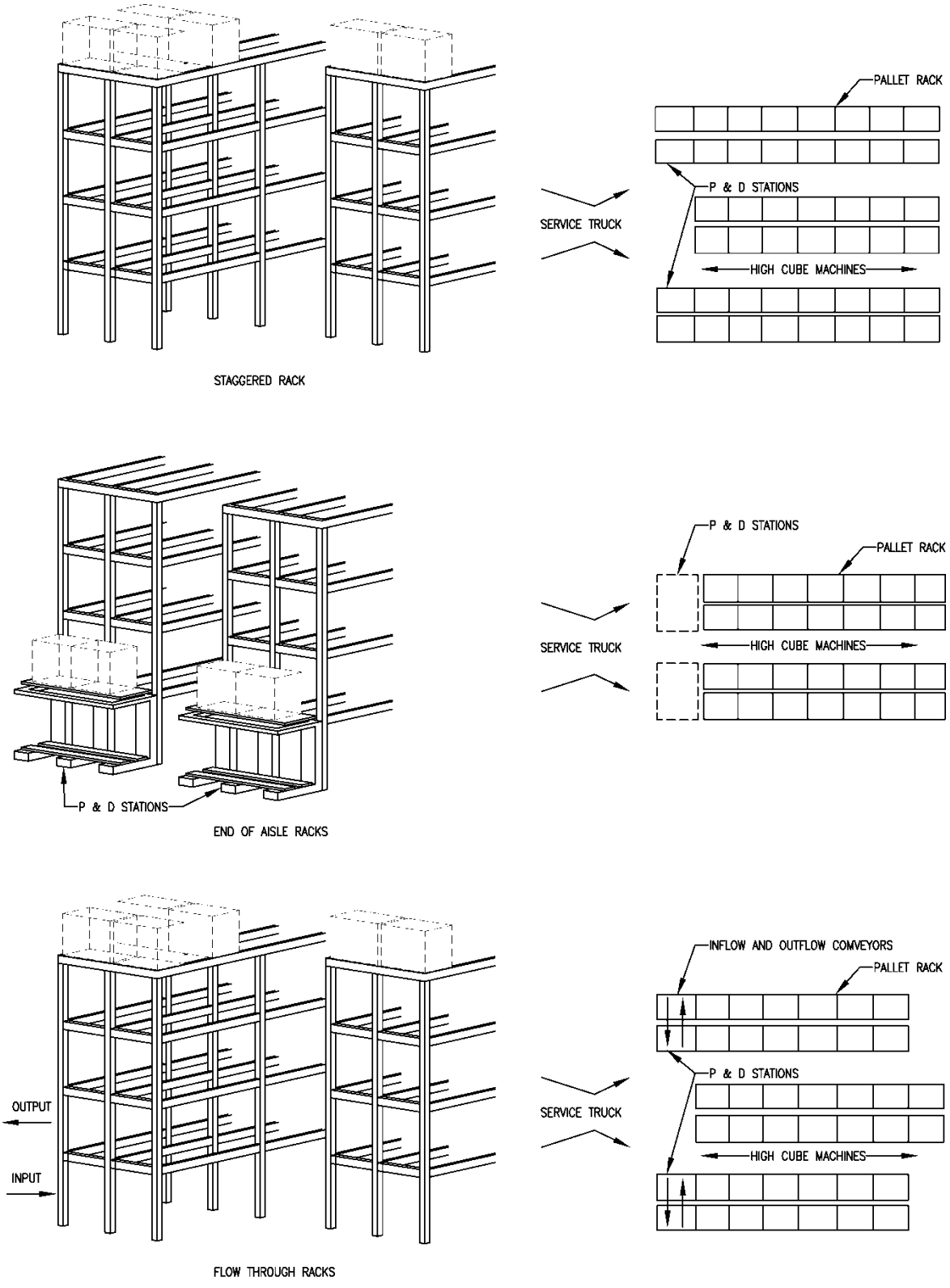
Securely attach all pallet racks to floors, walls, and each other, to ensure stability and safety.

3-7.11.5 System Interface

Interface operations with pallet rack using pickup and delivery (P&D) stations, as illustrated in figure 3-17. Provide additional cross-aisle width to accommodate these P&D stations.

Figure 3-17 Pickup and Delivery (P&D) Stations

Perspective Views and Plan Views



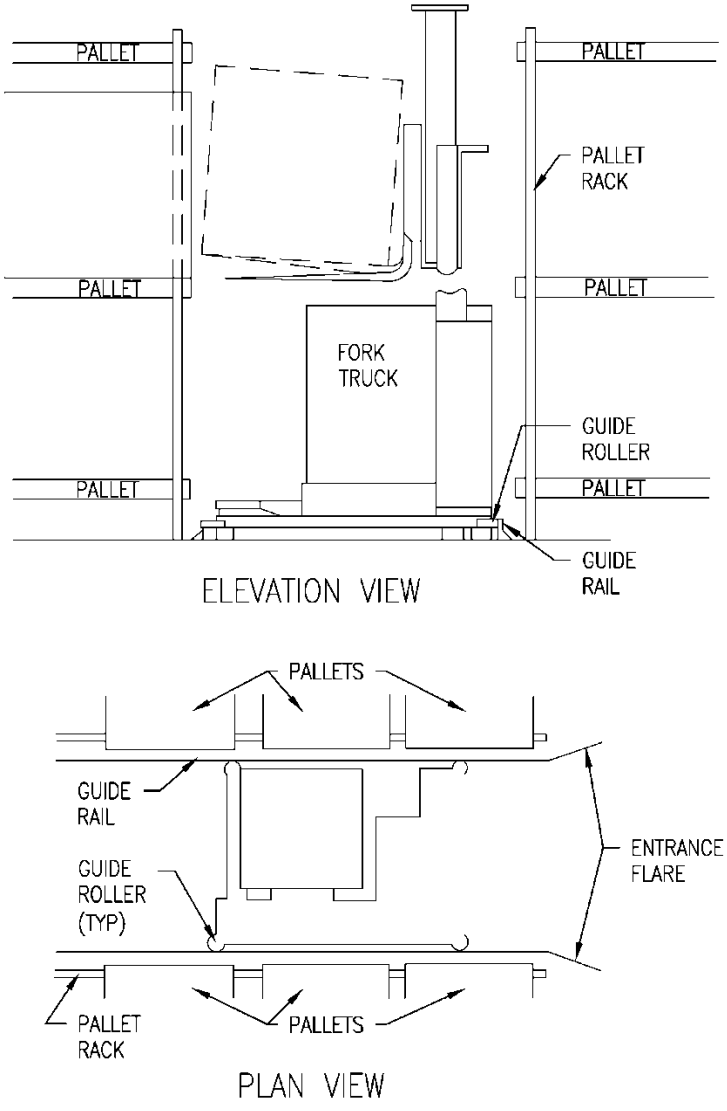
3-7.12 Aisle Dimensions

Coordinate aisle dimensions with specific equipment requirements. Observe the following:

3-7.12.1 Rail Guidance

Coordinate rail locations with pallet rack and vehicle characteristics (see figure 3-18). Provide sufficient cross aisle width to accommodate the entrance flare.

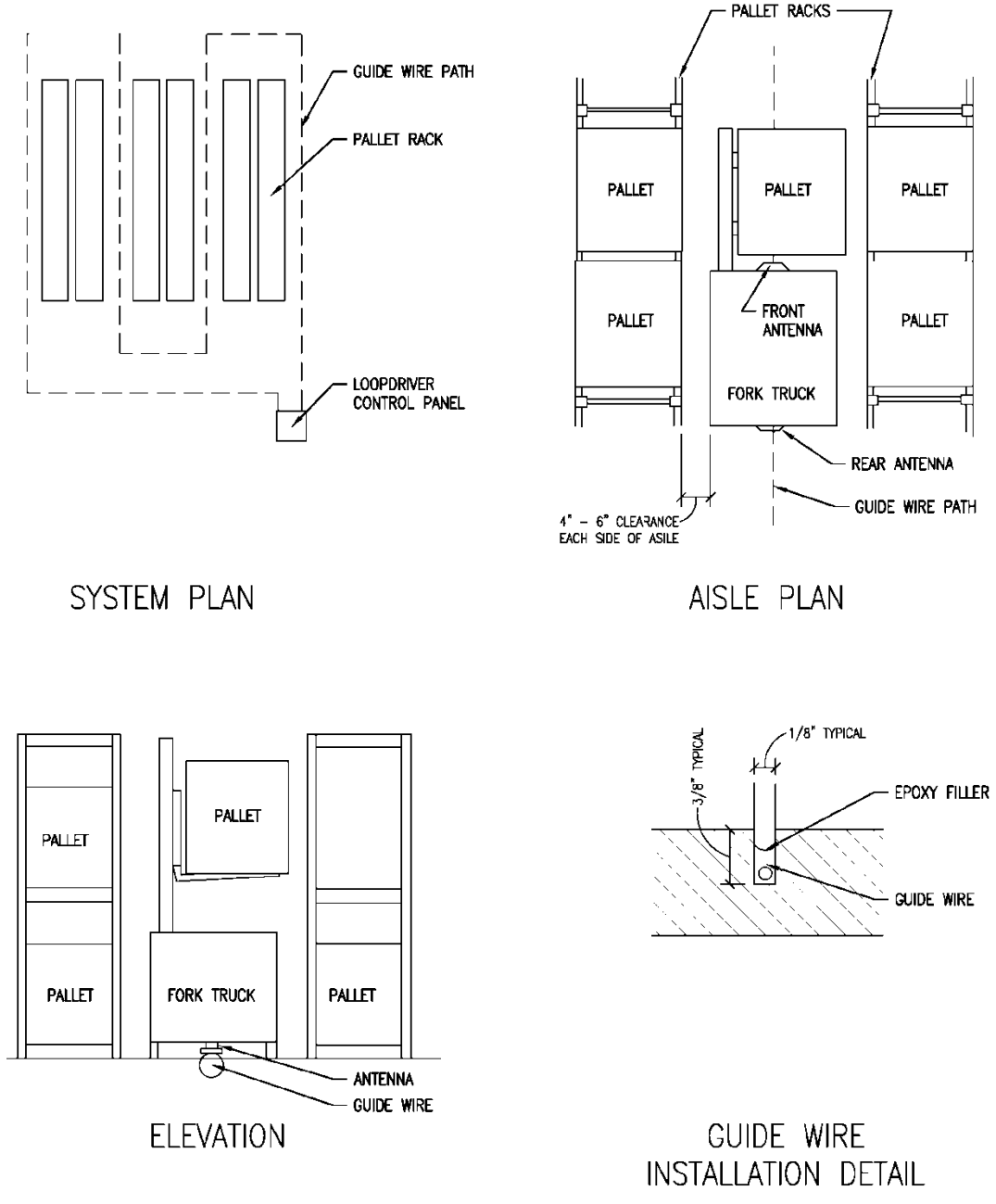
Figure 3-18 Typical Rail Guidance System



3-7.12.2 Wire Guidance

Coordinate guide wire locations with pallet rack and vehicle characteristics (see figure 3-19). Review guide wire location plan to provide a continuous loop and avoid crossovers. Install loop driver and control panel in a protected location.

Figure 3-19 Typical Wire Guidance System



3-7.12.3 Transport Aisles

Width of transport aisles must be at least twice the vehicle width plus 18 inches (145 mm) to permit two-way traffic.

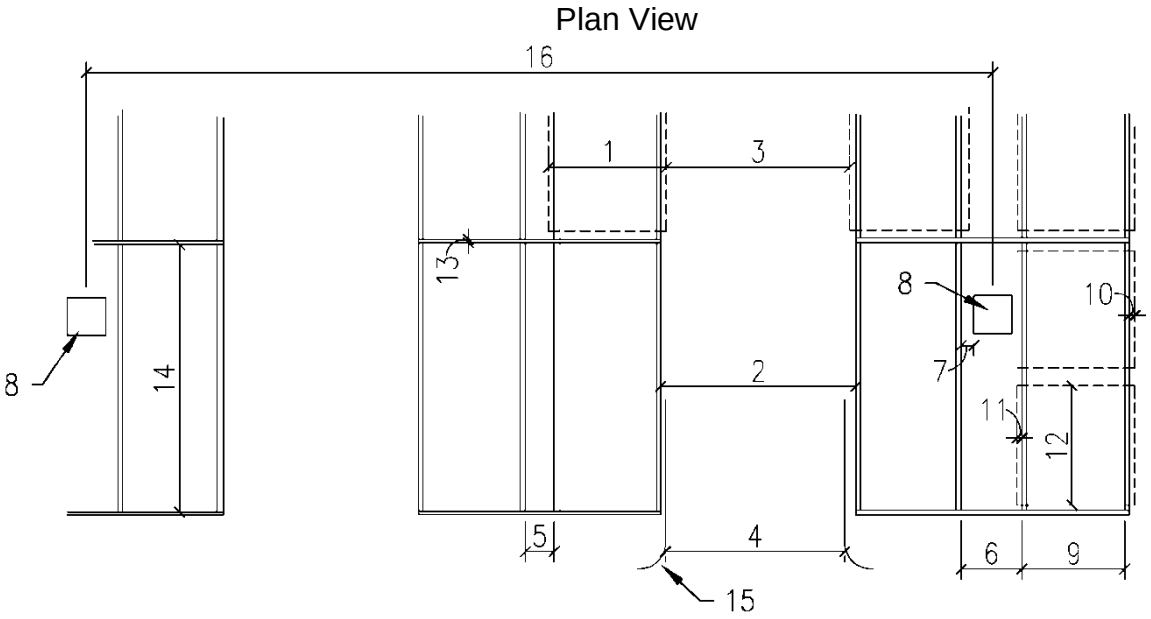
3-7.12.4 Fire Protection

Aisle width will affect sprinkler requirements and water demand.

3-7.13 Building Bay Dimensions

Modular building dimensions must be developed considering the relationship between column spacing, rack dimensions, aisle patterns, machinery and operations. Apply a 33 ft. x 64 ft. (10,060 mm x 19,510 mm) bay size when warehouse construction must be planned without knowledge of specific warehousing systems to be installed within new facilities. The universal bay size will not represent the optimum column spacing for every system. Figure 3-20 illustrates column spacing parameters which affect bay dimensions. For large facilities designed for a specific system, greater utilization of building area will be obtained by selecting a column spacing matching the requirements of the material handling system.

Figure 3-20 Building Column Spacing Parameters



1. PALLET DEPTH
2. RACK TO RACK
3. PALLET TO PALLET
4. GUIDE RAIL
5. BACK TIE SPACING (BETWEEN BUILDING COLUMNS)
6. BACK TIE SPACING (AT BUILDING COLUMN)
7. RACK COLUMN CLEARANCE
8. BUILDING COLUMN
9. SHELF DEPTH
10. PALLET OVERHANG (FRONT/AISLE)
11. PALLET OVERHANG (REAR)
12. PALLET WIDTH
13. PALLET RACK UPRIGHT WIDTH
14. PALLET RACK BEAM LENGTH
15. GUIDE RAIL ENTRY
16. BUILDING COLUMN SPACING

3-7.13.1 Universal Bay Size

If a general purpose facility is required, or a specific materials handling system has not been selected, maintain versatility in selecting the universal pattern subject to the following considerations:

a. The universal pattern will not represent the optimum spacing for all systems.

b. The facility may be costlier than necessary because of the inefficient use of space. A smaller building can generally be constructed if the optimum column spacing is used.

c. Use of the universal pattern will permit the building to fulfill a variety of missions due to its ability to function with many materials handling systems.

3-7.13.2 Optimum Bay Size

Use of the optimum bay size for a particular materials handling system will provide the most efficient use of the building area. In addition:

a. Use of the optimum bay size will reduce the size of the required building due to more efficient use of the building cube.

b. Ultimate versatility of the facility will be reduced because the column pattern will not fit every system.

3-7.13.3 Comparison of Bay Sizes

The information presented in table 3-5 provides comparison information to enable a designer to measure the effects of changes to the building bay size. Use of the universal bay size results in an average 7 percent increase in required building area.

Table 3-5 Building Bay Size Comparison

SYSTEM	OPTIMUM BAY SIZE ft-in x ft-in (mm x mm)	MODULAR EQUIVALENT BAY SIZE ft-in x ft-in (mm x mm)	BAY DIMENSION FOR FIT ft-in (mm)	SPACE UTILIZATION IN UNIVERSAL BAY %
Counterbalance Truck	39’-2” x 39’-2” (11,940 x 11,940)	39’-2” x 58’-4” (11,940 x 17,780)	64’-0” (19,510)	91.1%
Reach Truck	30’-2” x 44’-10” (9,190 x 13,670)	30’-2” x 44’-10” (9,190 x 13,670)	33’-0” (10,060) 64’-0” (19,510)	91.4% 92.9%
Front/Side-loader Truck Turret Truck Man-Up Turret Truck	26’-2” x 38’-10 (7,980 x 11,840)	26’-2” x 38’-10” (7,980 x 11,840) 26’-2” x 64’-2” (7,980 x 19,560)	33’-0” (10,060) 64’-0” (19,510)	79.3% 100.3%
Hybrid Truck	24’-2” x 35’-10” (7,370 x 10,920)	24’-2” x 59’-2” (7,370 x 18,030)	64’-0” (19,510)	92.4%
Manual Order Picker	31’-0” x 49’-0” (9,450 x 14,940)	31’-0” x 61’-0” (9,450 X 18,590) 31’-0” x 61’-0” (9,450 X 18,590)	33’-0” (10,060) 64’-0” (19,510)	93.9% 95.3%
Order Picking Truck	33’-0” x 49’-0” (10,060 x 14,940)	33’-0” x 59’-0” (10,060 X 17,980) 33’-0” x 59’-0” (10,060 X 17,980)	33’-0” (10,060) 64’-0” (19,510)	100.0% 92.2%
Manned S/R Machine	31’-0” x 49’-0” (9,450 x 14,940)	31’-0” x 61’-0” (9,450 X 18,590) 31’-0” x 61’-0” (9,450 X 18,590)	33’-0” (10,060) 64’-0” (19,510)	93.9% 95.3%
Carousel	32’-6” x 45’-6” (9,910 x 13,870)	32’-6” x 45’-6” (9,910 x 13,870) 32’-6” x 58’-6” (9,910 x 17,830)	33’-0” (10,060) 64’-0” (19,510)	98.5% 91.4%
Mini-S/R Machine	26’-0” x 51’-0” (7,920 x 15,540)	26’-0” x 63’-6” (7,920 x 19,350) 26’-0” x 63’-6” (7,920 x 19,350)	33’-0” (10,060) 64’-0” (19,510)	78.8% 99.2%

3-7.13.4 Clear Storage Height

For clearance requirements between top of storage load and any overhead obstructions and sprinklers refer to NFPA 13. Refer to DOD 4140.1-R, *DoD Supply Chain Material Management Regulation* for details.

Consider the following:

- Clearance from sprinkler deflectors to the top of storage load will affect sprinkler requirements and water demand.

- Clear building height requirements for specific levels of storage, as well as three modular clear heights covering a range of storage levels, are summarized in table 3-6. Construction of a warehouse facility to a modular height greater than that required for the desired system or level of storage will result in an unutilized cube and extra construction and operating costs.

Table 3-6 Required Clear Building Heights

SYSTEM	PALLET STORAGE LEVELS								
	2	3	4	5	6	7	8	9	10
Counterbalance truck	8'-6" (2,590 mm)	12'-6" (3,810 mm)	18'-0" (5,490 mm)	22'-0" (6,700 mm)	-- --	-- --	-- --	-- --	-- --
Reach Truck	9'-6" (2,900 mm)	13'-6" (4,110 mm)	19'-0" (5,790 mm)	23'-0" (7,010 mm)	-- --	-- --	-- --	-- --	-- --
Front/Side-loader	8'-6" (2,590 mm)	12'-6" (3,810 mm)	18'-0" (5,490 mm)	22'-0" (6,700 mm)	26'-0" (7,920 mm)	30'-0" (9,140 mm)	34'-0" (10,360 mm)	-- --	-- --
Turret Truck	8'-6" (2,590 mm)	12'-6" (3,810 mm)	18'-0" (5,490 mm)	22'-0" (6,700 mm)	26'-0" (7,920 mm)	30'-0" (9,140 mm)	34'-0" (10,360 mm)	38'-0" (11,580 mm)	42'-0" (12,800 mm)
Man-Up Turret Truck	8'-6" (2,590 mm)	12'-6" (3,810 mm)	18'-0" (5,490 mm)	22'-0" (6,700 mm)	26'-0" (7,920 mm)	30'-0" (9,140 mm)	34'-0" (10,360 mm)	38'-0" (11,580 mm)	42'-0" (12,800 mm)
Hybrid	-- --	-- --	-- --	-- --	-- --	31'-6" (9,600 mm)	35'-0" (10,670 mm)	39'-6" (12,040 mm)	43'-6" (13,260 mm)
SYSTEM	STORAGE UNIT LEVELS								
	1		2	2	3	4		5	Other
Manual Order Picker	9'-0" (2,740 mm)	-- --	18'-0" (5,490 mm)	-- --	26'-0" (7,920 mm)	-- --	-- --	-- --	-- --
Order Picking Truck	-- --	-- --	17'-0" (5180 mm)	-- --	24'-0" (7,310 mm)	31'-0" (9,450 mm)	-- --	38'-0" (11,580 mm)	-- --
Manned S/R Machine	-- --	-- --	-- --	-- --	24'-0" (7,310 mm)	31'-0" (9,450 mm)	-- --	38'-0" (11,580 mm)	-- --
Carousel	10'-0" (3050 mm)	-- --	-- --	20'-0" (6100 mm)	29'-0" (8,840 mm)	-- --	-- --	-- --	-- --
Mini-S/R Machine	-- --	-- --	-- --	-- --	24'-5" (7,440 mm)	-- --	-- --	34'-6" (10,510 mm)	44'-7" (13,590 mm)
Modular Building Clear Height	19'-0" (5,790 mm)			31'-0" (9,450 mm)			47'-0" (14,330 mm)		
Height Use Efficiency	47% - 105%			65% - 100%			73% - 95%		

Notes:

- Hybrid Truck Storage above 10 levels is not listed.
- Clear height includes sprinkler clearances per NFPA 13. Clear height does not include clearance allowance for draft curtains.
- Pallet storage levels based on a standard 48 in (1220 mm) vertical spacing.
- Height use efficiency is ratio of required clear building height to modular building clear height.

(1) 20 ft (6,096 mm) high system.
(2) 30 ft (9,144 mm) high system.
(3) 40 ft (12,192 mm) high system.

3-7.14 Telecommunication Systems

Provide telephones, service entrances, telephone cabinets, conduit runs, and telephone outlets. Locate at least one telephone in each office. Provide in accordance with UFC 3-580-01 *Telecommunications Building Cabling Systems Planning and Design*.

3-7.14.1 Navy and Marine Corps

For Navy and Marine Corps projects use UFC 3-580-10 *Navy and Marine Corps Intranet (NMCI) Standard Construction Practices* where NMCI is a requirement.

3-7.14.2 Army

For Army projects, building telecommunications must be designed to satisfy Army Installation Information Infrastructure Architecture (I3A) Policy.

3-7.15 Alarm Systems

Provide fire, hydrogen, ventilation failure, hazardous chemical spill, neutralizer tank and security alarms.

3-7.15.1 Fire Alarms

Provide storage facilities with fire alarm system that transmits a signal to the fire department, in accordance with UFC 3-600-01, *Fire Protection Engineering for Facilities*.

3-7.15.2 Hazardous Chemical Spill Alarms

Provide hazardous chemical storage areas with alarms signaling release or spillage of stored chemicals.

3-7.15.3 Security Alarms

Protect stored materials with Electronic Security Systems (ESS) when required by Agency policies and as defined by the DoD Security Programs Guidance.

3-7.16 Casework

Counters, casework, and cabinets must be of high-quality and durable construction. Specify Architectural Woodwork Institute (AWI) Premium or Custom for finishes per AWI Quality Standards Illustrated. Casework, cabinet doors, and drawer faces must be provided as veneer panel core. Doors, drawers, and casework faces must be plastic laminate at a minimum. Countertops are to be solid surface/solid composite plastics only. Specify .75-in. (20-mm) minimum thickness for plywood, plywood backing, and solid wood panels.

3-7.17 Elevators and Lifts

Elevators may be needed if required for ADA/ABA compliance or the activity specifically requests an elevator. See the section on Accessibility for further clarification.

Size elevator based on activity requirements. If elevators are required at least one elevator must accommodate a 24 in. wide x 84 in. long (610 mm x 2,134 mm) emergency stretcher.

3-7.18 Furniture Considerations

Coordinate with the Comprehensive Interior Design package during the design process. All case goods and hardware will be coordinated with the Structural Interior Design package for the project to ensure matching woods, stains, and finishes as best possible. Selection of materials and finishes for the main entry point area(s) will accommodate heavy use.

3-7.19 Equipment Considerations

Coordinate the use and location of recycling centers throughout the common areas to complement the interior design while supporting sustainability guidance.

All appliance colors must be coordinated with the FF&E. The construction contractor or design/build contractor will submit cut/datasheets of proposed equivalents/substitutions appliances for review/approval. Purchase appliances meeting Energy Star program standards and specifications as included in this guide. Qualifying products are listed on the Energy Star website.

3-8 PEST CONTROL

Incorporate pest control measures into building design to ensure the efficient control and quarantine of insects, rodents, and other pests. Refer to Armed Forces Pest Management Board Technical Guide No. 17, *Military Handbook – Design of Pest Management Facilities*. Measures must include:

a. Establishment of construction needs and maintenance criteria for prevention of pests.

b. Land drainage; clearing and control of vegetation in outside storage and pest breeding areas.

c. Application of pesticides on materials, in buildings, on the ground, and as soil treatment.

d. Use of wood preservatives

3-9 ACCESSIBILITY FOR THE DISABLED

Every facility must be designed to ensure access in accordance with UFC 1-200-01, *General Building Requirements*.

3-10 ACOUSTICS

Design the facility to provide a comfortable acoustical environment and provide comprehensive sound isolation and sound absorption measures for individual spaces as appropriate. Provide acoustical design to prevent sound from noisy spaces such as corridors, toilets, elevator machine rooms, and mechanical rooms from having negative impact on the adjacent spaces.

Use the "suggested design values" STC ratings in UFC 3-450-01, *Noise and Vibration Control*, as the basis for the sound design of partition, door and window assemblies for the facility. Utilize gypsum board wall "improvements" to increase the STC of gypsum board "stud type" partitions to achieve the project sound requirements. Unless noted otherwise extend partitions and seal to the structure above around rooms that have a noise source such as but not limited to corridors, toilets, elevator machine rooms, training rooms, maintenance rooms, activity rooms, and mechanical rooms. Unless indicated in chapter 4, STC ratings do not need to be field verified. Do not provide any special acoustical conditions in the project unless specifically recommended by an acoustical study.

3-11 CONVEYING SYSTEMS

Conveying systems may not be required. For projects which require conveying systems, provide them in accordance with the following:

3-11.1 Overhead Bridge Cranes

Verify the crane capacity with the governing authority, but provide no less than a 5 ton (4.5 metric ton) overhead bridge crane. All cranes must be Duty Service Class C. All bridge cranes must be supported from patented track systems designed by the crane manufacturer. All overhead bridge cranes must be under running, double girder electric cranes.

Provide all cranes in accordance with Air Force Instruction 91-203, Air Force Consolidated Occupational Safety Instruction; Navy Crane Center Instruction 11450.2, *Design of Navy Shore Weight Handling Equipment*; title 29 CFR 1910.179(j), *Inspections;* title 29 CFR 1910.179(k), *Testing*; and the American National Standards Institute ANSI MH27.1, *Specifications for Patented Track Underhung Cranes and Monorail Systems*; and relevant portions of the Crane Manufacturing Association of America CMAA Specification 70, *Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes*, and the Crane Manufacturing Association of America CMAA Specification 74, *Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist*.

3-11.1.1 Hook Height

Hook height is to the saddle of the hook and must be determined by the overall height of the facility. Hook height for any facility must be no less than 20 feet (6.10 m).

3-11.1.2 Hook Coverage

The bridge crane must provide loaded hook coverage to within 12 feet (3.66 m) of the inside face of all walls and to within 15 feet (4.57 m) of the inside face of the warehouse dock doors. Where multiple cranes are provided, fully loaded hooks must be capable of locating within 15 feet (4.57 m) of each other.

3-11.1.3 Travel Speeds

Overhead bridge cranes must have electric motorized bridge, trolley and hoist. One crane must be used per warehouse module, with the bridge designed to travel the full width of the module. Trolley and bridge must be capable of operating at a slow speed of 15 to 20 ft/min (0.07 to 0.1 m/s) for positioning loads and at a high speed for moving loads of 60 ft/min (0.3 m/s); the hoist must be capable of operating at a slow speed of 3 to 4 ft/min (0.01 to 0.02 m/s) and at a high speed of 12 ft/min (0.06 m/s). Refer to UFGS 41 22 13.13 *Bridge Cranes* and UFGS 41 22 13.15 *Bridge Cranes, Overhead Electric, Under Running*.

3-12 MOTOR AND CONTROLS

Bridge, trolley and hoist controls must provide for two-speed reversing of a two-speed, squirrel-cage motor. The controls must be equipped with reduced voltage starting for the motors. Controls must be operable from the floor.

Provide service catwalks or platforms to maintain overhead bridge cranes. Ensure all safety requirements are met; see UFGS 01 35 26, *Governmental Safety Requirements*. The access must be from inside the warehouse.

3-13 PLUMBING

3-13.1 General

Provide plumbing in accordance with UFC 1-200-01, *General Building Requirements* and UFC 3-420-01, *Plumbing Systems.*

3-13.1.1 Emergency Shower / Eyewash Fixtures and Floor Drains

Provide emergency eyewash/shower fixtures and drainage system as required by this UFC and in accordance with UFC 3-420-01, *Plumbing Systems*.

3-13.2 Compressed Air

Provide compressed air where required by the governing authority.

3-14 ENVIRONMENTAL CONTROL

Provide heating in all offices in all heating zones. Provide air conditioning in offices. Determine requirements for environmental control in storage space based on the temperature requirements of material stored and the extent and activity level of occupancy. Need for heating of storage spaces must be clearly demonstrated. Warehouses for storage of materials not subject to freezing must not be heated. In warehouses containing materials subject to freezing, design heating system to maintain an inside winter temperature of 45°F (7°C). Maintain a temperature of 55°F (13°C) in warehouse areas with active employment. Refer to UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*.

The designer must consider a minimum of three HVAC systems that meet all the criteria and perform a life cycle cost analysis for the basis of selection. Refer to UFC 1-200-02, *High Performance and Sustainable Building Requirements* and UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*.

3-14.1 General

Provide HVAC in accordance with UFC 1-200-01, *General Building Requirements* and Unified Facilities Criteria series 3-400, *Mechanical*.

3-14.2 Heating

Provide heating in accordance with UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems* and as follows:

- The heating system must be a steam, hot water, gas fired hot air, or solar system. Provide unit heaters or hot air registers at cargo doors and over aisles between stored materials.

- Direct-fired hot air systems must not be used for hazardous materials warehouses.

- Selection of unit heaters, spot heating systems, and design of total heating systems, must be considered on energy and life-cycle cost basis.

3-14.2.1 Heating Plant

The heating plant must be located in a mechanical room with no access to the storage area. When the mechanical room is located inside the warehouse, the following must be observed:

a. Provide a wall with a 2-hour fire resistance rating between the heater room and storage area.

b. All access to the heating area must be from the outside only.

c. When infrared unit heaters are used, provide safe clearances in accordance with the manufacturer's safety instructions.

3-14.2.2 Infiltration Rate

Design for an infiltration rate of two air changes per hour in the warehouse area. This rate is dependent upon the installation of dock door seals.

3-14.2.3 Radiant Floor Heating System

Investigate the use of an under floor heating system for the warehouse storage areas.

Under floor heating systems must be 2 in. minimum and 3 in. maximum (50.8 mm and 76.2 mm) from the bottom of the floor slab. Depth of under floor heating system and slab thickness must be coordinated with the rack / shelving fastener depth to avoid conflict and damage to the heating system.

3-14.2.4 Cold Jet Destratifiers

Consider the installation of cold jet destratifiers based on an economic analysis.

3-14.2.5 High Volume Low-Speed Fans

Consider the installation of high volume low-speed (HVLS) fans based on an economic analysis.

3-14.2.6 Space Thermometer

A switch activated by opening the dock doors must override the space thermostat to stop the heating equipment in the warehouse area. Provide a minimum temperature thermostat field set at 34°F (1°C) to override the heating deactivation switch during door-open periods of subfreezing ambient temperatures. After the doors are closed, the room thermostat must assume control. Heating system recovery time must be a maximum of 60 minutes after the doors are closed.

3-14.2.7 Automatic Thermostatic Control

The automatic thermostatic control must meet the requirements of UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*.

3-14.2.8 Heating Zones

Provide heating zones to maximize energy savings and to meet sustainability requirements.

3-14.3 Ventilation

Provide ventilation in accordance with UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*, and UFC 3-410-04N, *Industrial Ventilation*.

Toxic fumes generated by gas powered fork trucks must be exhausted. It is recommended that gas powered fork trucks not operate inside the warehouse area.

3-14.4 Humidity Control

Provide humidity control in accordance with UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*, and UFC 3-410-04N, *Industrial Ventilation*.

3-14.5 Air Conditioning

Provide air conditioning in accordance with UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*.

Office areas in cooling zones must be air-conditioned by either high efficiency small area units or a central system, as appropriate. Consider radiant floor cooling systems for air conditioned storage areas.

3-14.6 Energy Conservation

Provide energy conservation measures to meet the project sustainability requirements. Refer to UFC 1-200-02, *High Performance and Sustainable Building Requirements*.

3-14.7 Insulation

Warehousing facilities that require heating or cooling must be insulated. Determine the amount and type of insulation by a life-cycle cost analysis.

3-14.8 Mechanical Equipment Requirements

3-14.8.1 Corrosion Protection

Provide special finish coatings on the interior and the exterior surfaces of HVAC equipment exposed to the weather, including all coil surfaces and interior equipment surfaces belonging to the first HVAC equipment (excluding louvers) in the supply ductwork system that is subjected to outside supply air. The coating must not act as an insulating barrier to the HVAC heat exchange capability. Unit casing – standard factory paint is not acceptable. Specify appropriate protection requirements, salt test hours of at least 3,000 hours. Coils must be copper tube/copper fin with a phenolic type coating applied by immersion. Spray-on coatings are not allowed.

Equipment located inside that handles outside air:

- Evaluate the outside air percentage; copper tube/copper fin or copper tube/aluminum fin with phenolic coating is suitable for low outside air percentages.
- Evaluate cooling and heating capacity reductions resulting from phenolic coating application whose thickness is typically three mils thick.

- Consider using copper tube / copper fin with phenolic type coating for 100 percent outside air units.

3-14.9 Noise and Vibration Control

Design mechanical systems and equipment to limit noise and vibration in accordance with UFC 3-450-01, *Noise and Vibration Control*.

3-15 FIRE PROTECTION

Provisions for fire protection and life safety will conform to National Fire Protection Association (NFPA) *Life Safety Code* NFPA 101, UFC 1-200-01, *General Building Requirements* and UFC 3-600-01, *Fire Protection Engineering for Facilities*.

3-15.1 Fire Protection Sprinkler Systems

For new construction and rehabilitation projects, install sprinkler systems in accordance with National Fire Protection Association (NFPA) *Standard for the Installation of Sprinkler Systems* NFPA 13 and UFC 3-600-01, *Fire Protection Engineering for Facilities*.

The following must be considered:

a. Coordinate location of ceiling mounted fixtures including destratification units with the placement of sprinklers.

b. The type of sprinkler protection provided and the water supply requirements can vary based on the following:

- Clearance from the sprinkler deflector to the top of storage
- Aisle width
- Storage height
- Storage configuration
- Type of storage (commodity)
- If the commodity is encapsulated or nonencapsulated

c. It is recommended to provide sprinkler protection that does not require in-rack sprinklers. Control Mode Specific Application (CMSA) and Early Suppression Fast-Response (ESFR) sprinklers can be used. Warehouses with a roof height greater than 15 feet must be protected with the customer defined storage arrangement (i.e., high pile, rack storage, etc.) to the maximum storage height allowable. For example, the sprinkler system for a warehouse using pile storage with a 25 ft roof

height will be designed to a maximum storage height of 22 ft regardless of the defined storage height.

3-15.1.2 Storage System Sprinklers

In general purpose, controlled humidity, refrigerated and other type warehouses where hazardous materials are not to be stored, provide \1\ /1/ face and flue sprinklers per NFPA 13. Rack shelving must not be adjustable on rack levels where \1\ /1/ face and flue sprinklers are provided. Additional flue sprinklers may be required depending upon storage height and its relationship to the\1\ /1/ sprinklers. Face and flue sprinklers must be placed at or below each 108-inch (2745 mm) open frame shelf at the required levels in a manner which prevents sprinkler damage during storage operations, as illustrated in figure 3-21. The sprinklers at all other shelf levels must be capable of vertical adjustment using mechanically grooved fittings.

3-15.1.3 In-Rack Sprinkler System

In-rack sprinklers must be provided in accordance with NFPA 13.

3-15.2 Fire Alarm Systems

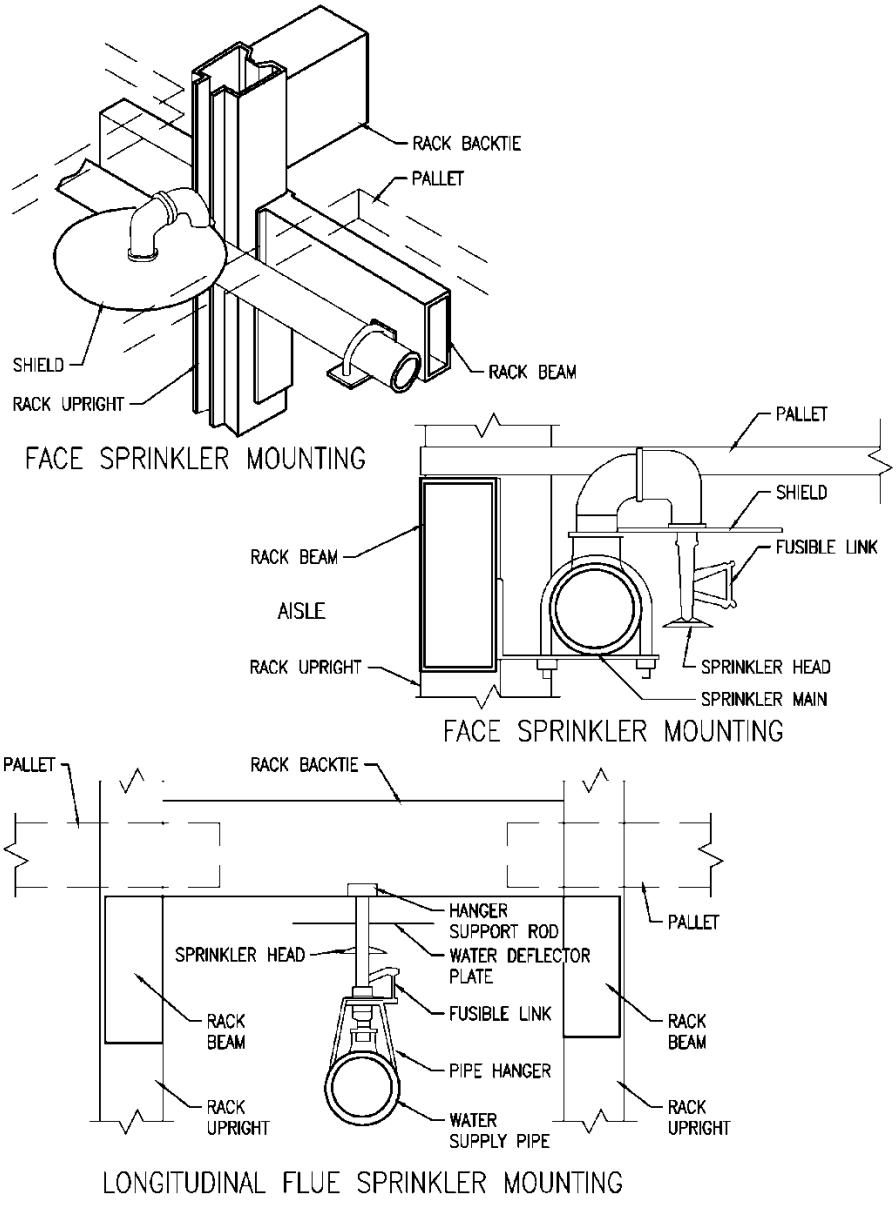
Install addressable building fire alarms systems that are compatible with the base system and connect to the base reporting system.

3-15.3 Smoke Detectors

Install smoke detectors in accordance with UFC 3-600-01, *Fire Protection Engineering for Facilities* and NFPA 72, *National Fire Alarm and Signaling Code*.

Figure 3-21 Standard Face and Longitudinal Flue Sprinkler Mounting

(to Prevent Pallet and Load Interference)
Detail and Sections



3-16 ELECTRICAL

Provide site electrical utilities, interior distribution systems, communications and security, and site lighting according to UFC 1-200-01, *General Building Requirements,* UFC 3-501-01, *Electrical Engineering* and the latest installation design requirements.

a. Site Electrical Utilities includes equipment, overhead power distribution, underground electrical systems, grounding, metering, exterior site lighting, and cathodic protection systems.

b. Site Lighting – Provide lighting to ensure occupants have a means of safely moving between outdoor spaces. Refer to the Installation Appearance Plan (IAP) in the selection of light poles and signs. Provide adequate site lighting at any point where there is a change in grade requiring steps, near handicap and motorcycle parking areas, and near main entrances to buildings. Provide exterior lighting in parking areas, building entrances, and walkways.

c. Interior distribution systems include service entrance and distribution equipment, TVSS, dry type transformers, wiring devices, raceways, conductors, interior lighting systems, emergency power systems, lightning protection systems, hazardous locations, housing distribution, and systems furniture.

d. Communications and security includes telecommunications systems, television systems, electronic security systems (ESS), and intercommunication systems.

3-16.1 Power

Provide separate dedicated panel boards to serve each separate user area.

Shops and Maintenance Administration

Serve shop spaces by distinct panels dedicated to shop and equipment loads only. Do not supply office spaces from shop circuits or panels. Except as specifically noted otherwise, feed loads located in each Shop space must be from panel boards located within the Shop space.

3-16.2 Emergency Power

Coordinate and provide emergency power as dictated by the mission.

3-16.3 Lighting

Design in accordance with UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls*.

3-16.3.1 Interior Lighting

Refer to UFC 1-200-01, *General Building Requirements* and UFC 3-530-01, *Design: Interior, Exterior Lighting and Controls* for guidance on system selection. Lighting requirements may be minimized by providing natural daylighting and specialized lighting on the materials handling equipment, as required by the user.

3-16.3.2 Exterior Lighting

Provide dock lights every 25 feet (8 m) of rail dock and for each truck dock for illumination of rail car, truck, or trailer interior.

Provide lighting at parking lots, maneuvering areas, outride storage, and, where required, fence lighting.

3-16.4 Receptacles

Locate convenience outlets in accordance with UFC 3-520-01, *Interior Electrical Systems*. There must be a minimum of one receptacle on every wall.

3-16.5 Battery Chargers

Provide circuits to power battery chargers for battery-operated materials handling equipment.

3-16.6 Lightning Protection

Provide lightning protection in accordance with UFC 3-575-01 *Lightning and Static Electricity Protection Systems*.

3-17 CIVIL

Refer to UFC 1-200-01, *General Building Requirements* and UFC 3-201-01, *Civil Engineering* for physical security, antiterrorism, standoff distances, setbacks, Low Impact Design (LID), storm drainage, geotechnical site investigation, vehicular and pedestrian circulation, and other site related requirements.

3-17.1 Siting

When siting the Warehouse, place emphasis on operation, function, energy efficiency and safety. Comply with the requirements of UFC 1-200-01, *General Building Requirements.*

3-17.1.1 Site Organization

Provide efficient access to the delivery drive aisle(s). Develop a sense of order, arrival, orientation, and community in planning the site. Arrange the placement of structures in relationship to one another to create outdoor spaces for use as passive or active recreation areas. Organize the site using functional zones and the appropriate relationship of functions. Other factors to consider include topography, vegetative cover, existing construction, weather elements, wind direction, soil conditions, flood

hazards, natural and man-made obstructions, adjacent land use and accessibility of utilities. Vehicular parking, pedestrian access and traffic flow must also be given careful consideration.

Truck traffic must be separated from other vehicular traffic. Truck delivery routes must be planned so drivers are not backing up to the dock on their blind side. Truck arrival route must be counterclockwise to the facility.

3-17.1.2 Finished Floor Elevation

Establishing the finished floor elevation of the project is one of the most important aspects of site planning. The finished floor elevation affects grading, cut and fill, and visual impact of the facility and interior and exterior transitions. In addition, the finished floor elevation has a significant impact on the landscape architect's ability to effectively introduce plant materials into the new environment. When the approach is to "level the site" without sensitivity to other demands, the results lack visual interest. Closely combine efforts of the landscape architect, architect, and civil engineer to achieve the most optimum design results. Provide the facility's minimum finished floor elevation and the mechanical/electrical equipment pad elevations in accordance with UFC 3-201-01, *Civil Engineering*.

3-17.2 Utilities

Design utilities in accordance with UFC 3-201-01, *Civil Engineering*.

3-17.3 Utility Metering

Provide metering in accordance with UFC 1-200-02, *High Performance and Sustainable Building Requirements*.

3-18 SUSTAINABLE DESIGN

Refer to UFC 1-200-01, General Building Requirements and UFC 1-200-02, *High Performance and Sustainable Building Requirements* for minimum requirements and guidance to achieve high performance and sustainable facilities.

CHAPTER 4 HAZARDOUS MATERIALS STORAGE GENERAL DESIGN CRITERIA

4-1 GENERAL

Requirements from Chapter 1 – 3 of this UFC must be applicable to Hazardous Materials Storage Facilities except as modified by Chapter 4.

Reference UFC 1-200-01; *General Building Requirements* for Use and Occupancy requirements.

4-2 HAZARDOUS MATERIALS STORAGE

Space justified for hazardous materials storage must be considered a portion of the total space allowed for the facility type. Use DoD Real Property Classification System (RPCS); Category Codes 441-10 through 441-40 facility types. Such space must not exceed 5 percent of the total space unless justified. Hazardous materials storage must be designed and constructed in accordance with the standard references listed in the paragraph in Chapter 4 entitled, “General” for storage of materials classified as hazardous to health, environment, and property, i.e., flammables, acids, caustics, oxidizers, water reactives, or others considered hazardous by the following Code of Federal Regulations (CFR's): Title 29 CFR 1910, *Occupational Safety and Health Standards*; 40CFR - *Protection of Environment*; 49CFR - *Transportation* - parts 171-177, *Hazardous Materials Safety;* and FED-STD-313, *Material Safety Data, Transportation Data, and Disposal Data for Hazardous Materials Furnished to Government Activities*.

4-2.1 Compliance Standards

Comply with \1\NFPA 400, Hazardous Materials Code and /1/the following federal, industry, and association standards.

4-2.1.1 Federal Regulations

Comply with requirements of 29CFR - *Occupational Safety and Health Standards*, 40CFR - *Protection of Environment*, 49CFR - *Transportation*, Army Pamphlet DA PAM 710-7, *Hazardous Materials Management Program,* DoD 4140.1-R, *Supply Chain Material Management Regulation*, and Army TM 38-400/ Navy NAVSUP PUB 572/ Air Force AFJMAN 23-210/ Marine Corps MCO 4450-14/ Defense Logistics Agency DLAM 4145.12, *Joint Services Manual (JSM) for Storage and Materials Handling*.

4-2.2 Hazardous Materials Storage

Hazardous materials storage facilities must be designed and constructed to offer protection against the physical, health, or environmental hazards presented by the material. Storage and handling of hazardous materials must be confined to buildings or parts of buildings meeting the requirements of this section.

4-2.3 Design Criteria

Facility design and layout must take into consideration the incompatibility of hazardous materials and hazardous materials groups. Individual facility design and layout must be based upon the specific types and categories of hazardous materials that are to be handled and stored.

4-2.3.1 Building Spacing

Provide a buffer zone between the facility and the nearest inhabited area, stream, or body of water in accordance with UFC 1-200-01, *General Building Design Requirements* and UFC 3-600-01, *Fire Protection Engineering for Facilities*.

4-2.3.2 Docking Facilities

Dock areas in hazardous materials facilities must provide a manually operated valve in the outside drain trench to prevent spills from entering the storm sewer system. The drain must discharge into a sump sized to accommodate the expected quantity of discharge.

4-2.4 Storage Requirements

Accommodate the following storage requirements in the design of hazardous materials storage areas within other warehouse types listed in the paragraph entitled “Types of Storage Facilities”.

a. The storage area must be designed to prevent surface or groundwater contamination in the event of a spill or leak, and to capture completely each class of material individually.

b. In acid or caustic liquid storage, a man-up type vehicle MUST be used. Otherwise, the liquids must be stored on the floor to keep the loads below the operator's eye level.

c. Spill Containment must be provided as required by the paragraph entitled “Segregation of Materials”.

4-2.5 Material Handling Equipment

Electrically powered materials handling equipment is the only type of powered material handling equipment rated for use in hazardous materials storage areas. Use vehicles which have all electrical equipment completely enclosed in hazardous materials warehouses. Type EX vehicles, which have all fittings and equipment, designed, constructed, and assembled for use in atmospheres containing flammable vapors, dust; and fibers, may be required for unique chemicals or applications. Verify the need for any additional requirements which may be imposed by special storage conditions.

4-3 SEGREGATION OF MATERIALS

Provide segregated storage areas for materials having incompatible hazardous characteristics.

4-3.1 Categories of Materials

Normally, six categories of hazardous materials must be accommodated and provided segregated storage areas within a hazardous materials storage facility. Other categories may be encountered in some designs and require additional segregated storage areas. These materials as defined by OSHA consist of the following:

4-3.1.1 Flammable and Combustible Liquids

Liquids are defined by National Fire Protection Association (NFPA) *Flammable and Combustible Liquids Code*, NFPA 30 as any material having a fluidity greater than 300 penetration asphalt, when tested in accordance with the *Standard Test Method for Penetration of Bituminous Materials*, ASTM D5/D5M.

4-3.1.1.1 Flammable

Flammable liquids have a flash point below 100°F (38°C) and a vapor pressure not exceeding 40 psi absolute (275 kPa) at 100°F (38°C). These liquids are also classified as Class I liquids.

4-3.1.1.2 Combustible

Combustible liquids have a flash point of 100°F (38°C) or higher. Combustible liquids are further classified as Class II for flash points at or above 100°F (38°C) and below 140°F (60°C), and Class III for flash points at or above 140°F (60°C).

4-3.1.2 Acids

Acids and acid mists and gases react with arsenides, borides, carbides, cyanides, fluorides, phosphides, selenides, silicides, sulfides, sulfites, and tellurides to generate toxic fumes. They also liberate hydrogen upon contact with metals and hydrides.

4-3.1.3 Oxidizers

Oxidizing materials are those chemicals which will decompose readily under certain conditions to yield oxygen. They may cause a fire in contact with combustible materials, may react violently with water, and when involved in a fire may react violently. Typical oxidizers include: organic and inorganic peroxides, permanganates, chlorates, perchlorates, persulfates, organic and inorganic nitrates, bromates, perbromates, chromates, and dichromates.

4-3.1.4 Poisons

Poisons are materials that cause death by systemic poisoning rather than by corrosive destruction of tissue. Under adverse conditions, such as a leak, spill, fire, or poor

ventilation, a common chemical or compound (e.g., ammonia) may be considered poisonous.

4-3.1.5 Water Reactive Materials

These materials react with water, steam, or water solutions to produce flammable gases, toxic gases, explosive gases, or heat. Flammable gas producers include calcium, cobalt, hydrides, lithium, potassium, rubidium alloys, and sodium. Explosive gas producers include arsenides, borides, carbides, nitrides, phosphides, selenides, silicides, sulfides, and tellurides. Heat producers include acid anhydrides, concentrated acids, and concentrated alkalis. It is essential that no water-based fire extinguishment system be used in storage areas designated for water reactive materials. \1\ /1/

4-3.1.6 Caustics

Caustics (alkalis) may liberate hydrogen upon contact with aluminum. They are not compatible with acids and must be segregated from acids for safe and efficient operations.

4-3.1.7 Organic Peroxides

Organic peroxides must be stored in a segregated storage area, separated from all other materials.

4-3.2 Segregation Requirements

Provide for segregated storage of hazardous materials as required by Army Pamphlet DA PAM 710-7, *Hazardous Material Management Program,* DoD 4140.1-R, *Supply Chain Material Management Regulation*, and Army TM 38-400/ Navy NAVSUP PUB 572/ Air Force AFJMAN 23-210/ Marine Corps MCO 4450-14/ Defense Logistics Agency DLAM 4145.12, *Joint Services Manual (JSM) for Storage and Materials Handling*. Typical segregated storage block layouts are shown in figure 4-1. Comply with the following segregation requirements:

a. Acids must be isolated from other materials, including chemicals within the corrosives area.

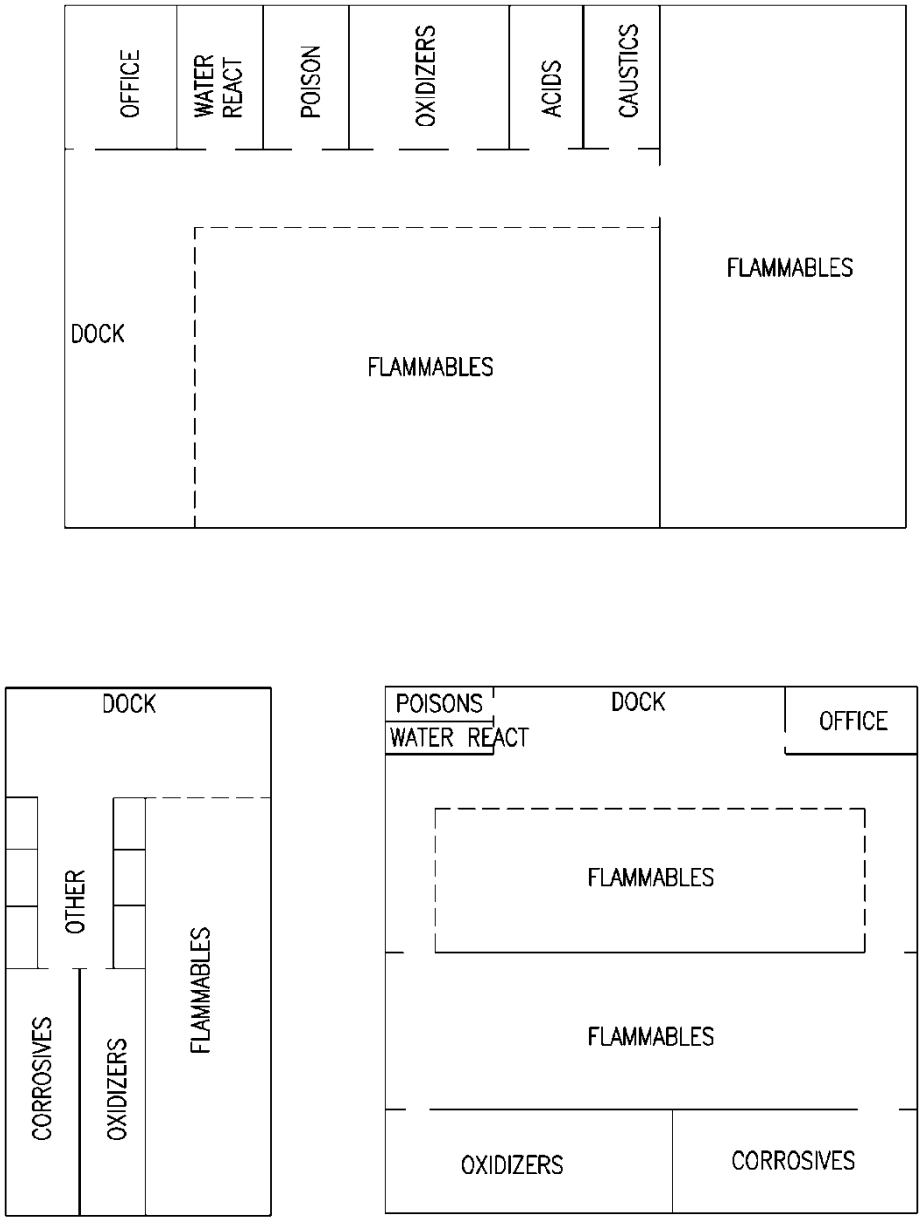
b. Flammable liquids must be isolated from acids and oxidizers.

c. Organic acids must be isolated from oxidizers.

d. Oxidizers must be isolated from all flammable and combustible liquids.

Figure 4-1 Hazardous Materials Storage Segregation Layouts

Plan Views



4-3.2.1 Compressed Gas Cylinders

Compressed gas cylinders of flammable and nonflammable gases, and gases classified as oxidizers, must be stored in sheds and neither in hazardous materials warehouses or hazardous materials storage areas within a general storage warehouse. Small cylinders in boxes, which are an integral part of other equipment, may be stored in hazardous materials warehouses, if properly segregated from incompatible materials.

4-3.2.2 Drummed Petroleum/Oil/Lubricant (POL)

Drummed POL products with a flash point of more than 100°F (38°C) must be stored in shed or open storage facilities with sealed pavements and berms/dikes to contain spills. Outside storage for drummed POL may be used, provided the drums are of corrosion resistant material or are hot-dipped galvanized for corrosion protection.

4-3.2.3 Other Materials

Dry corrosive materials, Other Regulated Materials, and radioactive materials having no other hazard, may be stored in general purpose warehouses. All other radioactive materials must be stored in a designated, separate area in accordance with DLAI 4145.8 / NAVSUPINST 4000.34C / AFJI 23-504 / MCO P4400.105E*, Radioactive Commodities in the DOD Supply Systems*.

4-3.3 Combined Shed Storage

When a hazardous materials warehouse is combined with shed storage, provide a 4-hour fire wall to separate the two storage areas. Shed and warehouse floors must be at the same elevation, with spill containment trenches or drains at fire doors. Access to the shed must be from the dock area of the warehouse, NOT from within a storage area.

4-4 SPILL CONTAINMENT AND CONTROL

Means of providing containment and removal must be provided in the event of spills. Refer to 29 CFR 1910.106 for additional information.

4-4.1 Exterior Containment

Exterior containment areas must be graded in a manner to divert possible spills away from buildings or other exposures or be surrounded by a curb at least 6 inches high, see paragraph in Chapter 4 entitled “Dikes”. When curbs are used, provisions must be made for draining of accumulations of ground or rain water or spills of flammable liquids. Drains are to terminate at a safe location and must be accessible to operation under fire conditions.

4-4.2 Interior Containment

Inside storage rooms must be constructed to meet the required fire-resistive rating for their use. Such construction must comply with the test specifications set forth in Standard Methods of Fire Tests of Building Construction and Materials, NFPA 251. Openings to other rooms or buildings are to be provided with noncombustible liquid-tight raised sills or ramps at least 4 inches in height or the floor in the storage area must be at least 4 inches below the surrounding floor. Openings must be provided with approved self-closing fire doors. The room must be liquid-tight where the walls join the floor. A permissible alternate to the sill or ramp is an open-grated trench inside of the room that drains to a safe location, see paragraph in Chapter 4 entitled “Floor Trenches and Capture System”. Where other portions of the building or other properties are

exposed, windows must be protected as set forth in the Standard for Fire Doors and Windows, NFPA No. 80.

4-4.3 Dikes

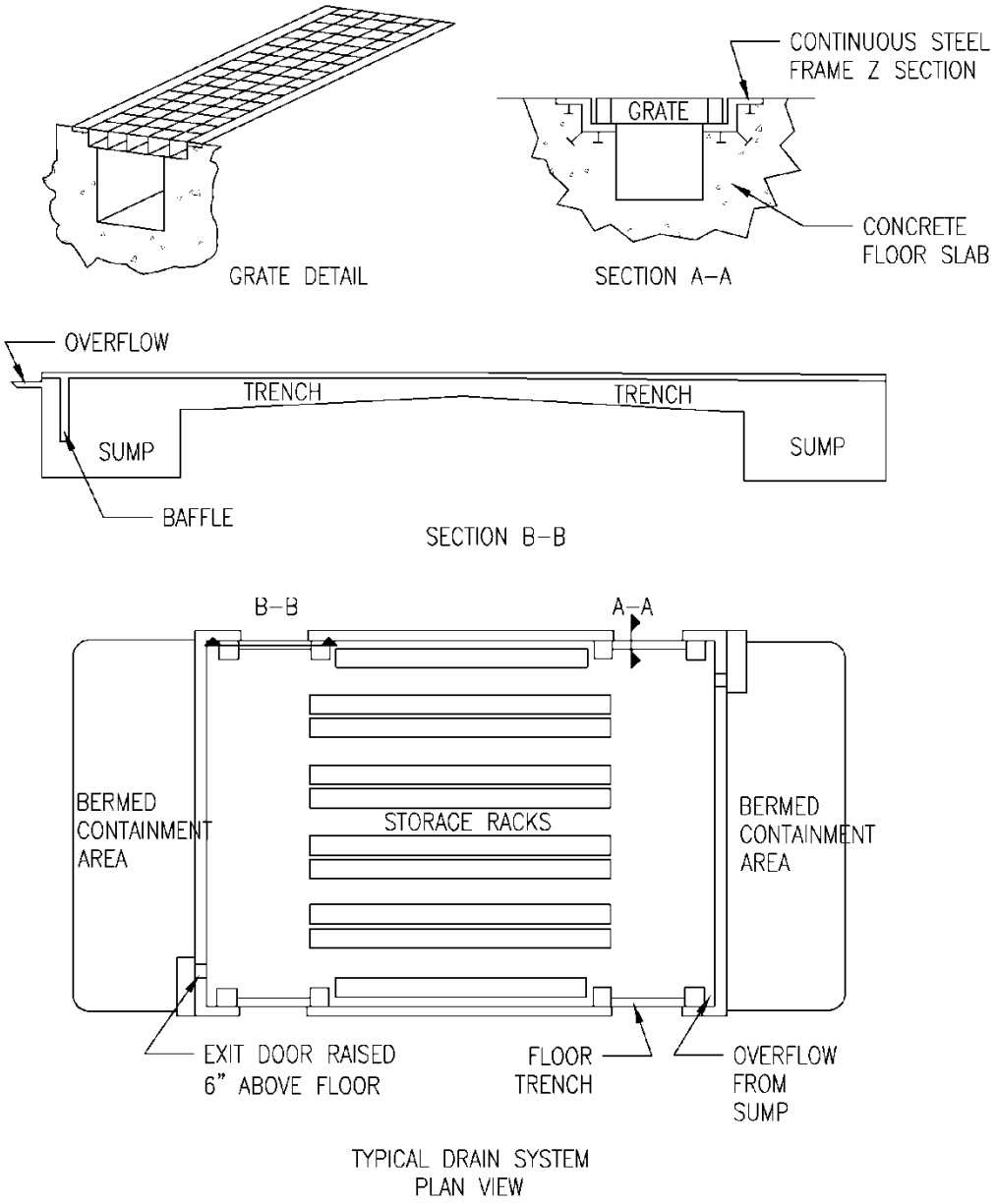
Dikes must be used for containment of spills for gasoline and/or diesel fork truck refueling stations and commodities stored or handled outside of buildings. In accordance with National Fire Protection Association (NFPA) *Flammable and Combustible Liquids Code*, NFPA 30, their volume must be not less than 110% of liquid that can be released from a fork truck or the largest storage container within the diked area or a 10% minimum of all materials to be stored in the area, whichever is greater.

4-4.4 Floor Trenches and Capture Systems

Where a continuous floor trench with grating is used in areas of hazardous materials storage for the capture and control of hazardous chemical spills see figure 4-2. All spill containment systems must provide separate containment as described in the paragraph in Chapter 4 entitled, “Containment”. Secure grate frame support channels to concrete floors. Grate design must provide for the ability to latch the removable grate sections at aisle crossings and cargo doors to ensure that grates will remain firmly in place when material handling equipment moves over them. The cross section of the grate frame members must be "Z-", rather than "L-", shaped so that two legs of the "Z" form a pocket for grates and the third leg is in the horizontal plane at floor level, as illustrated in figure 4-2. This protects the edges of concrete around grate frames from impact damage from the wheels of materials handling equipment.

Where a trench passes in front of a personnel door use \1\concrete cover or solid concrete plates sufficient /1/ to prevent a fire in the trench from blocking the exit door.

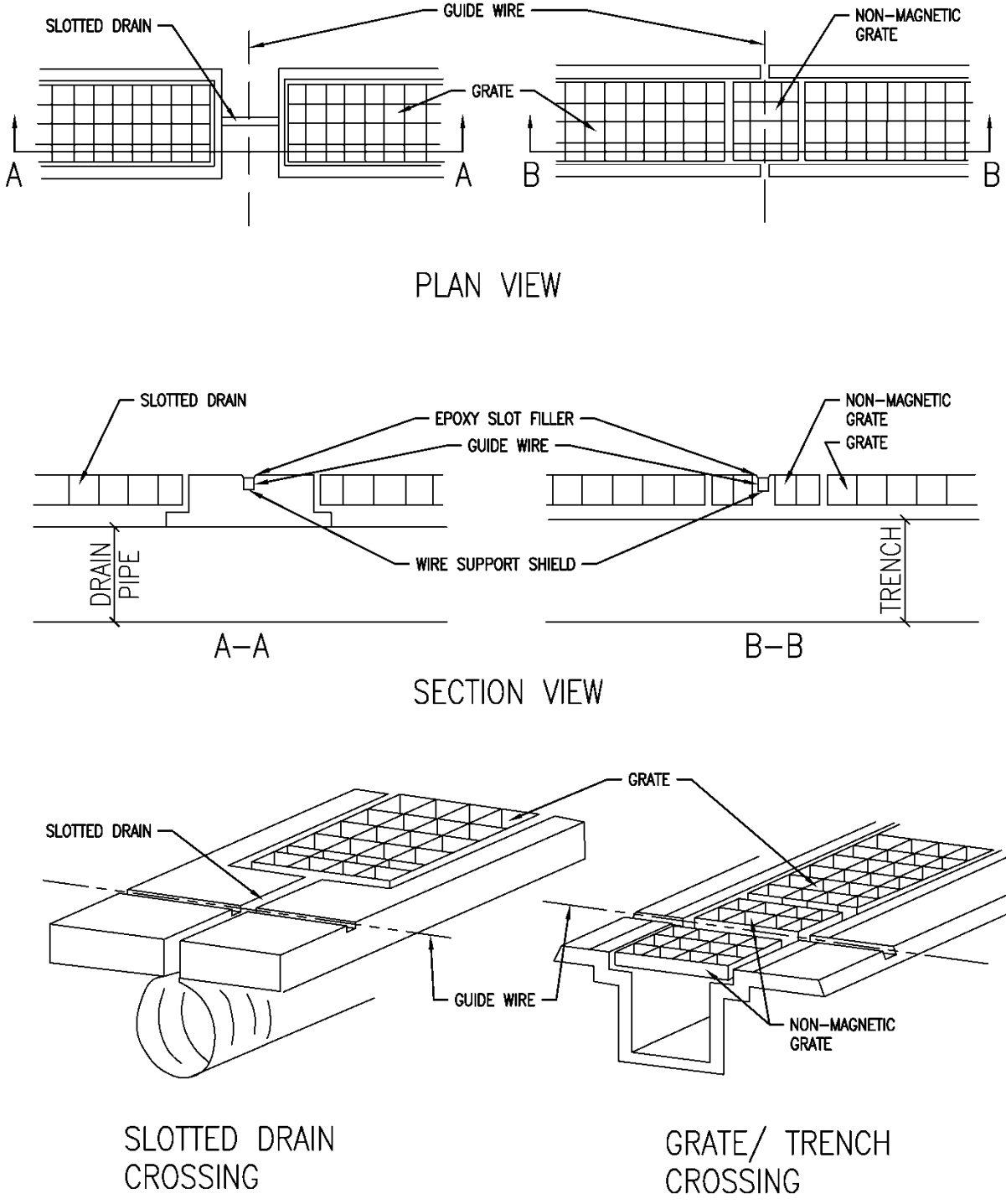
Figure 4-2 Spill Capture/Containment System



4-4.4.1 Electronic Guide Wire Crossing

When floor-buried electronic guide wire is used to guide material handling vehicles across trench grates that cross aisles or are at cargo doors, use a nonmagnetic grate section extending at least 6 inches (150 mm) on each side of the wire path so that the magnetic field of the guide wire is not distorted by passing the wire through a ferrous or magnetic grate. Alternatively, use slotted drains and pass the guide wire under the drains and shield the guide wire when passing through ferrous or magnetic grates or drains. Figure 4-3 illustrates typical crossing methods.

Figure 4-3 Electronic Guide Wire Crossing



4-4.5 Recessed Floor

When required for specific design or containment needs, interior storage floor surfaces may be recessed 6 inches (150 mm) below the level of adjoining dock, office, and support areas to prevent the flow of spilled hazardous liquids into these areas. Vehicle access ramps must be provided at all doorways into such areas. The use of this method is discouraged due to operational inefficiencies and the additional space requirements caused by the ramps.

4-4.6 Containment

Use grate-covered interior 350 gallon (1323 l) sumps in conjunction with the trench system to provide spill or leakage containment for the lesser of 1,000 gallons (3785 l) or 10 percent of the total free flowing liquid volume of all containers stored in each segregated area. Provide a containment capacity of 1,000 gallons (3785 l) at the truck apron adjacent to the shipping and receiving area. Include a controlled flow system to prevent spilled or leaking materials from entering the environment.

4-4.7 Drainage

Install pallet racks and associated mechanical vehicle guidance systems so as to permit the unimpeded flow of spilled liquids to collecting trenches. Maintain floor flatness requirements. Floor drains connecting to the sanitary sewer are not permitted in storage areas of hazardous materials.

APPENDIX A REFERENCES

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

http://www.aamanet.org/

AAMA WSG-11, *Window Selection Guide*

AMERICA CONCRETE INSTITUTE (ACI)

http://www.concrete.org/

ACI 302.1R-04, *Guide for Concrete Floor and Slab Construction*

AMERICAN NATIONAL STANDARDS INSTITUTE

http://www.ansi.org/

ANSI MH27.1, *Specifications for Patented Track Underhung Cranes and Monorail Systems*

ANSI B11.19, *Performance Requirements for Safeguarding*

ANSI/BHMA - A156.13, *Mortise Locks and Latches*

ANSI/BHMA - A156.2, *Bored and Preassembled Locks and Latches*

AMERICAN SOCIETY FOR TESTING AND MATERIALS

http://www.astm.org/

ASTM D5/D5M, *Standard Test Method for Penetration of Bituminous Materials*

CODE OF FEDERAL REGULATIONS (CFR)

Title 29 CFR 1910, *Occupational Safety and Health Standards*

Title 29 CFR 1910.22, *General Requirements*

Title 29 CFR 1910.23, *Guarding Floor and Wall Openings and Holes*

Title 29 CFR 1910.144, *Safety Color Code for Marking Physical Hazards*

Title 29 CFR 1910.179(j), *Inspections*

Title 29 CFR 1910.179(k), *Testing*

Title 29 Code of Federal Regulations (CFR) Part 1910, *Occupational Safety and Health Standards*

Title 40 CFR - *Protection of Environment*

Title 49 CFR *Transportation*

CRANE MANUFACTURING ASSOCIATION OF AMERICA (CMAA)

http://www.mhi.org/cmaa

CMAA Specification 70, *Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes*

CMAA Specification 74, *Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist*

DEPARTMENT OF THE AIR FORCE

Air Force Instruction (AFI) 91-203, *Air Force Consolidated Occupational Safety Instruction*

DEPARTMENT OF THE ARMY

DA PAM 710-7, *Hazardous Material Management Program*

TM 5-301-2, *Army Facilities Components System Planning (Tropical)*

DEPARTMENT OF DEFENSE (DOD)

DOD 4140.1-R, *DoD Supply Chain Material Management Regulation*, http://www.dtic.mil/whs/directives/

DoD Directive 5200.8-R, *Security of DoD Installations and Resources*, http://www.dtic.mil/whs/directives/

DoD Instruction 6055.1, DoD Safety and Occupational Health (SOH) Program, http://www.dtic.mil/whs/directives/

FED-STD-313, *Material Safety Data, Transportation Data, and Disposal Data for Hazardous Materials Furnished to Government Activities, http://www.wbdg.org/ccb/FEDMIL/fedstd313d.pdf*

MIL-HDBK-1013/1A, *Design Guidelines for Physical Security of Facilities*, http://www.wbdg.org/ccb/NAVFAC/DMMHNAV/1013_1a.pdf

MIL-STD-882, *System Safety Program Requirements,* http://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=36027

UNIFIED SERVICE BRANCH CRITERIA

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UFC 3-110-03, *Roofing*

UFC 3-120-01, *Design: Sign Standards*

UFC 3-120-10, *Interior Design*

UFC 3-190-06, *Protective Coatings and Paints*

UFC 3-201-01, *Civil Engineering*

UFC 3-220-01, *Geotechnical Engineering*

UFC 3-301-01, *Structural Engineering*

UFC 3-310-04, *Seismic Design for Buildings*

UFC Series 3-400, *Mechanical*

UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*

UFC 3-410-04N, *Industrial Ventilation*

UFC 3-420-01, *Plumbing Systems*

UFC 3-450-01, *Noise and Vibration Control*

UFC 3-460-01, *Design: Petroleum Fuel Facilities*

UFC 3-501-01, *Electrical Engineering*

UFC 3-520-01, *Interior Electrical Systems*

UFC 3-530-01, *Design: Interior, Exterior Lighting and Controls*

UFC 3-575-01, *Lightning and Static Electricity Protection Systems*

UFC 3-580-01 *Telecommunications Building Cabling Systems Planning and Design*

UFC 3-580-10 *Navy and Marine Corps Intranet (NMCI) Standard Construction Practices*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

UNIFIED FACILITIES GUIDE SPECIFICATIONS

UFGS 01 35 26, *Governmental Safety Requirements*

UFGS 11 41 11, *Refrigerated and Frozen Food Storage Equipment*

UFGS 41 22 13.13, *Bridge Cranes*

UFGS 41 22 13.15, *Bridge Cranes, Overhead Electric, Under Running*

INTERNATIONAL CODE COUNCIL

http:/www.iccsafe.org

International Building Code (IBC)

MASTER PAINTER INSTITUTE

http://www.paintinfo.com/

MPI 212, *Floor Coating, Thin Film, for Aircraft Maintenance Facilities*

NATIONAL FIRE PROTECTION ASSOCIATION

http://www.nfpa.org/

NFPA 101, *Life Safety Code*

NFPA 13, *Standard for the Installation of Sprinkler Systems*

NFPA 30, *Flammable and Combustible Liquids Code*

NFPA 72, *National Fire Alarm and Signaling Code* \1\

NFPA 400, Hazardous Materials Code /1/

NFPA 430, *Code for the Storage of Liquid and Solid Oxidizers*

NAVAL FACILITIES ENGINEERING COMMAND

Interim Technical Design Guidance ITG FY05-02, *NAVFAC Humid Area HVAC Design Criteria*, http://www.wbdg.org/ccb/NAVFAC/INTCRIT/fy05_02.pdf

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STEEL DOOR INSTITUTE

http://www.steeldoor.org/

ANSI/SDI A250.8, *Standard Steel Doors and Frames*

UNDERWRITER'S LABORATORY

http://www.ul.com

UL325, *Door, Drapery, Gate, Louver, and Window Operators and Systems*

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APPENDIX B BEST PRACTICES

B-1 GENERAL

This appendix identifies background information and practices for accomplishing design and engineering services. The Designer of Record (DOR) is expected to review and interpret this guidance and apply the information according to the needs of the project. If a Best Practices document has guidelines or requirements that differ from the UFGS or UFC, the UFGS and the UFC must prevail. If a Best Practices document has guidelines or requirements that are not discussed in the UFGS or UFC, the DOR must submit a list of the guidelines or requirements being used for the project with sufficient documentation to the Government Project Manager for review and approval prior to completing design.

B-2 WHOLE BUILDING DESIGN GUIDE

The Whole Building Design Guide (**WWW.WBDG.ORG**) provides additional information and discussion on practice and facility design, including a holistic approach to integrated design of facilities.

The WBDG provides access to Construction Criteria Base (CCB) criteria, standards and codes for the DoD Military Departments, National Aeronautics and Space Administration (NASA), and others. These include, UFC, UFGS, Performance Technical Specifications (PTS), design manuals, and specifications. For approved Government employees, it also provides access to non-government standards.

B-3 FACITILTY DESIGN

Comply with UFC (Latest Version), FC, and other related criteria as noted in UFC 1-200-01, General Building Requirements under the heading “UNIFIED FACILITY CRITERIA”.

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APPENDIX C GLOSSARY

ABA	Architectural Barriers Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
AFCEE	Air Force Center for Engineering and the Environment
BIA	Bilateral Infrastructure Agreement
CFR	Code of Federal Regulations
DoD	Department of Defense
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
IBC	International Building Code
MPI	Master Painter's Institute
NAVFAC	Naval Facilities Engineering Command
NFPA	National Fire Protection Association
SOFA	Status of Forces Agreements
UFC	Unified Facilities Criteria
U.S.	United States

UFC 4-510-01
03 February 2023
Change 3, 30 November 2023

UNIFIED FACILITIES CRITERIA (UFC)

DESIGN: MILITARY MEDICAL FACILITIES

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UNIFIED FACILITIES CRITERIA (UFC)

DESIGN: MILITARY MEDICAL FACILITIES IN UPPERCASE

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location
1	6 Sep 23	Metric conversions, adds acronyms for metric units, and miscellaneous clerical changes. 1-3, 2-3.1.1, 3-3.3, 3-3.3.2.5a, 5-4.11.1, 5-5.3.3, 6-5.2, 7-6.1, 9-2.4, 9-2.4.1, 9-2.4.2, 9-2.4.2.1, 9-3.1.4, 9-5.18, 9-5.20.2, 9-5.27, 9-5.27.1, 10-2.1, 10-2.7, 10-2.9, 10-7.1.2b, 10-8.8.3, 10-9.4, 10-11.1, 11-3.5, 11-3.7, 11-4.1.3.1, 11-4.9, 11-4.12.3, 11-4.14.2, 11-4.14.2d, 11-4.14.2g, 11-4.14.2j, 11-5.2.3.1, 11-5.2.5, 11-5.3, 11-5.4.3i, 11-5.8.2, 11-5.9, 11-5.9.3, 11-5.9.9, 11-6.1.3, 12-2.1, 12-2.1a, 12-2.1 d, 12-2.1h, 12-2.2, Table 12-1, 12-2.3, 12-2.5, 12-2.6, 12-4.3, 12-5.1, 12-7.5, 12-9.5.5.1, 12-9.6.2, 12-11.1, 12-18.1, 19-2, B-3.1, B-7.1, and B-8. Includes changes in Table B-1: changes to room codes DNTB1, DNTC1, DNTE1, DNTG1, DNTG2, DNTG3, DNTG4, DNTP1, DNTP2, NBCD1, and NBCD2; and adds room codes PHHR1 and SHRM2. Adds definitions for Ambulatory Care Center and Hospital and eliminates third unnumbered paragraphs.
2	25 Oct 23	Correct captions for Table B-1, change med gas for DNTE1, and provide missing Table B-1 page (room codes OFA03 through OPD01).
3	30 Nov 23	Corrections in Table B-1 - Task lighting.

This UFC supersedes UFC 4-510-01, dated 30 May 2019, with Change 2 dated 4 December 2019.

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FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States, its territories, and possessions is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

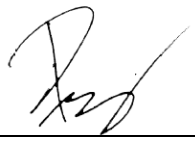
UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Military Department's responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Technical content of UFC is the responsibility of the cognizant DoD working group. Defense Agencies should contact the respective DoD Working Group for document interpretation and improvements. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide website https://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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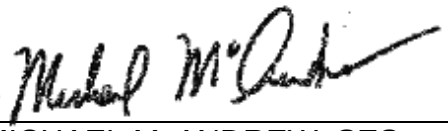
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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This Unified Facilities Criteria (UFC) 4-510-01 provides technical guidance and mandatory requirements to implement laws, regulations, executive orders, and policies to sustain, operate, plan, design, and construct DoD medical, dental and all other medically related facilities authorized by Title 10, United States Code (Reference (k)) and policies. This document defines performance and quality requirements as defined in MIL-STD-3007 for Military Medical Facilities supporting Health Service Support as defined in Joint Publication 4-02 (JP 4-02) throughout the life cycle. Federal legislation, Executive Orders (EOs), DoD Directives, DoD Instructions, and selected technical data, publications, and standards are referenced in the text by basic designation only and form a part of these criteria to the extent required by these references.

1-2 REISSUES AND CANCELS.

This UFC reissues and cancels UFC 4-510-01, dated 30 May 2019, with Change 2 dated 4 December 2019.

1-3 APPLICABILITY.

UFC 4-510-01 (hereafter referred to as 'this document') applies to medically unique portions of Category Code series 500 hospital and medical facilities and Category Code series 310 medically related research laboratories in the Defense-Wide Military Construction (MILCON) program, or other medically specific appropriations as provided by Congress. These requirements apply to **\1** Medical Treatment Facility (MTF) projects **/1/** and to veterinary, medical-related research, medical training facilities, and other projects which require conformance with UFC 4-510-01. This document should be employed by the Department of Defense (DoD) Components to sustainment, restoration, or modernization projects, in facility additions or alteration projects, or in Operations and Maintenance (O&M) projects.

1-4 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein. The requirements of this UFC take precedence over conflicts between this UFC and UFC 3- Series requirements.

1-5 POLICY.

As stated in DoD Instruction (DoDI) 6015.17, it is DoD policy to design efficient, economical, and safe facilities that sustain an effective combat force, support the DoD medical mission, and comply with the provisions of Title 10 U.S. Code (U.S.C.).

Detailed instructions and procedures, which may be developed and issued by the Design and Construction Agents must be consistent with the policy statements and criteria contained herein. Projects must:

a. Meet the current established operating requirements of the DoD Project Sponsor.

b. Provide reasonable flexibility in the design to accommodate future changes.

c. Meet applicable Federal legislation, codes, standards, and criteria.

d. Ensure that The Joint Commission (TJC), Accreditation Association for Ambulatory Health Care (AAAHC), or other applicable accreditations are achieved for Medical Treatment Facilities.

e. Meet certification requirements for Centers for Disease Control and Prevention (CDC), DoD Project Sponsor, Association for Assessment & Accreditation of Laboratory Animal Care (AAALAC), and Biosafety in Microbiological and Biomedical Laboratories (BMBL), or other applicable entities for laboratories.

f. Provide functional facilities at the most economical and practical life-cycle cost (LCC).

g. Be aesthetically compatible with the local environs and published Installation Design Guidelines.

1-5.1 Supplemental Technical Criteria.

The Design and Construction Agent(s) may maintain supplemental technical criteria to execute their organization's established design and construction regulations and procedures. Design and Construction Agents must produce designs for a complete and usable facility within the DoD Project Sponsor approved programmed scope and programmed authority.

1-6 FUNCTIONAL AUTHORITY.

The program functional and regulatory authority for applicable facilities is the Defense Health Agency.

Requests for project-specific waivers and exemptions to any UFC criteria or this document will be submitted in accordance with MIL-STD-3007. Regardless of DoD Project Sponsor, requests must have concurrence/nonconcurrence from the Defense Health Agency Facilities Enterprise (DHA-FE), as the Functional Authority for medical facilities, before final approval authority decisions are pursued.

1-7 ROLES & RESPONSIBILITIES.

1-7.1 Project Sponsor.

The DoD Project Sponsor is the DoD Agency or Service Component that provides the funding for the project. In most projects the DoD Project Sponsor will be the DHA-FE; however, other DoD Agencies can utilize these criteria for their medical projects.

The DoD Project Sponsor provides clinical and functional input on all aspects of facility sizing, functional requirements, and facility-essential or critical-use requirements such as, utility, sewer, water, and operational needs, and must work in partnership with the Design and Construction Agents throughout the design and construction process.

1-7.2 Design and Construction Agents.

The Design and Construction Agents are listed below.

1-7.2.1 U.S. Army Corps of Engineers (USACE).

The Headquarters USACE Program Integration Division (CEMP-II) is the primary USACE point of contact with the Functional Authority and DoD Project Sponsor for non-medically specific design and construction aspects of applicable facility projects and is responsible for all non-medically related program management issues and resolution between the Functional Authority, the DoD Project Sponsor, and USACE. The USACE Medical Facilities Mandatory Center of Expertise and Standardization, Huntsville Engineering and Support Center (CEHNC-EDX), has multi-disciplinary expertise in medical design criteria, standards, and policy, and has sole USACE responsibility for oversight, decision, and technical review of medically unique aspects of applicable projects. USACE's geographical District Offices must closely coordinate with CEHNC-EDX for all medically specific aspects of project design, construction, management, and execution of design and construction projects located within their respective geographical regions, including quality assurance (QA) and oversight of design and construction. CEHNC-EDX is responsible for assisting USACE geographical District Offices with project-specific design instructions to supplement the Architect/Engineer Firm (A/E) Scope of Work (SOW), for interfacing with the Functional Authority and DoD Project Sponsor regarding technical issues and mandatory submissions during both design and construction.

1-7.2.2 Naval Facilities Engineering Systems Command Headquarters (NAVFAC HQ) Medical Facilities Program Office (MFPO).

NAVFAC HQ MFPO is the Navy's point of contact with the Functional Authority and DoD Project Sponsor to provide the technical expertise for medical design and construction. NAVFAC HQ MFPO is the Navy's technical authority regarding project management and for providing project-specific design instructions to supplement the A/E SOW. NAVFAC HQ MFPO is responsible for technical issues, mandatory design and construction submissions, technical guidance, criteria, and all project standards, from project initiation to beneficial occupancy.

1-7.2.3 Air Force Civil Engineer Center (AFCEC).

AFCEC is the primary point of contact with the DoD Project Sponsor for all applicable facility design and construction projects in the United Kingdom and provides project management, technical reviews, and guidance for the Air Force.

Table 1-1 Responsibility Matrix

PROCESS GROUPS	FUNCTIONAL AUTHORITY	DoD PROJECT SPONSOR	DESIGN & CONSTRUCTION AGENTS
GROUP 1: STRATEGIC FACILITIES MANAGEMENT 1.1 Establish Program Policy 1.2 Authorize, Conduct, and Administer Research and Innovation Efforts Related to MHS Facilities 1.3 Integrate Inter-Agency Market Based Planning	R	C	C
GROUP 2: REQUIREMENTS PLANNING 2.1 Local Planning, Requirements Development and Gap Analysis 2.2 Analysis and Evaluation of Potential Solutions/Options 2.3 Business Planning, Market Solution Planning and Facility Requirements Planning	C	R	C
GROUP 3: DESIGN/CONSTRUCTION EXECUTION 3.1 Project Sponsor Representatives Coordination 3.2 Project Delivery and Contract Management	C	C	R
GROUP 4: FACILITY ACTIVATION AND OPERATIONS 4.1 Facility Transition and Activation 4.2 Facility Operations, Repairs, Maintenance, Sustainment, Restoration, and Modernization 4.3 Facility Specific Operations and Maintenance 4.4 Facility De-commissioning and Disposal	C	R	C
Key: R = Responsible; owns the problem or project C = To be consulted; has information or capability needed to complete the work			

1-8 CYBERSECURITY.

All facility-related control systems (including systems separate from a utility monitoring and control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service Implementation Policy.

1-9 GLOSSARY.

Appendix H contains acronyms, abbreviations, and terms.

1-10 REFERENCES.

Appendix I contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

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CHAPTER 2 PREDESIGN

2-1 GENERAL.

This chapter and its references provide requirements for predesign information required by the Design and Construction Agents to execute the design of applicable facilities. Predesign information includes requirements from the planning processes as defined and described in this chapter. Ensure that projects submitted contain sufficient planning, accurate scope, adequate documentation, and a valid cost estimate and realistic schedule for successful execution.

2-2 PREDESIGN PROJECT DOCUMENTATION.

Projects under consideration for budget submission must undergo additional detailed planning to include: additional project documentation; collection of relevant site, environmental, and Installation specific information; and development of other guidance essential for subsequent project design. The DoD Project Sponsor must prepare this information that is used by the Design and Construction Agent as the basis of design. Within 30 days of initial project Design Authorization (DA) release, this information/documentation must be submitted electronically to the Design and Construction Agent.

2-2.1 Documents Prior to DA.

Prior to release of the initial project DA, the DoD Project Sponsor must update and prepare this basic project documentation.

2-2.2 Functional Program.

The DoD Project Sponsor will develop the strategic objectives and the facility and operational requirements for the project (the Functional Program) in written narrative form as part of the project documentation. The DoD Project Sponsor will issue the Functional Program in a standard format with standardized content for consistency across all projects. This narrative must be coordinated with the Program for Design.

The DHA-FE current form for this narrative is titled the “Facility Planning Functional Program”.

2-2.3 Program for Design (PFD) and Project Room Contents (PRC).

The DoD Project Sponsor will develop the PFD facility space allocation and PRC requirements for installed equipment and furniture at an individual room level.

2-2.4 Existing Facilities Surveys.

The DoD Project Sponsor will provide facility deficiency tabulations and upgrade surveys to the Design and Construction Agent. The DoD Project Sponsor will provide an updated Deficiency Tabulation Report and updated estimate of costs and duration to

correct the deficiencies to establish the requirements in support of facility alteration projects.

2-2.5 Site Information.

For additions and new facilities, the DoD Project Sponsor will provide a completed site checklist as a project document. Sites with known contamination must not be considered, unless no other siting options are available and the appropriate cost and adequate schedule for mitigation are applied to the project for cleanup and other costs. The completed site checklist must reference or include Installation master plans for the specific site under consideration for development.

Site information collected for project design must be comprehensive and used to avoid site-related scope and cost impacts during construction. As applicable to a project, this information includes:

a. Area maps: location and site maps (including grades, access control points).

b. Description of existing site condition including previous use and contamination potential and environmental impacts.

c. Any Wetlands or other areas reserved for Fish & Wildlife preservation which would have a cost impact if encroached upon.

d. The statement regarding the facility's contingency-mode or mission assurance status and related additional sustained operations requirements.

e. Specific Installation requirements or restrictions, style of architecture, construction season limitations, seismic, wind, and snow considerations.

f. SOFA or other local host country agreements or criteria.

g. Soil and foundation conditions.

h. Utility distribution.

i. Site restrictions, for example, Air Installations Compatible Use Zones (AICUZ), potential helipad approach/departure zone obstructions, flood plain, rights-of-way.

j. Site security requirements and restrictions.

k. The National Capital Planning Commission (NCPC) requirements.

l. Cyber Security requirements.

m. Completed NEPA documentation.

n. Code restrictions and other surrounding building types and condition.

o. Any local traffic patterns or constraints (schools or high occupancy buildings), public transportation routes.

p. High noise levels or toxic fumes adjacent to building site affecting building occupants. Such as proximity to flightline operations or maintenance/cargo handling/refueling.

2-2.5.1 Utility Availability.

The site information must include a discussion of utility availability including water, sewage, storm drainage, electrical power, communications systems, existing fuel sources, and central steam, heating, or chilled water systems, including the tap-in locations. It must also include the available capacities, power service characteristics and locations, electrical distribution, water and wastewater needs or considerations, and the DoD Project Sponsor's intention, if any, for future expansion/construction of these services. Any abandoned utilities within the site footprint shall also be identified.

2-2.6 National Environmental Policy Act (NEPA) Documentation.

Provide a copy of the appropriate level of NEPA documentation as required by the NEPA, or host-nation equivalents for projects outside of the United States. If not completed, provide a plan and timeline for completion, in accordance with requirements of the NEPA.

2-2.7 Force Protection/Security Requirements/Cybersecurity.

The project documentation must include a situation report based on consideration of all applicable threat levels. Reference UFC 4-010-01, UFC 4-020-01, and UFC 4-010-06 for force protection, security, and cybersecurity requirements.

2-2.8 Mission Essential Facilities and Related Requirements.

If a project facility is identified by the hosting Installation as 'mission essential,' the DoD Project Sponsor will coordinate project requirements with the hosting Installation Command. During planning, it must be determined which operations within the facility need to be maintained, and to what extent, under a range of risk situations. The conclusions of this assessment must be documented in the project planning assumptions. Any added facility scope and cost related to 'mission essential' status must be included in the development of the project DD Form 1391.

2-2.9 Contingency Mode Functional Program (where applicable).

During healthcare requirements identification and facility requirements planning, the DoD Project Sponsor must define contingency operations and requirements in a contingency mode functional program. In addition to operational changes required to accommodate increased workload and levels of patient care, strategies to maintain operations over a stated period of time must be clearly stipulated. The impact on patient and staff access, utility services, emergency power availability, water supply, and sewer service must be assessed and included as design requirements.

The Functional Program must address medical mobilization expansion requirements where such temporary measures are included in the contingency mode of operations.

2-2.10 Fire Protection and Life Safety Considerations.

Fire protection and life safety considerations for alteration projects must be based on a completed Life Safety Assessment (LSA) as described in Chapter 14. In projects involving alteration or additions, the limitations of work in the existing areas of the facility must be determined and specifically addressed in the project DD Form 1391. Provide documentation of fire department access, supervision of protected premises, and fire service water supply.

2-2.11 Electrical.

Project document must include a description of exterior electrical power distribution systems covered in Chapter 11. Where exterior electrical service is connected from existing primary feeder, the Designer of Record (DoR) must coordinate with the Design and Construction Agent and receive direction regarding point of connection and concurrence that the existing circuit can support the new facility.

2-2.12 Communications.

Project documentation must include a description of all required systems covered in Chapter 12 to a level enabling development of a programmatic cost estimate. The infrastructure for various digital radiography technologies must be assessed and addressed. An Information System Cost Estimate (ISCE) must be included in DD Form 1391 development.

2-2.13 Commissioning.

Project documentation must include a description of the commissioning requirements for the project as covered in Chapter 19 to a level enabling development of a programmatic cost estimate. During planning, the DoD Project Sponsor must anticipate a requirement for commissioning based on facility and project type and include commissioning in the Budget-Ready DD Form 1391. As applicable, commissioning costs must be estimated during planning using DoD facility cost guidance.

2-2.14 Parking Requirement Calculation.

The DoD Project Sponsor must calculate and report on the 1391, the number of parking spaces including ABA spaces required consistent with the calculation method described in Appendix G and if applicable, the scope for any structured parking, including the number of spaces and where limited by known site restriction with the estimated number of floors (levels) above grade.

2-2.15 Addition-Alteration Facility & Demo Information.

For addition or alteration projects, information must be provided on the type and characteristics of the existing construction, size of the facility, roof and access, condition of utilities and services, existence of code or safety issues, environmental information or surveys, current HAZMAT report, and descriptions of previous alterations or additions of significance.

2-2.16 Safety Risk Assessment (SRA).

Provide predesign project documentation of the initial project-specific patient and staff SRA. These must be conducted by the DoD Project Sponsor. The project-specific SRA must be utilized to determine which design strategies are appropriate for the type of facility, and for incorporation in the project design. See Chapter 3 for SRA process requirements.

2-3 SCOPE AND COST CONSIDERATIONS.

During planning, the DoD Project Sponsor will be comprehensive in anticipating and considering scope and costs resulting from conditions that are applicable to a project. These scope and cost considerations may be based on specific studies or based on typical facility and project types. The scope and costs of such items or conditions must be estimated in the planning DD Form 1391 using DoD facility cost guidance.

2-3.1 Improvement/Alteration/Additions.

The criteria contained herein are not to be used as the sole justification for any addition, alteration, or improvement to an existing facility. These criteria define requirements that must be met when improvement or alterations of existing facilities, or sub-portions or systems thereof, are specifically authorized by reference in the project document, and justified during the above described programming and planning processes.

2-3.1.1 Levels of Facility Alteration.

All costs associated with projects containing altered areas (including the cost of temporary structures if required), **\1** Life Cycle Cost (LCC), **/1/** and other cost impacts must be categorized according to the following definitions:

2-3.1.1.1 Level 1.

Level 1 alterations include minor partition layout changes, new finishes, minor casework and equipment changes, minor modifications to HVAC distribution systems, and minor electrical branch circuit changes. The estimated cost of Level 1 alterations should not exceed 30 percent of replacement cost for the facility.

2-3.1.1.2 Level 2.

Level 2 alterations include Level 1 changes, minor to major partition layout changes with associated modifications to the HVAC distribution systems and electrical power and light requirements, minor structural modifications, new plumbing fixtures, allowances for roof repair, and changes in mechanical system insulation when asbestos is present. The estimated cost of Level 2 alterations should not exceed 50 percent of replacement cost for the facility.

2-3.1.1.3 Level 3.

Level 3 alterations include Level 1 and 2 changes, gutting of the building to structural frame without demolishing floors, exterior walls and roof assembly, modifications to structural frame, main electrical distribution system, air handling units (AHUs) and auxiliary equipment, plumbing system, and energy plant. The estimated cost of Level 3 alterations should not exceed 75 percent of replacement cost for the facility.

2-3.1.2 Cost of Alteration.

When proposed alteration project costs exceed 75 percent of the replacement cost for a facility, and when total facility replacement is feasible, selection of the total facility replacement option will be required.

2-3.2 Site Investigation.

The DoD Project Sponsor is responsible for all facility and site investigations required to generate design and cost impacts for planning and programming. Investigations may include, but are not limited to, inspection of concealed spaces (for example above-ceiling areas, chases, equipment rooms, and other reasonably accessible spaces to permit evaluation and accurate depiction of as-built conditions), environmental material testing or surveys, existing condition drawings and reports, and any other substantial information that would affect cost, scope, or schedule. When all possible, document site investigations with pictures, in particular areas that are confined or that depict complicated conditions.

2-3.3 Interstitial Building System (IBS).

In projects where IBS design concepts are under consideration as part of the base scope of the project, the scope and cost of IBS design concepts must be included as a separate line item in the DD Form 1391 and later updated in the project DD Form 1391. See Appendix E for IBS criteria.

2-3.4 Parking Facilities.

The scope (to include number of spaces) and estimated cost of parking provisions, surface or structured, must be determined during planning and included in the DD Form 1391. Cost of structured parking, appropriate road access and infrastructure must be included as a separate DD Form 1391 line item. DHA-FE is the sole Approving

Authority over Military Medical Facility parking requirements. The MHS parking policies and the standards for calculating parking requirements are located in Appendix G.

2-3.5 Future Expansion.

Consideration for future expansion must be incorporated into planning for all projects. Consider external and internal expansion of vital functions such as ancillary and utility services. Do not locate future expansion in areas that cause significant disruption to the future operations of the facility or significant cost (for example main entry, removal of mechanical rooms). Building site, vehicular access, structural systems, departmental adjacencies, functional layouts within departments, and utility type and source all play major roles in developing an economically expandable design. Provision for future expansion is authorized when approved by the DoD Project Sponsor. The scope and cost of approved expansion capability must be included as a separate line item in the project DD Form 1391.

2-3.6 Special Environmental Conditions.

Consideration must be given to water requirements for the facility, including availability and capacity of Installation water treatment facilities. Identify and provide documentation on Installation or environmental remediation requirements, if any, beyond those described in this document during the initial planning phase of the project, and adequately program associated costs into the budget for the project.

2-3.7 Emergency Power.

Consideration must be given regarding emergency power supply and availability. Identify Installation requirements, if any, beyond those described in this document during the initial planning phase of the project, and adequately program associated costs into the budget for the project. Give consideration to additional supply and availability requirements pursuant to determination of: reliability of power supply; facility Mission Assurance status; and special contingency mode Functional Program. Reference Chapter 11. Scope and cost emergency power supply must be included as a separate line item in the project DD Form 1391.

2-3.8 Antiterrorism/Force Protection (AT/FP).

Identify scope impact during the initial planning phase and adequately program associated costs int DD Form 1391 (reference Chapter 5).

2-3.9 Demolition of Vacated Facilities.

The DoD Project Sponsor must provide a descriptive plan for the disposition and extent of vacated facilities as part of the project planning package and adequately program associated costs into the budget for the project. Provide any documented HAZMAT report or survey data.

2-3.10 Sustainability Considerations.

The scope and cost of sustainable design features must be developed during the planning stage and included in DD Form 1391 (reference Chapter 4). Indicate the applicability of the Guiding Principle requirements and sustainability goals for the project in accordance with UFC 1-200-02. Provide a list of Renewable Energy Technologies that may be incorporated into the design of the facility (line item in the DD1391).

2-3.11 Special Studies.

Include special scope and cost considerations resulting from special facility studies performed prior to design or existing information where required or applicable for:

a. Material Handling and Transportation (reference Chapter 16)

b. Food Service (reference Appendix F)

c. Temporary facilities planned for occupancy during construction

d. Storm water management

e. Hazardous Containing Materials

f. Geotechnical

g. Identification of “Other” unique project requirements:

Identify and coordinate unique project requirements such as Construction restrictions due to airfield/waterfront operations, Explosive Safety Site Approval, base access restrictions, building hardening provisions for seismic, wind, or flood prone areas.

CHAPTER 3 DESIGN

3-1 GENERAL.

This chapter defines DoD Project Sponsor requirements for design procedures, submittals, and documentation. The Design and Construction Agent(s) may establish additional or fewer project-specific requirements in coordination with the DoD Project Sponsor to meet specific project requirements.

3-2 DESIGN CODES AND CRITERIA.

All DoD facilities must comply with UFC 1-200-01. Refer to UFC 1-200-01 for the effective dates for UFCs, codes and criteria. When scope, cost, and schedule permit, the Design and Construction Agent may include new or updated codes and criteria.

3-3 DESIGN PARAMETERS.

3-3.1 Scope and Cost.

3-3.1.1 Documentation.

During Concept Design (0–35 percent) or RFP development, the A/E must produce documentation that meets project requirements and complies with criteria while establishing final project scope and an appropriate Programmed Amount (PA), Design Directive Amount (DDA), or both.

3-3.1.2 Changes.

For projects submitted in the President's Budget or projects with funds appropriated by Congress, the project scope and cost are as stated on the submitted or enacted DD Form 1391. Cost and scope changes to these projects must be processed in accordance with Title 10 U.S.C. Section 2853 by the DoD Project Sponsor. For projects not yet submitted in the President's Budget, there is some flexibility to adjust scope and cost. The degree of flexibility varies with the level of design. Project scope is locked for DBB projects with the 20 percent deliverable and for DB projects with the draft RFP. Project cost is locked for DBB and other delivery method projects with the 35 percent deliverable, and for DB projects with the final RFP.

3-3.1.3 Added project.

In the event a project is added to the MILCON program by Congressional insert, the project scope, cost, and criteria are locked when the DD Form 1391 is submitted to Congress.

3-3.1.4 Functional changes during design.

The most cost-effective time to address functional requirements is during the 20 percent and 35 percent design development process. Functional changes must be addressed

not later than the 35 percent design. Changes to the functional design after 35 percent design dramatically increase cost with redesign work and possibly construction modifications. After the 35 percent design is approved, functional changes must be submitted as a user change request with justification to the DoD Project Sponsor for approval.

3-3.2 Gross Building Area Calculation.

Gross area accounting rules are illustrated in Table 3-1 and Figure 3-1. Gross area tabulation is the square footage measurement used on the project DD Form 1391. The gross area documentation requires calculation of the building gross floor area illustrated with small scale, single-line dimensioned drawings as demonstrated in Figure 3-1. The gross area includes the total area of all floors with a floor-to-clear height of 7 ft (2.1 m) or greater, including those building features listed in Table 3-1. Gross area is measured from the outer-most exterior surfaces of all enclosing walls. Utilize the instructions in Figure 3-1 to calculate the gross building area.

3-3.3 Departmental Building Area Calculation.

Departmental gross area calculations are illustrated in Figure 3-2. Departmental tabulation is the **\1** area **/1/** measurement associated with the Two-Step Method in the "DoD Space Planning Criteria Chapter 130: Net to Gross Conversion Factors". The Two-Step Method calls for allocating the building gross area between the various departments shown in the project Program for Design and overall building common areas not assigned to a specific department. The gross area rules of Table 3-1 and Figure 3-1 must apply to departmental tabulation. The instructions in Figure 3-2 must be used to calculate the departmental gross areas. A single line diagram must be provided with the design deliverable to clearly convey how the building gross area was proportioned.

Table 3-1 Gross Area Accounting Rules

Building/ Project Feature	Primary/ Supporting Facility Cost	Include in Building Gross Area (DD Form 1391)	Full or Half Area	Comment	Include in Gross Area on Property Record Card (DD Form 1354)
Departmental Scope	Primary	Yes	Full	Included in PFD. Refer to Figure 3-1 Areas A & B	Yes

Building/ Project Feature	Primary/ Supporting Facility Cost	Include in Building Gross Area (DD Form 1391)	Full or Half Area	Comment	Include in Gross Area on Property Record Card (DD Form 1354)
Walls and Partitions	Primary	Yes	Full	Included in departmental gross and circulation grossing factor. Refer to Figure 3-1 Areas A & B	Yes
Ambulance Garage	Primary	No	Full	Authorized when included as separate line on DD Form 1391	Yes
Ambulance Shelter	Primary	No	Half	Authorized when included as separate line on DD Form 1391	Yes
Atrium	Primary	Yes	Full	Included in circulation grossing factor. Count only floor area. Refer to Figure 3-1 Area E	Yes
Attic or Roof Sloping Space	Primary	No	N/A	Unoccupied space only	No
Circulation					
Building Circulation	Primary	Yes	Full	Included in circulation grossing factor. Refer to Figure 3-1 Areas A & B	Yes
Vertical Circulation (elevator shaft, interior stairwells, escalators, lifts, and trash chutes)	Primary	Yes	Full	Included in circulation grossing factor. Count only at one floor in gross area. Net area on subsequent floors must not be included. Refer to Figure 3-1 Area D	Yes

Building/ Project Feature	Primary/ Supporting Facility Cost	Include in Building Gross Area (DD Form 1391)	Full or Half Area	Comment	Include in Gross Area on Property Record Card (DD Form 1354)
Exterior Open Stairs	Primary	Yes	Half	Included in circulation grossing factor. Count only at one floor in gross area. Net area on subsequent floors must not be included. Refer to Figure 3-1 Area D	Yes
Alcove	Primary	No	N/A	Refer to Figure 3-1 Area F	No
Attached Covered but Not Enclosed Walks, Passageways, Ramps, and Canopies	Primary	No	Half	Tabulate scope separately for DD Form 1354	Yes
Unattached Covered but Not Enclosed Walks, Passageways, Ramps, and Canopies	Supporting	No	Half	Tabulate scope separately for DD Form 1354	No
Unattached Roof Overhangs, Soffits for Weather Protection	Supporting	No	N/A		No
Crawl Space	Primary	No	N/A	Unoccupied space only	No
Loading Dock/Logistics					

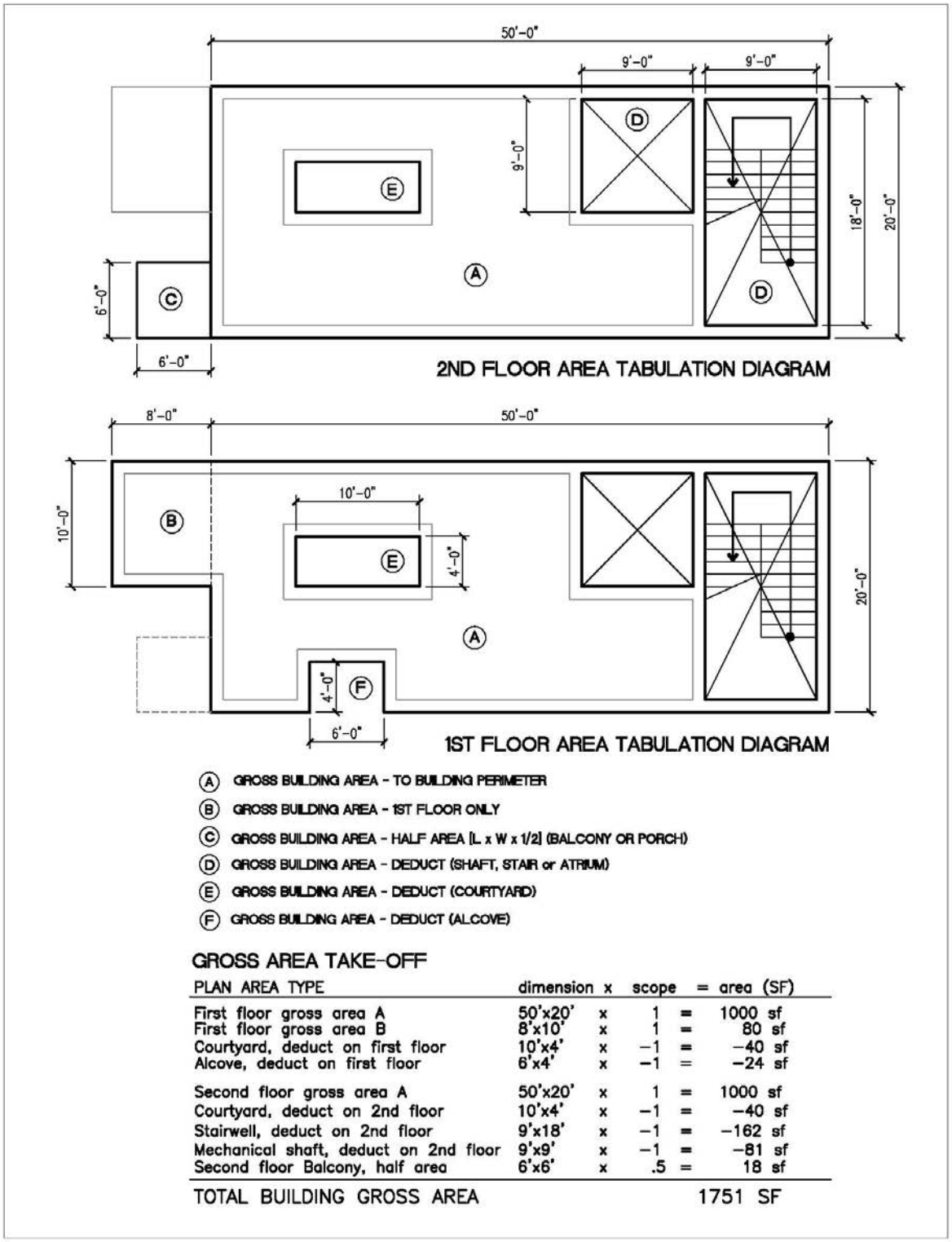
Building/ Project Feature	Primary/ Supporting Facility Cost	Include in Building Gross Area (DD Form 1391)	Full or Half Area	Comment	Include in Gross Area on Property Record Card (DD Form 1354)
Enclosed Loading Dock	Primary	Yes	Full	Authorized when included on PFD. Refer to Figure 3-1 Areas A & B	Yes
Unenclosed Loading Dock	Supporting	No	Half	Tabulate scope separately for DD Form 1354. Refer to Figure 3-1 Area F	Yes
Mechanical/Electrical/Communications					
Mechanical Space	Primary	Yes	Full	Included in mechanical grossing factor. Refer to Figure 3-1 Areas A & B	Yes
Electrical Space	Primary	Yes	Full	Included in electrical grossing factor. Refer to Figure 3-1 Areas A & B	Yes
Telecommunication Room (TR)	Primary	Yes	Full	Included in electrical grossing factor. Refer to Figure 3-1 Areas A & B	Yes
Enclosed Building Connectors	Primary	Yes	Full	Include in Building Gross Square Feet	Yes
Interstitial Space	Primary	No	Full	Authorized when included as separate line on DD Form 1391 and Life-Cycle Cost justified	Yes
Penthouse with Over 7 ft (2.1 m) Clear	Primary	Yes	Full	Included in mechanical grossing factor	Yes

Building/ Project Feature	Primary/ Supporting Facility Cost	Include in Building Gross Area (DD Form 1391)	Full or Half Area	Comment	Include in Gross Area on Property Record Card (DD Form 1354)
Penthouse with Under 7 ft (2.1 m) Clear	Primary	No	N/A	Excluded from building gross area when the average ceiling height is less than 7 ft (2.1 m) measured from the underside of a structural system and with perimeter walls measuring a minimum of 59 in (1500 mm) in height	Yes
Mezzanines or Platform for Stacking of Logistical Storage and Mechanical Equipment	Primary	No	Full	Tabulate scope separately for DD Form 1354	No
Roof Top Equipment	Primary	No	Full	Unoccupied space	Yes
Roof Top Equipment Maintenance Vestibule with Over 7 ft (2.1 m) Clear	Primary	Yes	Full	Manufacture enclosure integral with equipment for maintenance personnel	Yes
Roof Top Equipment Maintenance Vestibule with Under 7 ft (2.1 m) Clear	Primary	No	N/A	Manufacture enclosure integral with equipment for maintenance personnel	Yes
Pad Mounted Equipment	Support	No	N/A		Yes

Building/ Project Feature	Primary/ Supporting Facility Cost	Include in Building Gross Area (DD Form 1391)	Full or Half Area	Comment	Include in Gross Area on Property Record Card (DD Form 1354)
Mechanical and Utility Shafts Connecting Two or More Floors	Primary	Yes	Full	Included in mechanical/electrical grossing factor. Count only at one floor in gross area. Net area on subsequent floors must not be included. Refer to Figure 3-1 Area G	Yes
Central Utility Plant	Primary	No	Full	Tabulate scope separately for DD Form 1354 when authorized as separate line on DD Form 1391	No
Internal Pump and Utility Rooms (for example fire pump, bottle gas storage)	Primary	Yes	Full	Fire pump room is included in mechanical grossing factor. Other rooms may be included unless specifically included in a department within the PFD, whereas bottle gas storage is included in departmental scope	Yes
External Pump House and Utility Buildings (for example sewage lift station)	Supporting	No	Full	Tabulate scope separately for DD Form 1354	No
Utility Tunnels	Supporting	No	N/A		No

Building/ Project Feature	Primary/ Supporting Facility Cost	Include in Building Gross Area (DD Form 1391)	Full or Half Area	Comment	Include in Gross Area on Property Record Card (DD Form 1354)
Equipment Yards	Supporting	No	N/A		No
Other					
Exterior Balconies	Primary	Yes	Half	Tabulate scope separately for DD Form 1354. Refer to Figure 3-1 Area C	Yes
Exterior Sun Shades	Primary	No	N/A		No
Courtyard	Supporting	No	N/A		Yes
Exterior Ramp, Stoops, and Pads	Supporting	No	N/A		No
Attached Roof Overhangs, Soffits for Weather Protection	Primary	No	N/A		No
Green Roof and Roof Top Healing Gardens and Unenclosed Roof Terraces	Supporting	No	N/A		No
Smoking Shelters	N/A	N/A	N/A	Not authorized	No

Figure 3-1 Instructions for Preparing Gross Area Tabulation



GROSS AREA TAKE-OFF

PLAN AREA TYPE	dimension	x	scope	=	area (SF)
First floor gross area A	50'x20'	x	1	=	1000 sf
First floor gross area B	8'x10'	x	1	=	80 sf
Courtyard, deduct on first floor	10'x4'	x	−1	=	−40 sf
Alcove, deduct on first floor	6'x4'	x	−1	=	−24 sf
Second floor gross area A	50'x20'	x	1	=	1000 sf
Courtyard, deduct on 2nd floor	10'x4'	x	−1	=	−40 sf
Stairwell, deduct on 2nd floor	9'x18'	x	−1	=	−162 sf
Mechanical shaft, deduct on 2nd floor	9'x9'	x	−1	=	−81 sf
Second floor Balcony, half area	6'x6'	x	.5	=	18 sf
TOTAL BUILDING GROSS AREA					1751 SF

Note: 1000 sf = 92.9 sm

3-3.3.2 Measuring instructions.

3-3.3.2.1 Terms.

This chapter uses Net Square Feet (NSF), Departmental Gross Square Feet (DGSF), and Building Gross Square Feet (BGSF) as defined in DoD Space Planning Criteria Chapter 130.

3-3.3.2.2 Departments.

Space and Equipment Planning System (SEPS) provides Net Area for specific rooms in a facility. Rooms are grouped into individual departments, such as Physical Therapy, Pharmacy and Common Areas. Some rooms in individual departments are not intended to be co-located and may be located outside of the general department area. Specific common area rooms, intended to be distributed throughout the facility, are combined in the Common Areas Department.

3-3.3.2.3 Departmental grossing factor.

SEPS applies a unique departmental grossing factor to departmental NSF to determine DGSF, which includes area of the rooms defined in the individual department, internal circulation, and interior walls/partitions. DGSF includes half of the wall thickness between other departments but does not include exterior walls.

3-3.3.2.4 Building grossing factor.

SEPS applies a building grossing factor to the sum of all DGSFs to determine the BGSF. The BGSF includes all areas within the exterior skin of the building according to the gross area rules of Table 3-1 and Figure 3-1. It includes all departmental areas and areas not specifically defined in the PFD, such as public corridors, building circulation, atria, walls/partitions, mechanical and electrical spaces, vertical circulation, and shafts.

3-3.3.2.5 Common area rules.

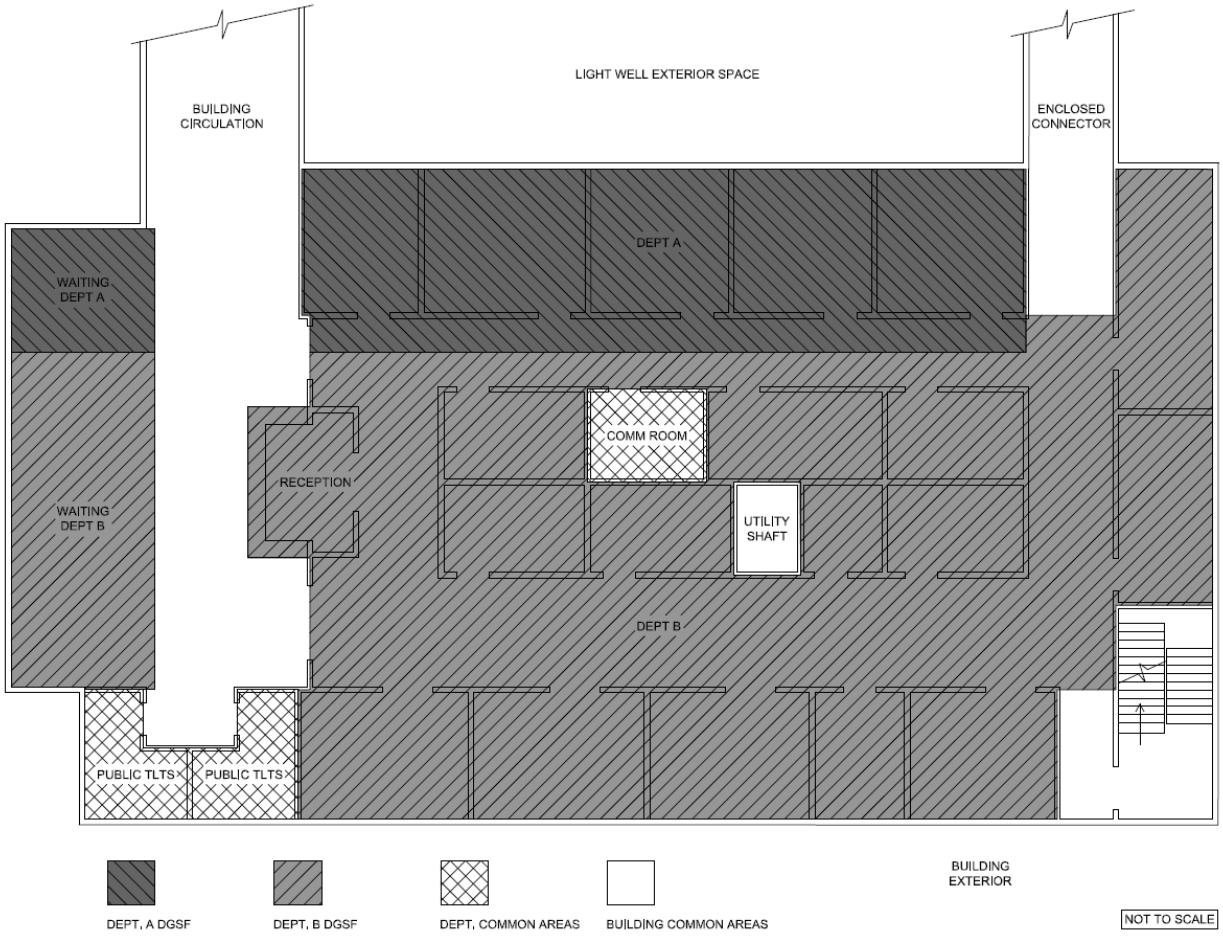
Departmental and Building Common Area rules are defined in Figure 3-2. The following are additional examples and rules:

a. Pro-rating example for shared room: **\1** Department A Waiting net area is defined as 100 sf (9.3 sm) and Department B Waiting net area is defined as 50 sf (4.6 sm) in the PFD. The as designed waiting net area is 120 sf (11.1 sm). The pro-rated net areas for Department A Waiting is 120*(100/150) = 80 sf (11.1*(9.3/13.9) = 7.4 sm) and for Department B Waiting is 120*(50/150) = 40 sf (11.1*(4.6/13.9) = 3.7 sm). **/1/**

b. For facilities that have multiple CATCODES specified in the project 1391: Dedicated Building Common Areas must be assigned to the respective CATCODE. Shared Building Common Areas must be prorated to each CATCODE at the designer's discretion, with the basis for pro-rating used

to determine the appropriate accounting of area to CATCODE being provided.

Figure 3-2 Instructions for Preparing Departmental Gross Area Calculations



Notes for Figure 3-2

1) Individual departmental gross area includes individual rooms in a department, corridors and walls within a departmental area, and half of the common wall shared with other departments and/or building common areas.
2) Shared walls between departments and/or building common areas shall be measured from the centerline of the wall.
3) For areas without partitions such as waiting areas, use the assigned floor area of the furniture seating area, or building feature (i.e. change in flooring or ceiling).
4) For rooms that are shared by multiple departments, pro-rate the area based on the individual departmental PFD areas that are combined.
5) For corridors that feed two or more rooms from two departments, assign half of the corridor to each department. For single rooms from a different department, the corridor will be assigned to the larger department.
6) The Common Areas Department includes telecommunication rooms, janitor closets, public toilets and other common rooms as identified on the PFD. These distributed areas shall be reported on the Net Area Tabulation sheet back to the Common Areas Department rather than the department where they are located on the floor plate.

3-3.4 Design to Cost.

During the final design phase (35 percent through 100 percent design completion) for DBB projects, the A/E must produce a set of construction documents within the PA, DDA, or both, established at Concept Design approval. If design requirements or refinements cause the estimated project cost to exceed the established PA or DDA, the Design and Construction Agent must present cost adjustment or reduction alternatives to the DoD Project Sponsor before completing the design documents.

For DB projects, cost is established at construction contract award. No cost updates are required to the DoD Project Sponsor post construction award.

3-4 DESIGN SEQUENCE AND RESPONSIBILITIES.

Detailed design submission requirements, including sequence, submittals, and documentation, are provided in Appendix C.

3-4.1 Title 10 U.S.C. Section 2807 Action.

The Design and Construction Agent is responsible for providing the estimated A/E design contract and other design costs and schedule to the DoD Project Sponsor for inclusion in Block 12 supplemental data on DD Form 1391. Using this estimate, the DoD Project Sponsor will determine if a project requires notification to Congress in accordance with Title 10 U.S.C. Section 2807. The DoD Project Sponsor personnel must notify the Design and Construction Agent when the notification letters have been signed and the date after which the contract can be awarded, and forward copies to the appropriate personnel. The Design and Construction Agent is required to strictly adhere to the statute and not obligate funds for design until the 14-day Section 2807 waiting period has expired.

3-4.2 Design Authorization (DA).

The DoD Project Sponsor will issue the DA to the Design and Construction Agent as appropriate to meet design and programming milestones. The Design and Construction Agent must manage design in accordance with established policies and procedures unless otherwise coordinated with the DoD Project Sponsor. The Design and Construction Agent must not pursue any level of design beyond that authorized by the DoD Project Sponsor.

3-4.3 Authorization to Advertise Construction.

The Design and Construction Agent must provide a Current Working Estimate (CWE) worksheet and the final design or RFP to the DoD Project Sponsor to request authorization to advertise the construction contract. Bid options must be clearly delineated on the CWE worksheet. The DoD Project Sponsor will notify the Design and Construction Agent when the project is approved for advertising.

3-4.4 Authorization to Award Construction.

The Design and Construction Agent must provide a CWE worksheet based on the latest construction estimate and bid results, accepted bid options, and other information the DoD Project Sponsor requires when Title 10 U.S.C. Section 2853 notification is required. When Title 10 U.S.C. Section 2853 action is complete, the DoD Project Sponsor will notify the Design and Construction Agent that the project is approved for award.

3-5 REVIEW OF DESIGN DELIVERABLES, ROLES, AND RESPONSIBILITIES.

3-5.1 Design and Construction Agent.

The Design and Construction Agent is responsible for executing the A/E and contractor's contract. They are also responsible for the overall design development, review of all design deliverables for contract compliance in accordance with codes, criteria; project design is in accordance with authorized project scope, cost, and schedule; the design incorporates best value design and construction practices; reviews for constructability; cost schedule risk analysis and mitigating strategies; development and review construction contract documents in accordance with approved acquisition strategy; incorporated accepted design review comments, ensures the designer complied with the approved quality control practices, and practices good stewardship of Government resources.

3-5.2 Installation Manager.

The Installation Manager is responsible for reviewing design deliverables for compliance with environmental requirements (NEPA), storm water management, and various permits; meeting the intent of the Installation master plan and exterior architectural standards; connection to the existing infrastructure and maintainability of the infrastructure utility systems; Installation force protection, traffic, fire protection, security standards; and real property transfer (DD Form 1354).

3-5.3 DoD Project Sponsor.

The DoD Project Sponsor is responsible for reviewing design deliverables for project planning and functional requirements (spaces, contents, finishes, departmental adjacencies, ability to support the flow of patients and logistics within facility and its compliance with the design concept of operations) to meet the medical program requirements; clarification of medical unique criteria; maintainability of the design solution; utility connection for medical equipment and suitability for initial outfitting; making notifications to Congress when design deviates from prior notifications; reviewing the design deliverables for compliance with the DD form 1391 and, project scope, criteria, and schedule. They are also responsible for the initial outfitting and transition (IO&T) of the facilities. They may comment on other aspects of the design deliverables.

3-6 REPORTING REQUIREMENTS.

The Design and Construction Agent must report project data as required in the Title 10 U.S.C. Section 2851 Monthly Report to the DoD Project Sponsor.

3-7 DESIGN CONSIDERATIONS.

3-7.1 General.

All design elements, including functional, architectural, electrical, energy, fire protection and life safety, mechanical, structural, Safety Risk Assessment (SRA), and other features, must be coordinated.

3-7.1.1 Dedicated Administrative Area.

When directed by Design Authorization in coordination with the Design and Construction Agent, administrative buildings and separate administrative suites (no internal spaces will be considered), and training buildings, which are not intended to flex into clinical (refer to the Functional Program) should use the technical requirements of UFC 1-200-01 General Building Requirements and not additional requirements of this UFC (cable trays, plenum returns, etc.).

3-7.1.2 Interstitial Building System (IBS).

The DoD Project Sponsor approval for the use of IBS design, and whether the DoD system module or alternate non-DoD system module concept design is used, must be made no later than the 20 percent submission and must include consideration of the required economic comparison with conventional design. See Appendix E for IBS criteria.

3-7.1.3 Safety.

The DoR must follow the concepts from the most current ANSI/ASSP Z590.3: Prevention through Design Guidelines for Addressing Occupational Hazards and Risks in Design and Redesign Processes. Through the application of Prevention through Design concepts, decisions pertaining to occupational hazards and risks can be incorporated into the process of design and redesign of work premises, tools, equipment, machinery, substances, and work processes including their construction, manufacture, use, maintenance, and ultimate disposal or reuse. This standard also provides guidance for a life-cycle assessment and design model that balances environmental and occupational safety and health goals over the life span of a facility, process, or product.

All DoD facilities must comply with DoDI 6055.01 and applicable Occupational Safety and Health Administration (OSHA) safety and health standards.

3-7.1.4 Equipment Room Locations.

The DoD Project Sponsor's preference is to locate mechanical, and electrical equipment rooms with exterior at grade access. Major equipment rooms must have exterior access with paved surfaces for wheeled transport of equipment. Provide horizontal and vertical access to interior, below-grade, or upper-level equipment rooms including transport of the largest items of equipment that may require replacement. Equipment rooms must be designed so the largest serviceable part of equipment can be transported in/out of the building. This includes transporting the equipment without voiding warranties or reducing the end-state performance of the equipment.

3-7.1.5 Distribution Equipment Space Clearances.

Provide the greater of manufacturer recommended maintenance and design criteria clearances in accordance with Chapter 9, Chapter 10, Chapter 11, and Chapter 12.

3-7.1.6 Utility Distribution Considerations.

Locate service isolation and balancing devices and terminal equipment that require periodic inspection or maintenance above corridors.

3-7.2 World-Class Checklist.

A project-specific checklist must be developed and provided in accordance with Appendix C. If the DoR is unable to incorporate a mandatory feature, justification must be included in the 35 percent design submittal.

3-7.3 Functional Program During Design.

During concept design, the design phase portion of the Functional Program is finalized by the Project Delivery Team. This document provides a departmental and area-specific narrative and graphic that documents what functions the organization envisions inside a facility as well as how those functions operate. It is a concise but detailed description of the projected operation of the facility that pulls together information concerning the mission and organizational purpose, types of services being performed, and patient and staff "flow" throughout the spaces. It may include the functional description of the spaces, special requirements specific to those spaces, and adjacency requirements within and among the various departments and clinics. The document depicts the routine, daily actions of staff and patients, the flow of supplies, the use of equipment and all other pertinent functions within the building. Refer to Appendix C for the functional narrative required in the 35 percent Design Analysis. For DB projects, the designer preparing the RFP documents may assist in the Functional Program development and ensure the RFP documents are coordinated with the Functional Program.

3-7.4 Parking.

Patient and staff parking guidance is provided in Appendix G. The amount of parking required is determined using the parking formulas provided. Design must ensure ease of patient access.

3-7.5 Future Expansion.

Provide external horizontal building expansion of 20% of the enacted DD Form 1391 gross building area divided by the number of number of floors within the project unless the project requirements state otherwise. Departments most likely to be expanded or converted for future adaptation need be located adjacent to the expansion zone or internal soft spaces.

The tenets of flexibility are:

a. Select sites wherever feasible and plan for the ability for expansion, horizontal and or vertical.

b. Facilities should have the capacity for adaptation and for possible conversion to alternative use.

c. Ensure continuous high-performance facilities by separating building components and systems for maintenance, according to their expected technical or utility lifespan.

d. Consider the potential impacts of future horizontal and vertical expansions on adjacent spaces, departments, chases, utilities, structure, and all other important features of the facility.

3-7.6 Alterations and Additions to Existing Facilities.

For alteration and building addition projects, the A/E must conduct thorough investigations of existing facilities to become knowledgeable of facility conditions. The A/E must establish the existing condition and characteristics of each affected facility to include: utilities and services, systems, existence of code and life safety issues, construction type, requirements for maintaining a secure environment, and infection control as they pertain to the design, construction, and phasing of the work. These investigations and their impact on design of facility alterations and additions must be described in the project design documents.

Alterations to existing equipment and systems, including temporary connections, changes to system performance, or measures necessary to sustain service, must also be shown and described in detail in the project design documents. The A/E must evaluate the impact on existing systems where connections are made that increase overall system demand. The locations of new connections must clearly be shown, described, or both. The A/E must determine and document any project work that must necessitate a reduction or interruption of any service to an existing occupied space.

3-7.7 Safety Risk Assessment.

A Safety Risk Assessment (SRA) must be applied from the programming phase through construction to guide, inform and aid in incorporation of risk based safety practices into each MILCON project. The SRA must be that developed by the Center for Health Design. It must be utilized to determine which design strategies are appropriate for the type of facility, and for incorporation in the proposal and design. A project-specific SRA must be submitted in accordance with Appendix C. The SRA must be initiated by the DoD Project Sponsor during the planning phase of the project. Management of the SRA must be the responsibility of the A/E of record as the SRA continues to evolve with additional levels of detail as needed to support the creation of a safe environment throughout the design, construction, and commissioning phases.

3-7.8 NFPA 99 Risk Assessment.

A NFPA 99 Risk Assessment for Risk Category, Space Category, and Building System Category must be developed and provided in accordance with Appendix C.

3-8 PROJECT COST ESTIMATES.

The Design and Construction Agent must review and approve all construction cost estimates. Construction cost estimates must separate the costs by the type of appropriations.

Cost estimates for building systems developed during design must include the costs associated with providing the Real Property Installed Equipment (RPIE) and the infrastructure to support Personal Property (PP). RPIE and PP is further defined in Chapter 15.

3-9 FUNDS MANAGEMENT POLICY.

3-9.1 Title 10 U.S.C. Section 2853 Action.

The Design and Construction Agent must provide the CWE to the DoD Project Sponsor with their request for authority to award a construction contract. When a project requires notification to Congress in accordance with Title 10 U.S.C. Section 2853, the Design and Construction Agent must plan for and allow at least four weeks to complete the Congressional Notification process prior to the desired award date. The DoD Project Sponsor will notify the Design and Construction Agent when the Congressional Notification correspondence is within 14 days of being complete so that a contract award may be made.

When a project requires reprogramming action in accordance with the applicable MILCON Appropriations Act, the Design and Construction Agent should allow three months prior to the desired award date after additional funds are secured. Projects that are authorized and appropriated through non-standard MILCON funding, such as Supplemental Appropriations or Base Realignment and Closure (BRAC), may require additional notification time so the DoD Project Sponsor can complete unique notification

and coordination requirements. DoD Project Sponsor personnel must notify the Design and Construction Agent when the notification letters have been signed, and forward copies to appropriate personnel. The Design and Construction Agent is required to strictly adhere to the statute and not obligate funds for award until the waiting period has expired.

3-9.2 Return of Excess Funds.

At the DoD Project Sponsor's request, the Design and Construction Agent must return any cost savings (difference between project funds allocated and award CWE) to the DoD Project Sponsor.

3-10 HISTORICAL ANALYSIS GENERATOR (HAG) DATA.

The Design and Construction Agent is responsible for loading construction contract award data into the HAG (also known as HII) database within 30 days of contract award. (Refer to the Historical Analysis Generator website.) These data are used to generate historical Guidance Unit Costs (GUCs) for publication in UFC 3-701-01, in accordance with the latest version of UFC 3-730-01.

CHAPTER 4 SUSTAINABLE DESIGN PRINCIPLES

4-1 GENERAL.

This chapter supplements UFC 1-200-02 High Performance and Sustainable Building Requirements by describing requirements and developing uniformity specific to applicable facilities.

4-2 DESIGN PROCESS.

Analyze LCC effectiveness in support of the military medical mission, to include first cost, energy consumption, annual O&M, and other associated direct costs when evaluating sustainable design features and systems. Prioritize sustainable features that have the highest potential for cost-effective implementation. Do not de-scope sustainable design elements that have been shown to be LCC effective to reduce cost.

4-3 SUPPORTING DOCUMENTS.

Supporting documents include DoD Project Sponsor and Design and Construction Agent publications and regulations including sustainable design policies applicable to DoDM projects, Medical Design Instructions (MDIs), Engineering Technical Letters (ETLs), project-specific design instructions, engineering and construction bulletins, and other DoD-related criteria.

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CHAPTER 5 ANTITERRORISM (AT) AND PHYSICAL SECURITY

5-1 GENERAL.

This chapter provides facility design criteria and guidance for antiterrorism, physical security, and crime prevention. These programs are intended to protect assets: people, facilities, and equipment from terrorism and other hostile manmade threats.

5-2 ADDITIONAL CRITERIA.

The Planning Team uses UFC 4-020-01 DoD Security Engineering Planning Manual, to develop the security and AT requirements. UFC 4-020-01 and the multiple supporting AT UFCs referenced by UFC 4-020-01 implement the facility requirements of DoD Instruction (DoDI) 2000.16, for new and existing construction. This criteria provides minimum construction requirements which must be incorporated in inhabited new construction and major renovations projects. See additional regulatory requirements for physical security of controlled substances in 21 CFR 1301.72. AT and physical security systems required by this chapter must also comply with NFPA 101.

5-3 DESIGN CRITERIA PLANNING TEAM.

Ensure appropriate key personnel are identified and are represented to ensure their varied interests relating to security and AT requirements are included. The specific membership of a planning team will be based on local considerations, but the following functions must be represented; facility user, engineer, security, intelligence, and Antiterrorism Officer.

5-4 ELECTRONIC SECURITY SYSTEMS (ESS).

5-4.1 Purpose.

Provide an ESS utilizing various combinations of capabilities for Access Control Systems (ACS), Duress Alarm Systems (DAS), Infant Protection Alarm System (IPAS), Intrusion Detection Systems (IDS), Video Surveillance system (VSS), Behavioral Health Staff Assist (BHSA) Alarm system, and photo badging. Refer to Chapter 12 for additional information and requirements for communication supporting infrastructure and interoperability.

5-4.2 Systems Considerations.

ESS is an integrated electronic system that encompasses interior and exterior ACS, DAS, IPAS, IDS, VSS, BHSA Alarm system, and photo badging. An assessment of ESS alarm systems requirements must be conducted for facilities in accordance with the project Functional Program and in coordination with the DoD Project Sponsor. Multiple ESS components may be integrated to provide an overall facility security system.

5-4.2.1 Stand-Alone Clinic Facilities Projects.

For stand-alone clinic facility projects, provide ESS with all the capabilities identified for ACS, DAS, IDS, VSS as appropriate for the services noted in the project Functional Program. Project-specific criteria must be fully coordinated with the DoD Project Sponsor.

5-4.2.2 Inpatient Facility Projects.

For inpatient MTF projects, provide an ESS with all the capabilities identified herein as a turn-key system that is networked together for a totally integrated ESS for the facility. An interface with the facility Radio Page (RP) System or other wireless personal communications device must be included (reference Chapter 12) so alarm events can be communicated to the facility security staff (for quick response), and the facility NTS System (reference 12-5, Network Time Synchronization System).

5-4.3 ESS Components and Funding Restrictions.

The systems and equipment items listed here require Proponent funds to purchase and install the items. The construction project can fund all infrastructure and utility support. Therefore, a listing for separate line-item funding and accounting is required for these items. The Military Interdepartmental Purchase Request (MIPR) of Proponent funding to the contracting agency is required to pay for the totally integrated ESS that must be provided as a turn-key system from a single qualified ESS contractor. Refer to MIL-STD-1691 Table 6-1 Systems Planning Matrix for property type designations for the ESS System and its subcomponents.

5-4.3.1 ESS: Access Control System (ACS).

Reference UFC 4-021-02 Electronic Security Systems for components and requirements associated with the ESS: Access Control System.

5-4.3.2 ESS: Duress Alarm System (DAS).

Reference UFC 4-021-02 Electronic Security Systems and Table 5-1 for components and requirements associated with the ESS: Duress Alarm System. Reference Appendix A for details on the functionality and requirements associated with the BHSA Alarm system.

This proponent-funded duress alarm equipment is not included as part of the door access control system.

5-4.3.3 ESS: Infant Protection Alarm System (IPAS).

Infant Protection Alarm System is required for all Medical Facilities with Pediatric Units, Labor and Delivery Units, Obstetric Units, Neonatal ICUs. Coordinate expansion of the IPAS to cover additional inpatient Units, as noted in 5-4.9 and per the project Functional Program.

5-4.3.4 ESS: Intrusion Detection System (IDS).

Reference UFC 4-021-02 for components and requirements associated with the ESS: Intrusion Detection System. Also reference Table 5-1for intrusion detection locations and component types.

5-4.3.5 ESS: Video Surveillance System (VSS) Equipment.

Reference UFC 4-021-02 for components and requirements associated with the ESS: Video Surveillance System. UFC 4-021-02 refers to this system as CCTV.

5-4.3.6 ESS: Behavioral Health Staff Assist (BHSA) Alarm System.

Reference Appendix A for details on the functionality and other requirements associated with BHSA Alarm system and the associated Duress Alarms for Behavioral Health inpatient and outpatient settings.

5-4.4 System Configuration and Major Functional Components.

Major functional components include but are not limited to:

a. ESS network
b. Intrusion detection and alarm system
c. Door access control system
d. Video surveillance system
e. Infant Protection alarm system
f. Behavioral Health Staff Assist alarm system

Major interfaces in inpatient MTFs include:

a. Interface with Radio Page (RP) Systems (reference 12-11)
b. Interface with Network Time Synchronization (NTS) System (reference 12-5)

5-4.5 ESS Network.

Provide an independent, dedicated, industry-standard network with DISA and DoD Project Sponsor standard LAN technology, protocols, equipment, and cabling to interconnect all provided electronic security capabilities into an integrated ESS in support of facility-wide security requirements and operations. During design consider all outlying medical buildings using the hospital ESS Network for Access Control. The facility Information System network must not be used for ESS networking:

a. As an independent, stand-alone network, the application design must incorporate the requirements of the DHA Cybersecurity Guidance for Facility-Related Control Systems (FRCS) and Medical Device and

Equipment (MDE) in support of the Risk Management Framework (RMF) process outlined in Chapter 12. This must include the system network architecture, software, hardware, and security requirements.

b. Servers and workstations must meet standardized baseline requirements and specifications as defined by DISA and DHA. Servers and workstations must utilize the most current DoD approved operating system and must provide central databases for all the operating systems, application programs, and data logging. In hospitals and medical centers which have an onsite Radio Page System and/or other wireless networked personal communication devices, the ESS network must also provide an interface with these facility systems to communicate security events to the staff.

c. Network Infrastructure (switches, routers, etc.) must meet the standard baseline specifications as defined by DISA and DHA. When possible, network electronics must match NiPR infrastructure for patch management and network administration.

5-4.5.1 Integrator Network Major Components.

The ESS integrator network must be configured as a Client Server network with the major components listed here to serve all the specified capabilities:

a. LAN and infrastructure

b. Database servers

c. Digital video servers and digital video recorders

d. System Operator Workstations

e. Management Workstation

f. Maintenance Workstation

g. System software

5-4.6 Intrusion Detection and Duress Alarm.

5-4.6.1 Sensors and Locations.

Intrusion detection and duress alarm locations and sensor types are as indicated in Table 5-1. Table 5-1 is provided for guidance. Specific design must be in accordance with the project Functional Program.

Table 5-1 Intrusion Detection and Duress Alarm Locations and Sensor Types

Location	Balanced Magnetic Switch	Motion Detector	Duress Alarms
Inpatient and Outpatient Pharmacy	X	X	
Inpatient and Outpatient Pharmacy dispensing Window(s) and consult rooms	X	X	X
Reception and Nurse Stations			X
Pharmacy Vault and vault-based equipment	X	X	
Food Service Account Office	X	X	X
Cashier Locations	X	X	X
Logistics Vault	X	X	
Logistics Warehouse	X	X	
Silver recovery central Collection point	X	X	
Behavioral Health			X*
Admissions Cubicles			X
Command Office			X
*This includes both inpatient and outpatient Behavioral Health settings. See Appendix A for locations of Duress Systems equipment and operational requirements in Behavioral Health settings.			

A balanced magnetic switch must be placed on each door or window of locations indicated in the Functional Program and Table 5-1 as requiring balanced magnetic switches and that could provide access. The motion detector must cover the entire area being protected. Locate the motion detectors in coordination with the systems furniture and equipment. Video surveillance monitoring and recording must be activated by the intrusion detection and duress alarms unless the cameras are recording 24/7/365 and meet recording period capacity as required by the DoD Project Sponsor for forensic purposes. The intrusion detection and duress capability design must follow the DoD

Project Sponsor regulations and other applicable specifications and be coordinated with the facility and Installation security staffs.

5-4.6.2 Remote Alarm Reporting.

Any combination of intrusion or duress alarms that requires immediate military police response must be communicated to the Installation Security Office. For the implementation of this function, provide an interface to the existing Installation ESS network. The system contractor must field coordinate the exact configuration and location of this interface with the Installation Security Office.

The selection of alarms to be routed to the Installation Security Office must be under software control from the facility ESS Management Operator Workstation. The initial list of alarms to be programmed for remote reporting at the time of facility ESS activation must be coordinated with the Contracting Officer.

5-4.7 Door Access Control.

Provide electronic door access control capability, as a minimum, at the locations listed here and as required by the project-specific criteria. The capability must:

a. Provide for addition of access authorization to CAC cards as the primary access control card; and

b. Include photo badging equipment to produce access control cards, and a Management Workstation to issue access cards, when CAC card usage is not feasible; and

c. Generate and maintain a listing of current authorized access by individual, location, and time; and

d. Discontinue access authorization for issued cards. Monitor and control of door access activity and events must utilize the integrator network Workstations. Where required, provide an interface between the video surveillance and the door access control capabilities to initiate video monitoring and recording of surveillance cameras anytime these doors are opened unless an authorized access control card has been read by the card reader or an authorized personal identification number (PIN) is entered in an access control keypad. This must be as further defined herein in paragraph 5-4.8.

A staff identification card system with multiple levels of access control may be provided.

5-4.7.1 Access Controlled Door Locations.

Electronic door access control devices must, as a minimum, be provided at these locations:

a. All building exterior doors, including doors to the first floor mechanical and electrical equipment rooms

b. Each door between waiting areas/general circulation corridors to clinical spaces

c. Each storage room entrance door

d. Each Pharmacy entrance door

e. Each Pharmacy vault door

f. Server Room Support Equipment (CMP04) door

g. Each Cashier Office door

h. Each Behavioral Health Unit entrance door

i. Command suite entry door

j. All Telecommunication Room doors

k. Service Entrance Facility (COMC2) door

l. Server Room (CMP01) door

m. Communications Radio Equipment (COM04) door

n. Penthouse equipment room door

o. Each staff locker room door

p. Inpatient Records room door

q. Outpatient Records room door

r. Multimedia equipment room door

s. Security Department entry doors

t. Medication Rooms

u. Mail Room

v. Select elevators as directed by the DoD Project Sponsor

w. Additional locations must be as directed by the DoD Project Sponsor

5-4.7.2 Door Access Control Major Components.

Reference UFC 4-021-02 for components and requirements associated with the ESS: Access Control System. Major components of the door access control system are listed in UFC 4-021-02.

5-4.8 ESS: Video Surveillance System (VSS).

The provided video surveillance capability must perform functions for capturing, viewing, controlling, monitoring, and recording of video surveillance scenes for specified locations throughout the facility and site. Operation for monitoring and control functions for video surveillance must take place at system integrator network Operator Workstations. Where required, all images from all video cameras must be digitally recorded on video camera servers at all times. Provide as many video camera servers

as are required for recording all images from all video cameras. Recording parameters, to include frame rate, resolution, and record duration, must be as specified by the DoD Project Sponsor and verified by the system contractor. All alarms routed over the ESS integrator network must be received and processed for automatic initiation of special video monitoring and recording protocols for the alarm event point and a designated zone associated with the alarm event point.

5-4.8.1 Color Video Camera Coverage.

Color video images of surveillance scenes from points throughout the facility and site must include but not be limited to these locations:

a. Main Entry Lobby area
b. Ground level Elevator Lobby area
c. Mechanical Room door
d. Cashier Office
e. Cashiers locations in food service and Installation exchange
f. Vaults
g. Entrances and exits from the Labor and Delivery (L&D) Unit, NICU, Pediatric and Behavioral Health Units
h. Server Room Support Equipment (CMP04) door
i. Service Entrance Facility (COMC2) door
j. Server Room (CMP01) door
k. Communications Radio Equipment (COM04) door
l. Emergency Waiting areas
m. Emergency Walk-In Entrance and Reception
n. Ambulance dock and entry area
o. Corridors connecting buildings
p. Pharmacy dispensing windows and Waiting Area
q. Pharmacy narcotic counting & prescription preparation area
r. Main and secondary building entrances and exits
s. Service elevator lobbies
t. Loading docks and dock dumpster areas
u. All Parking Lot areas
v. Inpatient Behavioral Health outdoor areas
w. Additional locations must be as directed by the DoD Project Sponsor

All other locations can be covered using black and white cameras as directed by the DoD Project Sponsor.

5-4.8.2 Video Surveillance Major Components.

Reference UFC 4-021-02, Chapter 4, for components and requirements associated with the ESS: Video Surveillance System.

5-4.9 ESS: Infant Protection Alarm System (IPAS).

Provide the capability to detect and report alarms if an attempt is made to abduct an infant or pediatric patient from protected patient care areas, such as the L&D Unit, Obstetric Unit, Pediatric Unit, Med/Surg Unit when infants or pediatric patients are admitted to them, Level 1 Well Baby/Holding Nursery and Level II, III or IV Neonatal ICUs. To protect the infants or pediatric patients in these units, an interactive tag must be attached to each patient in the units. The tag must signal an alarm and the VSS must begin recording if there is any unauthorized attempt to remove the patient from the secured unit (exit alarm) or if there is an unauthorized removal of the tag or strap from the patient (tag tamper alarm). In an alarm condition, electromagnetic locks on exit doorways from the unit must be activated to delay or prevent the unauthorized individual from being able to leave the unit with the patient and allow time for the staff in the area to respond to the alarm.

The system must be continuously supervised to detect any tampering or removal of a monitoring device. Any detected unauthorized tampering with, or unauthorized removal of equipment must generate an alarm condition. All alarms must be concurrently routed in real-time to all Operator Workstations and transmitted to the security staff and staff in the alarmed unit via radio page or other wireless networked personal communication device. Operation and management of the IPAS capability must take place at Infant Protection Workstations installed in the designated Nurse Station of each unit. The electromagnetic door locks must be interfaced with the facility fire alarm and fire detection system to unlock the doors in the event of a fire or other emergency. Also, if there are elevators within the perimeter of a protected area, an alarm condition signal must be routed to the elevator controls to prevent the elevators from arriving in or leaving the protected unit area.

5-4.9.1 Infant Protection Major Components.

Major components to provide Infant Protection Alarm capability include, but are not limited to:

a. Network adapters
b. Infant Protection Workstations
c. RF readers
d. Low frequency (LF) readers
e. Infant tags and straps

f. Door position switches

g. Exit door dome lights with tone device

h. Electromagnetic door locks and power supplies

i. Proximity card readers

j. Speakers

k. Infant protection software

5-4.10 ESS: Behavioral Health Staff Assist (BHSA) Alarm System.

Appendix A describes the required functionality of the primary signaling (response managed within the unit or clinic) and secondary signaling (elevated response by resources external to the unit or clinic) for the BHSA Alarm system. **\1\ /1/** The primary signaling capability must consist of wired and wireless components as prescribed by Appendix A.

The secondary (external to the unit or clinic) signaling for BHSA Alarm system must consist of centrally located Duress Alarm components as prescribed by paragraph 5-4.6.2 and Appendix A.

5-4.11 Basic Design Requirements.

5-4.11.1 Electrical Power.

ESS equipment in inpatient MTFs must be powered from the essential electrical system with branch assignments per Table 12-1. AC powered equipment must be protected by either an internal battery backup or a UPS unit which must provide at least 15 minutes of full power during an AC power failure. UPS units must comply with **\1** Underwriter's Laboratory (UL) **/1/** 1778 and 47 CFR Part 15.

Power all video cameras from camera power supplies located in the nearest Telecommunications Room (TR).

5-4.11.1.1 DoD Assessment and Authorization.

The ESS must be RMF certified in accordance with DoD Assessment and Authorization Process. This certification requires the system to have a number of security characteristics and features.

5-5 SPECIAL CONSIDERATIONS FOR SECURITY SENSITIVE AREAS AND ROOMS.

Sensitive areas and rooms must be designed to store valuable assets (for example, funds, narcotics, dangerous drugs, and controlled substances and materials). The most cost-effective method of providing adequate security for these assets must be selected.

5-5.1 Safes.

Drugs classified as Schedule I or II controlled substances under the Controlled Substance Act of 1970 must be stored in safes or vaults. Drugs classified as Schedule III–V may also be stored in safes or vaults as deemed appropriate by the DoD Project Sponsor.

5-5.2 Vaults.

Features to be considered for vault storage areas are outlined in 21 CFR 1301.72 and DoD Project Sponsor directives.

5-5.3 Pharmacies.

Walls, floors, ceilings, doors, and service windows of pharmacies must provide resistance to forced and covert entry where necessary and required by the DoD Project Sponsor physical security regulations. Doors and windows must be kept to a minimum and doors must be keyed separately from the master key system. IDS sensors must be installed at all doors and windows including windows opening to corridors. As a minimum, walls surrounding pharmacies must be constructed full height from floor slab to structure above.

5-5.3.1 Doors.

Doors must be provided with security hinges and must be locked with security locksets. Doors must be solid core wood or hollow core steel. Other considerations include “peep holes”, two-way intercom system with camera, and card access system with keypad for the main staff entrance door, double-locking locksets with 1 in. (25 mm) throws, warning signs stating doors must remain unlocked during normal operating hours (for emergency egress), and warning signs stating “Controlled Area.”.

5-5.3.2 Service Windows.

Provisions, such as roll-up shutters, must be made for securing all service windows after normal operating hours. Frames holding roll-up shutters and security screens, or bars must be securely fastened with smooth-headed bolts with nuts peened in place.

5-5.3.3 Utility Openings.

Duct terminals and connecting points must be in exposed locations where they may be readily observed to detect tampering. Openings of 96 in^2 (0.062 m^2) or larger must be protected **\1** in accordance with (IAW) **/1/** MIL HDBK 1013/1.

5-5.4 Medical Supply Storage Areas or Facilities.

In addition to the criteria provided for pharmacies, high value, critical, and pilferable resources stored in this type of storage area or facility must be protected in accordance with specific requirements as defined by 21 CFR 1301.72 and the DoD Project Sponsor.

5-5.5 Other Security Sensitive Areas and Rooms.

Other activities or locations may be identified by the DoD Project Sponsor as security sensitive. These areas and rooms must minimize the security risk for these activities or locations. Package inspection devices may also be considered for mail rooms. Design ESS in accordance with UFC 4-021-02.

CHAPTER 6 ARCHITECTURAL

6-1 GENERAL.

This chapter provides architectural design guidance. Design of applicable facilities must emphasize architectural design excellence while balancing economical, functional, energy efficient, and sustainable architectural design elements. Principles of Evidence Based Design (EBD) and world-class facility standards must be included where applicable, based on project scope and building type. Designs must adhere to general healthcare industry standards, DoD and DoD Project Sponsor specific functional requirements, Core UFCs such as UFC 3-101-01, and criteria specified herein.

6-2 EXTERNAL DESIGN.

Adhere to applicable Installation design guidance and individual DoD Project Sponsor exterior design standards where applicable. Give special attention to provide convenient and Architectural Barriers Act (ABA) compliant patient access and drop off areas. Consider safety and separation of public, staff, emergency, and logistics travel paths as an integral part of the design.

6-3 EXTERIOR WALL DESIGN

All facilities must comply with the requirements listed in Chapter 4 and with any DoD Project Sponsor or Design and Construction Agent directives mandating increased energy performance.

6-4 FENESTRATION AND WINDOWS.

Provide natural day lighting to maximum extent possible throughout the facility. Exterior windows must be provided in normal nursing care areas. Intensive Care and Cardiac Care bedrooms, Prosthodontic Dental Treatment Rooms (DTRs), and Prosthodontic-Ceramics Laboratories should also be provided with natural lighting or artificial lighting balanced to the natural wavelength. Natural lighting may be provided in Dermatology Clinics if required by the DoD Project Sponsor. Exterior windows must also be provided per host nation requirements where it exceeds DoD criteria.

6-5 INTERIOR CONSTRUCTION.

6-5.1 Aseptic Environments.

An Infection Control Risk Assessment (ICRA) must be developed to address risk management during the project. The risk assessment must include requirements that address patient care, facility design, construction, construction phasing, ventilation, safety, and epidemiology. Selection of interior construction and finishes must consider the need for aseptic environments. Use smooth, nonporous, seamless materials to minimize contamination and reduce housekeeping requirements. Smooth, seamless wall and floor coverings facilitate cleaning. Cabinetry should be designed and installed without gaps behind or underneath base units. At a minimum, these areas must be

designed for ease of housekeeping, with elimination of materials or surfaces that could harbor contamination and to minimize maintenance requirements:

a. Oral Surgery Rooms, DTRs

b. Special Procedure Rooms, for example, Cardiac Catheterization, Angiography, Endoscopy

c. Operating Rooms (ORs), including C-Section and Hybrid

d. Emergency and Trauma Rooms

e. Decontamination Rooms in Surgery, Labor/Delivery, Dental, and Central Processing and Distribution (CPD)

f. Sterile Storage Rooms (Surgery, Labor/Delivery, Dental, CPD)

g. Sub sterile and Recovery Rooms (Surgery and Labor/Delivery)

h. All Patient Treatment Rooms

i. Intravenous Admixture and Chemotherapy Preparation Rooms in Pharmacy

6-5.2 Interior Design.

All finished designs must comply with Appendix B.

\1 Design all direct patient care spaces at full scope in accordance with the Program for Design (PFD) area requirement. Design all other spaces to meet the PFD area requirements without varying more than plus or minus 10 percent. Approval from the DoD Project Sponsor is required to deviate from these requirements. Record all area differences from the PFD in the submittal requirements, Appendix C, specific to the net area calculations with narrative justification. **/1/**

6-6 FRONT DESK AND RECEPTION AREAS.

For areas that regularly receive patients for care or administrative reasons, patients and users must have a clear understanding of where to go upon check-in and must be within immediate, physical reach of attendants if directional or medical assistance is required.

Position and design the front desk or reception areas to provide direct observation of the entry area and the waiting area of each department to ensure that the desk attendant(s) have unobstructed line of sight to the patients in the area and can physically access anyone needing assistance or summon other staff to assist.

6-7 FLOORS.

Reference Appendix B for required floor finishes. Ensure floor to receive finish is properly cured, level and free from any loose material prior to any installation.

6-8 WALL AND PARTITION SYSTEMS.

Reference Appendix B. Provide systems that permit modification with the minimum cost and difficulty within acoustical and fire criteria, except in areas subject to severe impact. Interior non-load bearing metal studs must be a minimum 20 gauge, 16 in. (405 mm) on center. The DoR will determine if more stringent structural requirements apply. Provide non-combustible wall backing **\1** (alternatively fire-retardant wood blocking may be used as coordinated with the equipment vendor and DoR) **/1/** at all wall-hung equipment and accessories. Architectural acoustics must be coordinated across all building systems. Resilient channels are prohibited to be used. Consider the use of other methods and products to control sound, vibration and achieving required STC ratings listed in Appendix B.

6-8.1 Use of Full Height Partitions.

Full height partitions (floor to structural slab above) must be used where required to meet fire or smoke separation, critical pressurization, and sound performance requirements and in the rooms, spaces, and compartments listed below for physical security purposes. Refer to Appendix B and paragraphs 10-7.5 and 10-14.1 for construction and leak test requirements for rooms with critical pressurization.

a. Medical Record Storage areas (paper file areas or large centralized areas), Legal, credentials, quality, and Human Resource records storage areas

b. Materiel Services Storage areas

c. CPD Storage areas

d. Pharmacy

e. Prosthodontics and Ceramic Laboratory

f. Medical Equipment Maintenance and Repair

g. Orthotic Appliance Manufacturing

h. Facility Engineer Maintenance Shops

i. Pulmonary Function and Laboratory

j. Medical Service Account (MSA) Funds Storage

k. Labor, Delivery, and Recovery Rooms (LDR)/Labor, Delivery, Recovery, and Postpartum Rooms (LDRPs)

l. Corridors

m. Neonatal Intensive Care Unit (NICU), Nurseries, and Pediatric Inpatient Rooms

n. Behavioral Health Inpatient and Seclusion Rooms

6-8.2 Barriers.

Design protective barrier partitions to protect occupants or equipment in rooms, spaces, and compartments from fire, smoke, radiation exposure, electrical interference, magnetic resonance imaging (MRI) shielding, or for physical security purposes.

6-8.3 Protection and Safety Features.

Use door and wall guard systems (for example corner guards, crash rails, handrails, chair rail, wall protection panels) in all patient care areas subject to frequent abrasion and impact. Areas include, but not limited to, corridors, alcoves, patient treatment rooms, utility (soiled/clean) rooms, CPD, gurney storage, laboratories, kitchens, loading docks and others.

Provide handrails in corridors where patients routinely travel and public areas where travel along a wall is possible. Handrails are not necessary in administrative areas.

6-8.4 Toilet Facilities.

Provide appropriate floor slope, water containment, and drainage as required. Give consideration to slip resistant surfaces in wet areas. All thresholds must meet ABA requirements.

6-8.5 Toilet Partitions.

In locations where toilet partitions are utilized, provide ceiling hung type, unless directed otherwise by the Design and Construction Agent.

6-9 CEILINGS.

6-9.1 Support.

Suspended ceiling surfaces cannot be used for the direct support of cubicle curtain tracks and ceiling lights. Ceiling-mounted accessories must be secured through the ceiling to secondary support members.

6-9.2 Utility Access.

Provide maximum accessibility in corridor ceilings to the mechanical, electrical, plumbing and telecommunication distribution systems. Do not use concealed-spline ceiling systems requiring special tools to lower tile assemblies. Identify the access panels into ceiling plenums in order to identify the type of utility present and coordinate with all disciplines.

6-10 VESTIBULES.

Provide exterior vestibules at primary patient entrances. Vestibules must comply with ABA requirements and should be of sufficient depth to allow the outside doors to close

before the inside doors are opened. The Design and Construction Agent may waive this requirement in moderate climates if justification concerning energy and life cycle cost are provided.

6-11 DOORS.

6-11.1 Automatic Doors.

Electrically operated or hydraulically operated automatic doors must be provided for Emergency Trauma entrances and primary patient entrances of MTFs.

6-11.2 Doors, Frames, and Hardware.

Door sizes and types are as indicated in Appendix B. Unless otherwise stipulated by the Design and Construction Agent, all door frames must be hollow metal. Refer to Chapter 14 for fire protection and life safety labeling requirements. Provide a glass view panel in OR doors and other areas where staff may be transporting non-ambulatory patients. At patient toilets, provide rescue hardware that, in an emergency, allow access to the room regardless of privacy lock type or obstruction on interior side of door. Door hardware must be of Builders Hardware Manufacturers Association (BHMA) Grade 1, meet ABA requirements, and be aesthetically compatible with the design of the facility.

6-12 SUSTAINABLE DESIGN.

Reference Chapter 4 for sustainable design principles.

6-13 WAYFINDING PLAN.

A wayfinding plan must be generated for all new medical facilities. The Design and Construction Agent must substantiate that all architectural and engineering systems, specifications, and contract documents support the elements and features proposed in the wayfinding plan. Signage, a tool associated with wayfinding, must be fully coordinated and consistent with the facility's wayfinding plan. Development of a wayfinding plan must begin at the start of a project's design and conclude with the project's final design submission.

For addition/alteration projects, coordinate the wayfinding plan with existing conditions. In the absence of a base or facility wayfinding master plan, evaluate and assess one's ability to navigate, via wayfinding cues, from the existing facility to the addition/alteration project. Consider adjacencies, circulation, building entrance locations, parking considerations, and overall building configuration as part of this evaluation.

6-14 BEHAVIORAL HEALTH.

See Appendix C and Appendix A for other specific requirements.

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CHAPTER 7 STRUCTURAL

7-1 GENERAL.

This chapter provides criteria for the selection, analysis, and design of structural system(s) and materials, including Seismic criteria, to be used for applicable facilities.

7-2 DESIGN CRITERIA.

Structural design must be in accordance with UFC 3-301-01. The Risk Category of buildings and other structures must be based on the nature of occupancy in accordance with Table 2-2 of UFC 3-301-01 for the purpose of applying design load. The desired seismic level of performance for a particular facility is dependent on the nature of the occupancy and whether the structure is required for post-earthquake recovery. The structural engineer of record must assign a Risk Category, as defined in UFC 3-301-01, based on the facility function and the desired seismic performance level. The Authority of Jurisdiction must review and approve the designation.

If required by the DD Form 1391, certain facilities may require only key areas to be operational after the Design Earthquake. Areas that are not required to remain operational may be assigned a lower Risk Category only if both the structural and non-structural systems are designed by the structural engineer of record to be seismically independent or fully isolated from areas that are required to remain operational. Systems that are required to be operational following the Design Earthquake are identified as Designated Seismic Systems in accordance with ASCE 7.

7-3 DESIGN LOADINGS.

Unless otherwise indicated herein, the minimum design loadings must be in accordance with UFC 3-301-01. Floor live loads must be in accordance with UFC 3-301-01, and as amended by Appendix B of this UFC.

7-4 POST-EARTHQUAKE EMERGENCY STATUS.

During the planning period, an evaluation of water for potable and fire suppression purposes, fuel, sanitary sewer, and power, is required for all Risk Category IV facilities in Seismic Design Categories D through F to support continued operations 72 hours after a seismic event. Onsite storage of these lifeline utilities may be required when established by the project DD Form 1391.

7-5 CONCEPT DESIGN DEVELOPMENT.

Develop project specific seismic design concepts. Coordinate the type of structural system to be used in the early concept development of the functional layout, in accordance with UFC 3-301-01. Specific project criteria include mechanical, electrical, medical gases, and communication systems design criteria.

7-6 DESIGN OF NON-STRUCTURAL SYSTEMS.

Design all non-structural systems in accordance with UFC 3-301-01. Special Designated Seismic Systems are non-structural building systems, utility services, equipment, and medical equipment required to remain operational after an earthquake to sustain life safety systems. Some Designated Seismic Systems known as “Active” require Special Seismic Component Certification to ensure that they do not change state or fail during an earthquake. “Active” Designated Seismic Equipment is a limited subset of Designated Seismic Systems that have parts that rotate, move mechanically, or are energized during operation; and may be limited to motors greater than 10 horsepower or greater than 200 MBH. Pipes, ducts conduits, and similar apparatus are not “Active”. Special seismic component certification must be based on shake table testing per ICC-ES AC156 unless the component is inherently rugged. See UFC 3-301-01, Appendix E-1. Develop a complete list of Designated Seismic Systems and Active Designated Seismic Systems for approval and identify in the Construction Documents. Where applicable, Designated Seismic Systems must be placed above tsunami inundation elevation height as determined by ASCE 7, Chapter 6 including onsite power generators. **\1**

7-6.1 Equipment and Furniture.

From the Equipment and Furniture in the PRC, identify the items where falling may pose a life safety hazard or displacement may cause injury or damage to Designated Seismic Systems. For these items, identify and specify Special Seismic Component Certification requirements and design seismic anchorage and/or bracing elements per ASCE 7 as amended by UFC 3-301-01. Provide a table in the construction documents that defines requirements for this equipment and furniture. **/1/**

7-6.2 Hazardous Materials – Special Storage Provisions.

Provide special storage equipment or accessories that are convenient for normal daily use and functional after earthquakes. Examples of such equipment are lower profile shelves with face bars to secure shelves to the wall or floor and restrain their contents, specially designed racks for restraining reserve oxygen (O) and nitrous oxide (NO) tanks, and special bins for storing anesthetic gas containers.

7-6.3 Hazardous Materials – Fuel Gas Piping.

Brace piping and provide shut-off valves. Use malleable fittings and valves and provide swing joints where necessary.

7-6.4 Electrical Systems – Vibration Isolation.

Where vibration isolation is not required, bolt generators directly to an appropriate foundation. Where vibration isolation is necessary, provide restraining clips at vibration isolators to prevent failure of the isolation mountings in earthquake vibration conditions.

7-6.5 Emergency Generators.

Where practicable, use generators with integral radiator cooling systems. Where auxiliary cooling systems are necessary, install cooling towers or remote radiators at grade level. Brace cooling towers or radiators and provide special bracing for piping. All emergency generators must be set above tsunami inundation height as determined by ASCE 7, Chapter 6 and above the flood design elevation per ASCE 24.

7-6.6 Medical Systems and Equipment – Stationary equipment.

Secure stationary equipment or shelving to a partition or floor. Shelving or equipment with doors that does not require continuous access must have automatic positive latching devices.

Blood bank, drug storage, critical refrigerators, freestanding incubators, and centrifuges should be secured.

7-6.7 Medical Systems and Equipment – Fragile equipment.

Secure sequential multiple blood analyzers and other fragile laboratory equipment. Anchor related shelving and provide lips and face bars as necessary.

7-6.8 Medical Systems and Equipment – Wheeled equipment.

Wheeled equipment must have wheel locks and must be assigned a specific location when not in use. Wheeled equipment must have programmed closets or alcoves whenever possible to limit rolling. Portable equipment must be stored in recessed cabinets secured to partitions, whenever possible.

7-6.9 Supply Storage.

Supply cabinets must have either plastic or tempered glass sliding doors, and the doors must slide closed automatically. Open shelving should have a shelf rim to preclude supplies from being shaken from their storage position.

7-6.10 Medical Gas Bottles.

Metal boxes attached to the floor and equipped with double chains must be provided for medical gas bottles. Wheeled carts carrying oxygen or other medical gases must be equipped with wheel locks and chains for fastening to walls.

7-7 EVALUATION OF EXISTING FACILITIES.

For existing facilities, the Design and Construction Agent and the DoD Project Sponsor must verify the performance objective or Risk Category and the Designated Seismic Systems required, as established in the planning documents. The performance objectives are defined in UFC 3-301-01, and must consider operational mission, disaster preparedness, and medical post-earthquake needs.

7-7.1 Seismic Hazards Evaluation Considerations.

Seismic Structural Evaluations. Seismic structural evaluations and retrofit of existing buildings must be conducted in accordance with UFC 3-301-01. For proposed facility alteration projects, seismic structural evaluations must be conducted during the project requirements planning phase (see Chapter 2).

7-8 ADDITIONAL DESIGN CONSIDERATIONS.

Several aspects of structural design typically associated with facilities are addressed here. It is essential that structural design considerations enter into the earliest stages of concept planning and design, to ensure compatibility with medical function and architectural and equipment features.

7-8.1 Vibration.

Structural vibration requires special consideration. Designs must limit vibration in floor framing systems and must ensure adequate isolation and damping of vibrations produced by HVAC equipment, emergency generators, elevator equipment, human activity, and other machinery. Provide a vibration design in accordance with the following standards:

- Structural steel structures – AISC Design Guide 11: Floor Vibrations Due to Human Activity.
- Reinforced concrete structures – CRSI Design Guide for Vibrations of Reinforced Concrete Floor Systems.
- Steel Joist Institute Technical Digest 5, Vibration Analysis of Steel Joist-Concrete Floor Systems.
- UFC 3-450-01.

7-8.2 Vibration Limits.

Limit floor vibration according to manufacturer requirements for all other vibration sensitive equipment. The below noted floor vibration limitation must apply to the floor above where said equipment is attached to the ceiling structure. Limit hospital floor vibration to 0.5% g or less, except in the case of the following stricter requirements wherein the maximum acceptable floor velocity is listed in micro inches per second. These values must be superseded by any explicit manufacturer requirements:

- Hospital patient rooms: 6000 mips
- Standard operating rooms, surgery suites, bench microscopes up to 100X, and laboratory robots: 4000 mips
- Bench microscopes up to 400X: 2000 mips

- Microsurgery, eye surgery, neurosurgery, and bench microscopes greater than 400X: 1000 mips
- Magnetic resonance imagers: 500 mips

7-8.3 Magnetic Resonance Equipment (MRI) Foundations.

Provide non-ferrous foundation reinforcement for MRI foundation according to manufacturer requirements. Ensure that primary structural foundations surrounding MRI rooms are free of ferrous materials that may cause magnetic interference. Consult with the equipment manufacturer.

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CHAPTER 8 - NOT USED

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CHAPTER 9 PLUMBING AND MEDICAL GASES

9-1 GENERAL.

This chapter provides design requirements for plumbing and medical gas systems. The primary purpose of these systems is to provide safe and reliable support to the medical functional mission. In addition, appropriate design consideration must be incorporated to ensure system maintainability, economy and energy efficiency, and adaptability to future facility modification or expansion.

9-1.1 Supplemental Criteria and Standards.

This chapter may be supplemented with individual Military Department (MilDep) criteria, including Installation-specific requirements, as established by the Design and Construction Agent. Minimum design requirements must be as provided by the International Plumbing Code (IPC) in accordance with UFC 3-420-01, the NFPA Standards, and the other documents noted in this chapter.

9-1.2 Plumbing Systems.

Plumbing systems include domestic cold and hot water; sanitary, storm, and industrial (acid) waste drainage; water treatment, for example, softening, deionization, reverse osmosis; fuel gas; and landscape irrigation. Plumbing systems must be designed to be safe, reliable, and maintainable. Selection of materials, equipment, and installation techniques must consider LCC effectiveness and maintainability in addition to medical functional requirements. Designers must provide for appropriate system isolation and balance with necessary equipment and design practices to avoid cross-connections and backflow.

9-1.3 Medical Gas and Vacuum Systems.

Medical gas and vacuum systems include compressed air (medical, dental, instrument, medical laboratory, dental laboratory, process), vacuum (medical, dental surgical, oral evacuation [OE], waste anesthesia gas disposal [WAGD]), exhaust (laboratory dental), positive pressure gases (nitrogen [N], oxygen [O], nitrous oxide [NO], carbon dioxide [CO2]), and the associated equipment, for example, piping, filters, regulators, alarms, manifolds, and tanks.

9-1.4 Seismic Requirements.

Seismic design criteria for bracing and utility systems, for example, storage, redundancy, are provided in Chapter 7.

9-1.5 Corrosion Protection.

All piping that must be installed in an environment that supports galvanic reaction must be protected from corrosion in accordance with MilDep criteria and the standards and recommended practices of the National Association of Corrosion Engineers.

9-1.6 NFPA 99 Risk Assessment.

A Risk Assessment must be performed in accordance with NFPA 99 to establish the System Categories for all medical gas and plumbing systems. See Appendix C for the timing and responsibilities of the Risk Assessment.

9-1.7 Piping Coordination.

All piping systems must be installed in a manner that promotes cleanliness, protection of room contents and addresses infection control concerns. **\1\ /1/** Piping must be concealed under floor, within walls, and/or above ceilings, except in dedicated mechanical spaces.

Piping must not be routed within the room or above the ceilings of communications, electrical and server rooms unless dedicated to serving the room as indicated in Chapters 11 and 12. Where feasible, avoid routing piping above other sensitive areas such as: operating rooms, delivery rooms, nurseries, food preparation areas, food serving areas, food storage areas, sterile processing clean side, and radiology equipment in procedure rooms, control rooms and equipment rooms. Where routing over sensitive areas cannot be avoided, provide all wet and drainage piping with special protection provisions (for example double wall containment piping or drip pans with leak detection) to protect the space below from leakage and/or condensation.

9-2 POTABLE WATER SUPPLY SYSTEM.

9-2.1 Quality.

All potable water supplies must have an established potability monitoring program to be acceptable for use by an MTF. When an MTF project includes a non-potable water service, for example, “gray water,” for systems, such as irrigation, heating, or cooling, the design must provide for requirements for signage, pipe labeling, and other means as needed to clearly identify the system (including outlets) as unsafe for human consumption.

9-2.2 Continuity of Service.

For hospitals and ambulatory surgery centers, provide a minimum of two water services, fed from either separate mains and sources or separate connections to a multi-sourced network, each designed for full demand (serving potable and process systems). These services must enter the building at separate locations from a piped loop around the facility with isolation valves. The purpose of this provision is to provide an uninterrupted supply of potable water or permit swift service restoration in the event of a water main break. If two separate water sources are not reasonably available, the Design and Construction Agent may seek authorization from the DoD Project Sponsor to utilize onsite storage in lieu of a second water service.

9-2.3 Backflow Prevention.

Backflow prevention must meet the requirements of UFC 3-420-01, the International Plumbing Code and be coordinated with the Design and Construction agent for maintenance accessibility and testing. Configure the backflow preventer(s) for device testing without disruption to the building water service for any MTF with 24/7 operation. Where Continuity of Service requirements allow for a single water service connection, parallel backflow preventers must be provided. Where dual service connections are required, ensure either connection can fully support the facility while the other supply backflow preventer is out of service.

9-2.3.1 Devices and Methods.

All potable water discharge points, such as a faucet discharging into a reservoir sink or tub, must be provided with an adequate air gap in accordance with UFC 3-420-01. Fixtures or equipment where the discharge point is positioned below the reservoir rim must be fitted with a vacuum breaker. Examples of concern include the devices listed here:

a. Bedpan washers, or similar fixtures including a flushometer valve

b. Flexible hoses or shower heads of length sufficient to reach below fixture rim, typically found in procedure rooms, hydrotherapy bath equipment, laboratories, and food service areas, for example, washers, steam tables

c. Laboratory or other serrated-nozzle fixtures designed to accept flexible tubing

d. Water delivery outlets serving therapeutic, surgical, or autopsy or mortuary procedures

e. Hose bibbs and wall hydrants

For the protection of make-up supplies to low-hazard equipment, for example, autoclaves and fire protection sprinkler systems, double-check backflow preventers may suffice. For the protection of sources supplying the building with potable water, and for high hazard equipment and processes, reduced-pressure backflow preventers are required. Designers must include provisions for drainage of the discharge from these devices; refer to Table 9-1 and Table 9-2.

9-2.4 Water Treatment.

A water chemistry analysis **\1** of all potential water sources to the facility (primary and alternate) reporting, at a minimum, the parameters indicated in Table 9-1 must be used as the basis for determining the facility water treatment design scope related to hardness, corrosivity, waterborne pathogen control, specialized treatment for high purity systems, etc. Water testing location must be coordinated with the DoD Project Sponsor and is typically at the point of connection or line of demarcation of real property

ownership. Facility water treatment requirements must be based on the recommendations of a qualified water treatment specialist and coordinated with the Installation, the water supplier, the Water Management Program and all unique water requirements for equipment and systems within the facility. Water treatment requirements must address the use of centralized vs. decentralized treatment based on life cycle cost considerations. These evaluations must include domestic water and all specialty water systems. The water treatment specialist must not be affiliated with any water treatment manufacturer or vendor and be independent from the Contractor for DB projects. **/1/**

Water treatment equipment for any facility operating 24/7 must include sufficient redundancy to enable routine maintenance, backflushing and regeneration without disruption to the facility water supply. Water treatment technologies for the control of waterborne pathogens are discussed in paragraph 9-2.5.

Table 9-1 Water Testing Parameters

Parameter	Units
Water Temperature	^{o}C
Water pH	-
Total Alkalinity	as CaCO3
Total Hardness	as CaCO3
Calcium	mg/l
Magnesium	mg/l
Sodium	mg/l
Chlorides	mg/l
Sulfates	mg/l
Nitrate	mg/l
Iron	mg/l
Manganese	mg/l
Lead	µg/L
Copper	mg/l
Conductivity	µS/cm
Total Dissolved Solids	mg/l
Chlorine Residual	mg/l
Langelier Index	Dimensionless
Calcium carbonate precipitation potential	as CaCO3
Dissolved inorganic carbonate (DIC)	as C
Equilibrium alkalinity	as CaCO3
Rysnar Saturation Index	dimensionless
Larson’s Ratio	Dimensionless
Chloride to Sulfate Mass Ratio	Dimensionless

Table 9-2 Potential Backflow Preventer Discharge Rates

Assembly Pipe Size in NPS inches (DN mm)	Discharge GPM (L/S) at 60 PSI (414 kPa)	Discharge GPM (L/S) at 150 PSI (1034 kPa)
¾–1 ¼ (20-32)	75 (4.7)	140 (8.8)
1 ½–2 (40-50)	170 (10.7)	280 (17.7)
2 ½–3 (65-80)	250 (15.8)	400 (25.2)
4–6 (100-150)	500 (31.5)	850 (53.6)
8–10 (200-250)	525 (33.1)	890 (56.2)

Table 9-3 Floor Drain Flow Rates

Drain Size	Flow Rate*
Inches (DN mm)	GPM (L/S)
4 (100)	88 (5.6)
6 (150)	264 (16.7)
8 (200)	575 (36.3)
10 (250)	1050 (66.2)
12 (300)	1700 (107.3)
* Flow rates for a floor drain with slotted cover and ⅛ in. per ft (10.4 mm per m) drain pipe slope.	

9-2.4.1 Scale Control.

Provide water softening when the water supply to **\1** a facility has a hardness of 170 mg/l of CaCO3 or more (85 mg/l of CaCO3 for a dental facility). Design the softening system to deliver water with hardness between 50-85 mg/l of CaCO3 unless specialized equipment in the facility requires more stringent standards. Potable water must not be less than 50 mg/l as CaCO3 due to the corrosive nature of overly softened water. All water softening systems must include a proportional blending valve and a bypass meter to ensure positive control over the discharge hardness. Include provisions for softener regeneration discharge, which may require a floor sink or receptor. Provide full automation of softener regeneration process and the ability to monitor blended water hardness, softener status and alarm conditions at the building automation system. All softener materials and additives used for potable water must be NSF certified for drinking water use. **/1/**

9-2.4.2 High Purity Water Systems.

Water purification is the process by which contaminants or impurities, which undesirably affect the performance of specific equipment or the outcome of medical and laboratory tests, are removed from the water. Water purification systems include reverse osmosis,

deionization, ultra-filtration, and ultraviolet (UV) sterilization. Type I and Type III reagent grade water, as specified in ASTM D 1193, are used in various applications such as for medicine preparation processes in pharmacies, in distillation units, for designated laboratory outlets, and in selected equipment for renal dialysis, glassware washing, central sterile supply, and other medical and laboratory functions. Their use must be coordinated with DoD Project Sponsor and the Design and Construction Agent. The designer is responsible to determine local and central treatment options and treatment system combinations to best meet DoD Project Sponsor needs and overall LCC **\1** as part of the water treatment analysis in 9-2.4. The water treatment specialist must confirm the required water quality for each end use and validate the system design can deliver the required water quality. **/1/** Refer to Chapter 10 for make-up water treatment design guidance for steam systems. **\1**

9-2.4.2.1 Sterile Processing.

Design water system to deliver water to sterile processing fixtures and equipment to meet water quality requirements of AAMI TIR 34 and equipment manufacture's recommendations. Large sterile processing departments in hospitals, or central instrumentation processing centers (CIPCs), typically involve larger workloads, more equipment, and more water demand. In these instances, centralized high purity water system should be evaluated which may involve pre-treatment (softening and carbon filtration), principle treatment (reverse osmosis, de-ionized water, or combination), distribution (water storage tank, recirculation at 2-3 fps (0.6 to 0.9 m/s), UV disinfection), and other microbial monitoring, testing, and sanitation features. These systems may also serve other high purity water demands in the facility. Small sterile processing, such as dental instrumentation processing centers (DIPC's), have the same water quality requirements, but have lower workloads, less sterile processing equipment, and less water demand. These small spaces are typically served with point-of-use treatment at a better LCC.

9-2.4.2.2 Reagent Water.

Reagent grade water (RGW) is water that is suitable for use in a specified procedure such that it does not interfere with the specificity, accuracy, and precision of the procedure. Process definitions alone (such as "RO", "DI", "Distilled") do not in themselves adequately define required water quality.

Design water system to deliver water quality that meets user and equipment requirements. Reagent water quality must be classified using ASTM Standard D 1193 reagent water type 1, 2, 3, or 4. When bacterial levels need to be controlled, the level of water quality required must additionally be classified as Type A, B, or C. Reagent grade water must be monitored for resistivity, microbial content, and total organic carbon.

9-2.4.2.3 Laboratory Water Systems.

Design water system to deliver water quality that meets user and equipment requirements for the laboratory. This typically includes compliance with the Clinical Laboratory Standards Institute (CLSI) Preparation and Testing of Reagent Water in the Clinical Laboratory for water requirements. Provide monitoring of resistivity, microbial content, and total organic carbon. **/1/**

9-2.5 Waterborne Pathogens Control.

The relative danger that Legionella and other waterborne pathogens, including pseudomonas, pose in any given facility is a function of (a) “system” factors that promote or discourage colonization, (b) the relative vulnerability of the patient population, and (c) climate and groundwater temperature. Procedures that increase aspiration increase the risk of infection from waterborne pathogens, as does the presence of aerosol-generating sources, such as showers and whirlpool baths. In addition to potential contamination danger from hot water systems, cold water systems pose the risk of supporting pathogen colonization if the piping systems are subjected to heat sources. The temperature of cold water systems might inadvertently be elevated into ranges more conducive to pathogen colonization by ground temperatures, piping located in attics, ceiling spaces, equipment rooms, crawlspaces, other unconditioned spaces, or by being located adjacent to hot water or steam piping. All of these risk factors must be considered when designing the domestic water system.

9-2.5.1 Scale, Sediment, and Biofilm.

Scale, sediment, and biofilm are contaminants that support Legionella bacteria (and other waterborne pathogens) colonization. The extent to which these contaminants support colonization is a function of factors including potable water service quality (including the presence of living aquatic amoebae such as are found in biofilms), system operating temperatures, and pipe material. Standard control technologies for scale and sediment deposits normally minimize the contribution of these factors to pathogen colonization. Biofilms are resistant to some treatments.

9-2.5.2 System Design.

Design the building water system to address management of water temperature, minimize water age, reduce stagnation, maintain a sufficient disinfectant residual, and minimize the use of materials that support colonization to maintaining water quality and manage control of waterborne pathogens.

9-2.5.2.1 Water Management Program \1\ (WMP). /1/

For new Hospitals and Ambulatory Surgery Centers comply with ASHRAE 188 to develop a Water Management Program in conjunction with a Water Infection Control Risk Assessment (format per CDC toolkit). The Program and its required analyses must address all potable and non-potable building water systems and incorporate all control measures prescribed in this Chapter plus any control measures that result from

the analyses. Coordinate the ASHRAE 188 Water Management Program and Water Infection Control Risk Assessment with the Facility Water System Management Team (for example Facility Water Safety Committee, Program Team, etc.) or DoD Project Sponsor to obtain facility and location specific information. Reference ASHRAE Guideline 12 for additional information. For additions or alterations to existing Hospitals and Ambulatory Surgery Centers, update and expand the existing Water Management Program to address the new conditions.

The Water Management Program must be developed and submitted during the 35% design for DBB acquisition or RFP development phase for DB acquisition for determination of design features. During final design, update the Water Management Program to comply with the Elements of Performance in the Environment of Care prescribed in The Joint Commission for the Water Management Program and submit for approval. **\1**

9-2.5.2.2 WMP Requirements for Projects with Limited Water System Impact.

/1/ For small projects affecting a Hospital or Ambulatory Surgery Center with limited impact to the water systems, verify compliance with the existing Water Management Program and provide a compliance report.

9-2.5.2.3 Supplemental Disinfection.

For all Hospitals, provide a supplemental disinfection system(s) with residual disinfection properties for waterborne pathogen control of the potable water system. Examples of systems include, but are not limited to, copper-silver ionization, chlorine dioxide, etc. Hot and cold water must be analyzed separately and provided with separate treatment systems if required by the analysis. Hot and cold water supplies must be provided with separate supplemental disinfection systems where water temperature impacts the required concentrations and controls to maintain efficacy. Provide permanent continual monitoring and trending of water temperature, pH, pressure, chlorine residual and any other environmental sampling or monitoring required for the selected treatment system. Trend, display, and alarm all monitoring points on the building automation system.

The selection of a supplemental disinfection system must be based on a comparison of all feasible alternatives for treatment systems which provide a measurable residual disinfection at the distal points. See ASHRAE Guideline 12 for further information. Comparison criteria must include efficacy for waterborne pathogens of local concern, local ordinances which may impose restrictions on implementation or operations, compatibility with the public water primary disinfection methods and byproducts, and life cycle cost. The supplemental disinfection system must be registered by the manufacturer with the EPA as a biocide for drinking water. Comply with applicable federal, state, and local government requirements. Start-up and activation of the treatment system must be integrated into the Commissioning Plan including documenting the baseline (pre-activation) and post-activation water quality; pre and post disinfection agent (for example copper ions, residual chlorine), etc. These tests

must be performed by a laboratory in addition to any field testing required by the manufacturer. A plan for on-going distal flushing and monitoring must be established in accordance with the manufacturer's recommendations and implemented immediately upon system activation (even before building occupancy). The plan must initially be implemented by the construction contractor and then integrated into the facility's ongoing maintenance plans.

Exception: Supplemental disinfection may be omitted where approved by CEHNC-EDX/MFPO with concurrence from the DoD Project Sponsor and the Facility Water System Management Team, as supported by the Water Management Program and its required analyses. The analyses must demonstrate that sufficient control measures are in place to address all potentially hazardous conditions without the need for the supplemental disinfection.

9-2.5.2.4 Connections to Existing Systems.

For addition and alteration projects, designers must take into consideration the likely presence of biofilms, sediments, and scale and how its disruption may impact the new and existing systems. These considerations must be addressed within the Water Management Program.

Flushing, disinfection, and testing plans for the associated existing system must be coordinated with local shutdown policies and procedures and be approved by the Design and Construction Agent and the Facility Water System Management Team. These plans must address all new piping and all existing piping potentially affected by the work. This requirement includes but is not limited to all piping downstream of the tie-in point and any piping that is inactive during construction.

9-2.5.2.5 Piping Materials.

Potable water distribution within the building must be copper or stainless steel. Specify equipment, and fixture components intended for direct water contact to be of materials that inhibit bacteria colonization, such as copper. For inpatient MTFs, avoid materials that support colonization, such as natural rubbers and some plastics, whenever practicable.

9-2.5.2.6 Piping Design/Distribution.

Design hot and cold water distribution mains to maintain balanced flow throughout. Design piping runs as short as practicable. Avoid creating piping "zones," which experience infrequent use and, therefore, stagnation. As practicable, route mains close to fixtures to minimize the lengths of branch piping runs. Avoid stagnant piping sections, for example, dead legs. To avoid water temperature rise, design cold water piping, distribution, and insulation to limit heat transfer from hot water piping or other heat sources. The developed length of hot water piping from the hot water recirculation piping to showers, emergency showers, and emergency eyewashes must not exceed 6

ft (1.8 m). The developed length of hot water piping from the hot water recirculation piping to all other fixtures must not exceed 10 ft (3.0 m).

9-2.5.2.7 Location of Temperature Limiting Devices.

Locate temperature limiting devices as close as practicable to the fixture discharge. Do not exceed a 6 ft (1.8 m) developed length from the temperature limiting device to the fixture discharge.

9-2.5.2.8 Hot Water Generation.

Provide a central system for hot water generation. To avoid stagnant storage conditions, consider semi-instantaneous and instantaneous hot water heaters where feasible and when onsite storage is not required by other criteria.

Exception: electric instantaneous water heaters (for example tankless point-of-use) may be considered where remote sinks or lavatories are more than 150 ft (45.7 m) away from a hot water circulation loop but may only be utilized when approved by the Design and Construction Agent.

9-2.5.2.9 Water Storage Tank Design.

Water storage or holding tanks, both cold and hot, must be designed to have continuous flow. Consider using horizontal tanks with baffles to limit stagnation.

9-2.6 Domestic Hot Water Systems.

9-2.6.1 Hot Water Demand.

The demand load can be calculated using several different methods, examples of which are contained in the ASHRAE Handbook: HVAC Applications and the American Society of Plumbing Engineers (ASPE) Data Book. The preferred method for calculating hot water demand for a facility is the Per Fixture method. This method provides a means to account for various uses within each facility and permits the tabulation of the hot water load using a specified demand for each fixture.

Table 9-4 provides a list of representative fixtures taken from MIL-STD-1691 and their demands based on data provided in ASHRAE Handbook: HVAC Applications and the ASPE Data Book. For any fixture not shown, the designer must determine the demand rate based upon experience, standard practice, and available DoD Project Sponsor input. The Per Fixture method is adequate for typical usage. Expanded usage for food service, non-standard fixtures, or abnormal usage patterns (extreme low- or high-demand peaks or erratic peak duration and occurrence) must be factored into the sizing calculations. For example, food service fixture demand factors need to be adjusted if disposable service ware is used. Concentrated patient treatment for sick call, or other instances of high-peak usage are other examples of fixture hot water demand adjustment.

9-2.6.2 Hot Water Storage Tank Sizing Factors.

The Demand Factor and Storage Capacity Factor are listed in the ASHRAE Handbook: HVAC Applications and the ASPE Data Book for given building types, which includes hospitals but not medical clinics, dental clinics, nor laboratories. A Demand Factor of 0.40 and Storage Capacity Factor of 1.00 must be used for clinics. Factors for facilities with laboratory space greater than 10 percent of the total facility space must be coordinated with the Design and Construction Agent. The Probable Maximum Demand is factored by the Storage Capacity Factor to determine the Storage Tank Capacity. The Storage Tank Capacity is the capacity required to be available for use. Storage tanks are not considered to be 100 percent usable and thus, a Usable Storage Tank Factor must be applied to the Calculated Storage Tank Capacity, unless the water in the entire tank is recirculated. The percent capacity considered usable for most tanks is 70, thereby resulting in a 1.43 Usable Storage Tank Factor. The Usable Storage Tank Factor for systems utilizing instantaneous generators or multiple tank arrangements must be coordinated with the Design and Construction Agent.

Table 9-4 Hot Water Demand per Fixture

FIXTURE	GPH (L/h)	HW SFU
Sink, Clinic	4 (15.1)	3
Sink, Plaster	10 (37.8)	3
Sink, Service (General)	20 (75.7)	3
Lavatory, Public (General)	6 (22.7)	1½
Lavatory, Patient (Private)	2 (7.5)	1
Lavatory, Clinic	8 (30.3)	3
Basin, Mop Service	20 (75.7)	3
Shower, Staff or Patient Group	75 (283.9)	3
Shower, Patient (Private)	30 (113.6)	2
Shower, Hydrotherapeutic	400 (1514)	11
Bathtub	20 (75.7)	3
Bath, Whirlpool, Arm	35 (132.5)	3
Bath, Whirlpool, Arm/Foot/Knee	15 (56.8)	3
Bath, Whirlpool, Leg	100 (377.5)	7
Bath, Body Hydrotherapy (Hubbard)	600 (2271)	17
Bath, Sitz	30 (113.6)	3

General Notes:

1. SFU = supply fixture units.
2. Summing individual fixture demands provides the Possible Maximum Demand. A Demand Factor is applied to the Possible Maximum Demand to calculate the Probable Maximum Demand. The Probable Maximum Demand is the rate at which the heater must generate hot water, or the recovery rate.

9-2.6.3 Domestic Water Heater Redundancy.

Provide facilities with Category 1 or 2 Spaces (per Appendix B) with multiple water heaters and storage tanks. Total installed capacity to meet or exceed design capacity. Individual heaters and storage tanks to be sized such that the loss of any unit would reduce system capacity by no more than 33%.

9-2.6.4 Hot Water Design Temperature.

Generate and store domestic hot water at a minimum 140 ºF (60.0 ºC). Temper water with a master thermostatic mixing valve at the hot water generator to minimum 130 ºF (54.4 ºC) hot water supply. Recirculate water from all points of use complying with the maximum developed length requirements of paragraph 9-2.5.3.3. Limit the recirculation system temperature drop to 6 ºF (3.3 ºC) for a minimum return temperature of 124 degrees F (51.1 degrees C), providing isolating and balancing provisions.

9-2.6.4.1 Thermal Eradication.

Provide system capability to increase the domestic hot water storage and supply temperature to 180 ºF (82.2 ºC) for a thermal eradication process occurring under the direction of the Infection Control Officer with restricted system use and no general demand.

9-2.6.4.2 Patient and Visitor Toilet Facilities.

Provide ASSE 1070 compliant point of use water temperature limiting devices for supplying tempered water to lavatories and sinks intended for use by patients or visitors. Grouped fixtures may be served from a common water temperature limiting device within the limits of the maximum developed length requirements of paragraph 9-2.5.3.4.

9-2.6.4.3 Showers and Baths.

Provide shower and bath-shower combination valves as point of use balanced-pressure, thermostatic or combination balanced-pressure/thermostatic type valves that conform to the requirements of ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1. Valves must be equipped with a field adjustable means to limit the maximum setting of the valve to 120 ºF (49.0 ºC).

9-2.6.4.4 Supply and Utility Areas.

Central sterile supply, soiled utility rooms equipped with bedpan washers, cart wash areas, and special pathological wash areas must be provided with 140 ºF (60.0 ºC) hot water.

9-2.6.4.5 Food Service Areas.

Review and comply with the Dishwashing and Ware Washing requirements in Appendix F and the Tri-Service Food Code (TSFC). Provide these areas with 140 °F (60.0 °C) hot water. Mechanical ware-washing and sanitizing equipment normally require 180 °F (82.2 °C) water. Provide Booster heaters to obtain the temperatures required.

9-2.6.4.6 Renovation, Additions and Alteration Projects.

Where a project includes upgrading an existing domestic hot water system to the current higher supply water temperature requirements, precautions for the prevention of scalding must be included.

9-2.7 Plumbing Fixtures and Other Equipment.

Plumbing fixtures should conform generally to American Society of Mechanical Engineers International (ASME) Standards Series A112 or International Association of Plumbing and Mechanical Officials (IAPMO) Standards Series Z124. For uniformity, all fixtures must be identified by the Joint Schedule Number (JSN) provided in MIL-STD-1691. Quantities of fixtures must be in accordance with the International Building Code and International Plumbing Code but not less than indicated in the approved PFD and PRC.

9-2.7.1 Accessibility Fixtures.

Provide accessible fixtures in accordance with Chapter 13.

9-2.7.2 Drinking Water Coolers.

Locate public drinking water coolers convenient to each public waiting room and elsewhere as required by the IPC and as directed by the DoD Project Sponsor. The standard rating and performance must conform to Air Conditioning and Refrigeration Institute (ARI) Standard 1010.

9-2.7.3 Emergency Shower and Eye Wash Fixtures.

Emergency shower and eye wash fixtures must be designed in accordance with the American National Standards Institute (ANSI) Standard Z358.1.

9-2.7.4 Water Usage Conservation.

Water usage conservation design must comply with UFC 1-200-02.

9-2.7.5 Wall Hydrants.

Provide wall hydrants where required by UFC 3-420-01 and within 20 ft (6 m) of any loading dock, emergency room ambulance drop-off, and ambulance shelter.

9-2.7.6 Urinals.

Urinals must be low flow with a maximum water use of 0.125 GPF (0.5 LPF). Waterless urinals may only be used when approved by the DoD Project Sponsor.

9-2.8 Coordination with Medical and Dental Equipment.

Medical and Dental equipment can have special water quality and pressure requirements. Plumbing designers must carefully analyze the building water supply condition before starting a project design. When a facility building water supply cannot meet equipment manufacturer's requirements, local (or centralized) water treatment systems and/or water pressure boosters must be provided in appropriate mechanical spaces.

9-2.8.1 Dental Water Purification Systems.

Dental water is specially treated water for patient use which undergoes multiple stages of filtration to achieve zero Total Dissolved Solids (TDS), chlorine and chemical free, prevent biofilm and bacterial growth in the water lines etc. The need for on-site production of dental pure water must be coordinated with the DoD Project Sponsor. Dental water purification systems may be direct feed or bottle-fill systems as determined by the DoD Project Sponsor. Installation of the purification system must be in accordance with manufacturer's recommendations and instructions. This includes providing any required pre-filters, booster pumps, water storage tanks, and dental water faucets. The purified water may also be used for sterilizers by direct feed or water faucet. Provide an additional water faucet with direct feed installation systems. Connect the dental water purification system to the building's essential electrical system where provided. Piping material downstream of the dental water purification system may be either type 304 or 316 stainless steel or material recommended by the dental water purification system manufacture. Do not use copper pipe downstream of the purification system.

9-3 DRAINAGE SYSTEMS.

9-3.1 Sanitary Drainage System.

The sanitary waste system must be connected to an approved existing sanitary sewer system, either Government or private as appropriate. If an existing sewage disposal system is not available, an approved alternative system must be provided. For example, a holding tank may be acceptable for remote locations, for temporary service while awaiting the installation or retrofit of an approved sewage disposal system, or a backup such as for hardened or essential facilities. Any alternative to an approved central sanitary system must be coordinated with the Installation's local approving authority. When connected to a local public system, code requirements in excess of the IPC imposed by the local regulatory agencies must be considered in the design. The system must be designed to avoid excessive back pressure and aspiration effects. If a facility sanitary waste requires lifting or pumping, comply with UFC 3-240-01. Connect

this equipment to the emergency power system if one exists or is included in the project scope.

9-3.1.1 Cleanouts.

Provide cleanouts in accordance with the International Plumbing Code to permit access to all sections of the sanitary sewage system. Locate the cleanouts to avoid or minimize disruption of medical functions. Do not locate cleanouts above ceilings; extend cleanouts to the floor above.

9-3.1.2 Protection of Special Fixtures and Equipment.

Fixtures and equipment used for sterilization, and food preparation, processing, or storage, must be protected from contamination by backflow of waste. An indirect waste line, such as an air break or physical disconnection (open drain) at the associated waste outlet, must be incorporated into the system design. These provisions also apply to equipment that cannot be easily cleaned. Included are sterilizers, glass washers, refrigerators, kitchen equipment, dental laboratory equipment, for example, boil-out assembly tanks, and vacuum system separator tanks.

9-3.1.3 Special Drainage Equipment.

Interceptors must be provided when precious materials or heavy metals, such as silver and barium, or sediment is in the waste drainage from spaces such as cast rooms, prosthodontics laboratories, barium procedure areas, and spaces employing blood analyzers. Interceptors for barium waste must be aluminum. Flush rim floor drains must be provided in Autopsy. Food waste disposers must be provided in kitchens on dishwashers, pot and pan sinks, and other sinks as designated. Grease traps must be provided with grease-producing kitchen equipment including prewash sinks, pot washers or sinks, and floor drains serving kettles. Separators must be provided in areas where petroleum products are subject to dripping or spills, such as ambulance garages and mechanical equipment rooms. **\1**

9-3.1.4 Coordination with Medical and Dental Equipment.

Placement of floor drains and floor sinks for specialized equipment must be coordinated to minimize infection control risk. Special consideration must be given to drains in rooms where infection control restrictions are heightened due to potential contamination of equipment, instruments, or supplies (for example central sterilization, dental instrument processing, pharmacy, etc.). For example, floor drains should not be located in Sterile Storage rooms and floor drains for pass-through sterilizers should be located in the loading-side room rather than the unloading side room. **/1/**

9-3.1.5 Special Purpose Waste Lines.

9-3.1.5.1 Acid Waste.

Separate waste lines must be provided for acid waste from laboratories when justified by the quantities, concentration, or both, of reagent expected to be introduced. Acid-resistant waste piping must be utilized for such applications and, must pass through a neutralizing or dilution tank before combining with building waste. If more than test tube quantities of acid or strong base solutions are to be discharged into the waste system, neutralization is required.

9-3.1.5.2 Radioactive Waste.

Separate waste lines must be provided for radioactive waste from laboratories and nuclear medicine treatment rooms. There are various radioactive materials to be found in medical facilities. The particular radioactive waste for a given facility must be identified. The appropriate prescribed manner of disposal in accordance with 10 CFR (Code of Federal Regulations) Part 20—Standards for Protection Against Radiation and local safety standards must be incorporated into the design.

9-3.1.6 General-Purpose Floor Drains.

General-purpose floor drains must be considered for rooms in which water-using plumbing fixtures or equipment are located. These include physical therapy (PT) rooms that are equipped with hydrotherapy equipment, central sterile areas for sterilizers and sanitizing washers, food service areas, wash-down and housekeeping spaces, and mechanical equipment rooms that contain water-using equipment. Floor drains are not required at emergency shower or eyewash locations but may be provided to facilitate mandatory testing. Provide properly sized floor drainage system for restrooms designed for more than single occupancy, where equipment wash-down might occur, and capture unplanned water dump from fixtures/equipment to prevent damage to adjacent spaces, to include floors below, following UFC 3-420-01. Floor drains, where provided, must follow the criteria in UFC 3-420-01.

9-3.1.7 Trap Priming.

Where a trap seal is subject to loss by evaporation, a trap seal primer valve must be installed. When utilized, automatic primers must incorporate a backflow prevention feature. Other means of trap prime maintenance are not permitted.

9-3.1.8 Retrofit or Alteration Considerations.

The replacement of older existing fixtures with lower-flow fixtures may alter system performance. Provide a system that ensures transport of solid wastes utilizing strategies that include flows from other water-consuming appliances, plumbing fixtures, (for example lavatory faucets, flushing urinals, showerheads), increased slope, or change of pipe diameter in accordance with UFC 3-420-01.

9-3.1.9 Elevator Pit Sumps.

Elevator pits must be provided with a sump and sump pump. Pumped designs must include integral oil sensors and must deliver fluids to an indirect connection to the sanitary or storm drainage systems, such as a floor drain. The sump discharge line must include a check valve to prevent backflow of fluid into the sump. If permitted by the local jurisdiction, a direct connection to the storm drainage system may be considered. Designers should also assess whether the DoD Project Sponsor requires an oil interceptor. No other drains or sump discharges must be connected to the elevator pit drain or sump. This equipment must be connected to the alternative power source if one exists or is included in the project scope. Refer to Chapter 16 for additional requirements.

9-3.1.10 Mercury Control.

Facilities containing operations that generate mercury wastes in the free or leachable states (for example dental filling amalgams) must be provided with ISO 11143 certified amalgam separators and comply with any additional Federal, state, or local requirements. See also paragraph 9-5.21.1.

9-3.1.11 Dialysis Waste Box.

Provide dialysis waste box drains with automatic trap primers and/or automatic disinfection systems.

9-3.2 Storm Drainage System.

9-3.2.1 Cleanouts.

Provide storm sewer cleanouts in accordance with the International Plumbing Code to permit access to all sections of the storm sewer system. Locate the cleanouts to avoid or minimize disruption of medical functions. Do not locate cleanouts above ceilings but instead extend the cleanout to the floor above (except for the top floor). Avoid placing cleanouts in high traffic areas.

9-4 FUEL GAS SERVICE.

Applications for fuel gas utilization include a fuel source for space heating, domestic hot water generation, cooking, generation of steam for humidification and sterilization, and as a point-of-use heat or flame source to support medical and laboratory functions. Fuel gas system design, including liquefied petroleum gas systems, must be in accordance with NFPA 54, 58, and 59A, as applicable.

9-5 MEDICAL GAS SYSTEMS.

Medical gas systems for all applications covered by this UFC must comply with NFPA 99 as limited by this UFC and United Facilities Guide Specifications (UFGS) 22 60 70 Gas and Vacuum Systems for Healthcare Facilities. Unless otherwise noted, the term

"medical gas systems" in this UFC refers to all medical gas, dental gas, and vacuum systems. Refer to Table 9-5 for general medical gas systems information.

Table 9-5 Medical Gas Systems[a]

Reference NFPA 99

System	Appendix B Notation	System Pressure
Compressed Air		
Medical Compressed Air	MA	50-55 psig (345–380 kPa)
Dental Compressed Air	DA	90-95 psig (620–655 kPa)
Laboratory Air – Dental	LA	30-35 psig (210–245 kPa)
Laboratory Air – Medical	LA	50-55 psig (345–380 kPa)
Instrument Compressed Air	IA	50-185 psig (345–1275 kPa)
Process Air	PA	120-125 psig (830–865 kPa)
Vacuum		
Medical Surgical Vacuum	MV	15-19 in-HgV (51–65 kPaV)
Dental Surgical Vacuum	DSV	15-19 in-HgV (51–65 kPaV)
Oral Evacuation	OE	6-8 in-HgV (21–27 kPaV)
High Volume Lab Dust Evacuation	LDE	50 in-HgV (10 kPaV)
Waste Anesthesia Gas Disposal	WAGD	6 in-HgV (21 kPaV)[b c]
Gases		
Oxygen	O	50-55 psig (345–380 kPa)
Carbon Dioxide	CO2	50-55 psig (345–380 kPa)
Nitrous Oxide	NO	50-55 psig (345–380 kPa)
Nitrogen	N	50-185 psig (345–1275 kPa)

a. Other gas systems included in this chapter but not in Appendix B: Gas (natural or propane) – flame or heat source.

b. This is a minimum value; vacuum controlled by healthcare provider administering the anesthesia gas.

c. For veterinary care, design pressure must be coordinated with the anesthetizing equipment.

9-5.1 Application of NFPA 99 to Dental Systems.

Dental gas and vacuum systems must comply with NFPA 99 and this UFC. Allowances/exceptions in NFPA 99-2018 Chapter 15 which reduce/relax NFPA 99 Chapter 5 system requirements are NOT permissible; as such do not incorporate any of the exempted features into designs for dental systems. All requirements for piping, piping installation, warning systems, testing and verification must follow NFPA 99 Chapter 5 for the system category determined in NFPA 99 Chapter 15. For example, if a Dental Air system is determined by NFPA 99 Chapter 15 to be Category 2, the system must meet all Category 2 requirements in NFPA 99 Chapter 5 as well as the prescriptive requirements in this UFC.

9-5.2 Application of NFPA 99 to Veterinary Care.

Medical gas systems for veterinary care must comply with NFPA 99 even though NFPA 99 indicates an exclusion for veterinary care. The required Risk Assessment process must be carefully implemented with the unique considerations of the veterinary patients and caregivers to arrive at appropriate System Categories.

9-5.3 Systems for Medical Clinics and Ambulatory Care Clinics.

Centrally-piped medical gas/air/vacuum systems are not normally required or authorized for outpatient medical treatment clinics, with the exception of ambulatory care clinics. If attached to a facility having central systems, designers must consider extending service lines to the clinic if LCC effective.

9-5.4 Systems for Dental Clinics.

Centrally-piped systems must normally be provided for dental compressed air (DA), OE, dental surgical vacuum (DSV), high volume laboratory dust evacuation (LDE), and dental laboratory air (LA). A separate system for WAGD must be required unless the DoD Project Sponsor designates the DSV system for that purpose. Fuel gas (natural or propane) must be provided as required to support prosthodontic and orthodontic laboratories and DTRs. For freestanding clinics with fewer than five chairs, selection of a central system for gases as opposed to point-of-use systems must be based upon LCC considerations.

9-5.5 Corrugated Medical Tubing.

Corrugated Medical Tubing (CMT) may only be utilized if approved by the Design and Construction Agent. CMT may be advantageous for emergency repairs or temporary facilities however it is limited in size, has a higher pressure drop than standard medical gas copper tubing and must not be utilized for wet vacuum systems.

9-5.6 Medical Gas Equipment Rooms.

Install medical gas system equipment such as air compressors and vacuum pumps in a mechanical equipment space complying with NFPA 99. The medical gas system

equipment space must be ventilated and conditioned in accordance with manufacturer's recommendation or mechanical room criteria (Appendix B Room Code MECH1), whichever more stringent.

9-5.7 Underground Piping.

Underground medical gas piping must be protected in a continuous concrete trench or steel pipe enclosure and comply with NFPA 55 section 7.1.17 Underground Piping and NFPA 99 section 5.1.10.11.5 Underground Piping Outside of Buildings. Consider provisions for future replacement of piping. Piping must not be installed under a building.

9-5.8 System Control Valves.

All medical gas centrally-piped systems must be provided with shut-off valves and zone valve box assemblies in accordance with NFPA 99. Additional shut-off valves must be included as designated by the Design and Construction Agent to provide system section isolation for maintenance or alterations.

9-5.9 Alarm Systems.

Medical gas alarm systems must be provided for all centrally-piped systems in accordance with NFPA 99 except that the use of a centralized computer system (for example Building Automation System) in lieu of a Master Alarm Panel is not permitted. A Building Automation System may be utilized for monitoring only of a medical gas system.

9-5.10 Gas System Sources (Storage).

Gas system sources or storage provisions must be designed in accordance with NFPA 99. Flammable and nonflammable storage containers must be stored in separate enclosures. Bulk oxygen storage design must be in accordance with NFPA 55.

9-5.10.1 Point-of-Use Sources.

Point-of-use cylinders are defined as B, D, or E sizes. The designer must coordinate with the DoD Project Sponsor the provisions for point-of-use cylinder storage when use is planned. Storage in the storage room for central system cylinder banks is permissible. The point-of-use cylinder volume must be included in the total when determining the storage room ventilation requirements. Design must incorporate Compressed Gas Association (CGA) requirements of Pamphlet P-2.

9-5.10.2 Alternative Compressed Air Sources.

Alternative compressed air sources, such as pneumatic control air or shop air compressors, must not be used as a source for medical compressed air (MA), DA, LA, instrument air (IA), or process air (PA).

9-5.10.3 Oxygen Concentrators.

Oxygen Concentrators may only be considered for utilization in unique circumstances where a reliable source for oxygen delivery is not available such as in forward deployed isolated locations. A written request documenting the requirement for this type of system must be provided and coordinated with the DoD Project Sponsor and the Design Construction Agent. When authorized these systems must comply with NFPA 99.

9-5.11 Color Coding and Labeling.

Labeling and color identification of piping must be in accordance with NFPA 99 and the CGA Pamphlet C-9. System components must also be labeled for identification to prevent tampering and inadvertent closing. In particular, shut-off valves and pressure gauges must be labeled in accordance with NFPA 99.

9-5.12 Medical Gas Systems Outlets.

Appendix B contains guidance for allocation and location of medical services and outlets in the various spaces within a facility. Refer to the MHS Space Templates for typical locations of medical equipment that may require medical gas. The designer must coordinate the gas types and outlet quantities with the DoD Project Sponsor. Additional outlets and gas types may be provided when justified by the DoD Project Sponsor. All outlets must comply with the latest edition of NFPA 99 and the requirements of CGA Pamphlet V-5. There are Diameter Index Safety System (DISS) and quick connect-type outlets, with three primary configurations of the quick connect outlet (geometric configuration, pin index, latching type). Therefore, the designer must also coordinate the outlet type configuration with the DoD Project Sponsor so users must not have to use outlet adapters for existing medical equipment.

The use of a central medical gas system to serve an outlet that indirectly supports the medical function, such as in a laboratory, may be justified. If so, the branch piping and outlets must be in accordance with NFPA 99. Non-medical uses are not permissible except for unique circumstances with documented waiver requests, coordinated with the DoD Project Sponsor and Design and Construction Agent, reviewed individually.

9-5.13 Power Source for Medical Gas Systems.

Medical gas system equipment must be served by an EES where determined through an NFPA 99 Risk Assessment or where otherwise required within NFPA 99 or this UFC.

9-5.14 Medical Compressed Air (MA).

The MA system must be an independent centrally-piped system consisting of two or more medical air compressors and a central receiver, all conforming to the requirements of NFPA 99. It must be used only for medical functions requiring breathable air to support respiration or for air-driven instruments that discharge into the pharynx. The MA system must not be used to satisfy any other compressed air requirements. The

system design must include automatic operation of the compressors, including alternating lead and lag status.

9-5.14.1 Air Quality Standards.

Medical air compressors must be specifically designed and manufactured for Medical Air purposes, meeting NFPA 99 and these requirements. Intake air must be direct from outdoors or from an HVAC supply air system operational 24/7 and in compliance with NFPA 99 paragraph 5.1.3.6.3.11(E) with the following clarification: HVAC supply air systems with motors or drivebelts in the air stream may be utilized as an air source provided that an intermediate filter of MERV 13 (or better) is located downstream of the fan(s) and cooling coils.

Filtration of intake air must include redundant activated carbon filters with redundant pre-filters and final filters (located downstream of the carbon filters). System pressure regulators and filters must be duplexed with the ability to isolate any device.

9-5.14.2 General Requirements.

MA must be provided by two or more compressors with provisions for automatic, alternating, and simultaneous operation. The compressors must be sized such that if any one compressor fails, the remaining compressor(s) must provide 100 percent of maximum system demand. Provide an alarm to indicate compressor failure that annunciates at the master medical gas alarm panel. All system components downstream of the compressors must be sized for 100 percent standard system demand and be duplexed. The receiver must be sized per manufacturer recommendation and must have an automatic drain feature.

9-5.14.3 Air Drying.

System must include an air dryer of the desiccant type capable of drying the air to a dew point of -40 ^{o}F (-40 ^{o}C). Designers must consider: **\1**

a. **/1/** Desiccant dryers are capable of drying the air to a dew point as low as -40 ^{o}F (-40 ^{o}C), which may be considered too low for some medical applications. When required by the DoD Project Sponsor, the design must include specification of equipment accessories that permit upward adjustment of air moisture to the required dew point. **\1**

b. **/1/** To improve the efficiency of a desiccant dryer system, a refrigerated dryer may be used to precondition the intake air to the desiccant dryer. When mechanical refrigeration systems are specified, designers must include specification of a cycling feature for all systems under 5 hp (3.7 kW) to minimize the possibility of icing and moisture carryover. Designers must evaluate whether anticipated flow conditions require the cycling feature for systems 5 hp (3.7 kW) and over.

9-5.14.4 MA Demand.

System demand must be calculated utilizing the peak flow and simultaneous use data in Table 9-6 as a minimum. The simultaneous use factors must be used with judgment and modified to adapt to special conditions if required.

Table 9-6 Medical Compressed Air (MA) System Demand

	General Demand[1]			Ventilator Demand[2]			
	SCFM (SLPM)	Units	Usage Factor	SCFM (SLPM)	Units	Qty	Usage Factor
Ventilator Locations:							
Recovery Phase 1 (RRSS1)	2.0 (57)	Bed	25%	2.6 (75)	Bed	1	100%
Patient Bedrooms, ICU[3]	2.0 (57)	Bed	50%	2.6 (75)	Bed	1	100%
Biomedical Equipment Repair (BMER1)	1.5 (42)	Outlet	10%	2.6 (75)	Room	1	100%
Anesthesia Ventilator Locations:							
Operating Room[4]	0.5 (14)	Room	100%	0.9 (25)	Room	1	100%
Veterinary Surgery (VS001)	0.5 (14)	Room	50%	0.9 (25)	Room	1	100%
Veterinary, Surgery, Preparation / Dental (VSPD1)	0.5 (14)	Bed	50%	0.9 (25)	Room	1	100%
Trauma – (TRET1 & TRET3)	0.5 (14)	Room	25%	0.9 (25)	Room	1	100%
Radiology (XABP1 & XCCE1)	0.5 (14)	Room	10%	0.9 (25)	Room	1	100%
Medical Air for Peripheral Device Locations:							
Exam/Treatment[5]	1.1 (30)	Room	10%				
LDR/LDRP (LDRP1, LDRP3) includes infant armoire	1.0 (28)	Room	50%				
Observation (OOTR1)	1.1 (30)	Bed	10%				
Anesthesia Workroom (ANCW1)	1.1 (30)	Room	10%				
Respiratory Equipment, Clean (OPRC1)	1.5 (42)	Station	10%	2.6 (75)	Room	1	100%
All Other Room Codes[6]	0.5 (42)	Outlet	10%				

[1] Demand for devices not including ventilators.
[2] Ventilator demands (locations and flow rates) must be validated for each project but will not be less than provided for in this table.
[3] ICU Bedroom category includes Room Codes BRIC1, BRII1, BRII2, BRIT2, BRUN1, NYIC2, NYEC1, NYIR1, NYUN1, NYUN2.
[4] Operating Room category includes Room Codes ORCS1, ORCT1, ORGS1, ORHY1, ORNS1, OROS1, LDDR1.
[5] Emergency Room category includes Room Codes EXEB1, EXEN2, EXER1, EXER2, TRET4, TRET5.
[6] All room codes in Appendix B that have one or more medical air outlet requirements.

9-5.15 Dental Compressed Air (DA).

A centrally-piped DA system with two or more compressors and other components described herein must be provided in accordance with NFPA 99. DA must be used for drying applications during dental procedures and as a power or drive source for lifts, locks, and pneumatic dental instruments and equipment. DA, unlike MA, is not used for breathing or respiratory support of any kind and must not be used to satisfy MA requirements. Air that is normally used for dental laboratory restorative and fabrication techniques may be provided by the DA system.

9-5.15.1 Air Quality Standard.

Dental Air compressors must be designed and manufactured IAW NFPA 99, UFGS 22 60 70 and these requirements. Intake air must be direct from outdoors or from an HVAC supply air system operational 24/7 and in compliance with NFPA 99 paragraph 5.1.3.6.3.11(E) with the following clarification: HVAC supply air systems with motors or drivebelts in the air stream may be utilized as an air source provided that an intermediate filter of MERV 13 or better is located downstream of the fan(s) and cooling coils.

Filtration of intake air must include redundant activated carbon filters with redundant pre-filters and final filters (located downstream of the carbon filters). System pressure regulators and filters must be duplexed with the ability to isolate any device.

9-5.15.2 DA Components.

DA must be provided by two or more equally sized compressors, with provisions for automatic, alternating, and simultaneous operation. Each compressor must be sized such that if any one compressor fails, the remaining compressor(s) must provide 65 percent of standard demand. Provide an alarm to indicate compressor failure that annunciates to the master medical gas alarm panel. All system components downstream of compressors must be sized for maximum combined compressor output. In-line pressure regulators must be provided when DA and dental LA systems are served by a common compressor. Each laboratory supply main must have a pressure regulator. Dryer type must be desiccant.

9-5.15.3 DA System Demand.

The system must be sized using these criteria:

Select a DTR Usage Factor:

Number of DTR Chairs	DTR Usage Factor (DUF)
1–3	1.0
4–6	0.9
7–12	0.8
13–19	0.7
20 and up	0.6

Equation 9-1. DTR Demand = No. of DTR chairs X 3 SCFM (85 SLPM) X DUF

Select a lab usage factor:

Number of Technicians	Lab Usage Factor (LUF)
1–5	0.6
6–10	0.5
11–19	0.4
20 and up	0.3

Equation 9-2. Lab Demand = No. of Technicians X 1 SCFM (28 SLPM) X LUF
+ No. of sand/shell blasters X 4 SCFM (113 SLPM) X LUF
+ No. of air chisels X 3 SCFM (85 SLPM) X LUF
+ No. of denture presses X 1 SCFM (28 SLPM) X LUF
+ No. of micro-blasters X 6 SCFM (170 SLPM) X LUF
+ No. of high speed hand pieces X 3 SCFM (85 SLPM) X LUF

Equation 9-3. Sterilization demand = No. of hand piece purge stations X 1 SCFM (28 SLPM)

Equation 9-4. Standard demand = DTR demand + Lab demand + Sterilization demand

Select the optimum compressor grouping:

Table 9-7 Compressor Grouping

Type	System Usage Factor (SUF)
Duplex	0.65
Triplex	0.33
Quadplex	0.25

Equation 9-5. Compressor size = SUF X Standard demand

The receiver must be sized based on Table 9-7

Table 9-8 Receiver Size

Number of DTR Chairs	Gallons (Liters) per DTR Chair
1–6	10 (37.8)
7–9	9 (34.0)
10–12	8 (30.3)
13–15	7 (26.5)
16–18	6 (22.7)
19–21	5 (19.9)
>21	4 (15.1)

9-5.16 Laboratory Air (LA).

The medical or dental LA system must be a centrally-piped system consisting of two or more compressors and a central receiver, all conforming to the requirements of NFPA 99.

9-5.16.1 Air Quality Standard.

Laboratory Air compressors must be designed and manufactured IAW NFPA 99, UFGS 22 60 70 and these requirements. Intake air must be direct from outdoors or from an HVAC supply air system operational 24/7 and in compliance with NFPA 99 paragraph 5.1.3.6.3.11(E) with the following clarification: HVAC supply air systems with motors or drivebelts in the air stream may be utilized as an air source provided that an intermediate filter of MERV 13 or better is located after the fan(s) and cooling coils.

Filtration of intake air must include redundant activated carbon filters with redundant pre-filters and final filters (located downstream of the carbon filters). System pressure regulators and filters must be duplexed with the ability to isolate any device.

9-5.16.2 LA System Components.

LA must be provided by two equally sized compressors with provisions for automatic, alternate, and simultaneous operation. Each compressor must be sized to provide 65 percent of maximum demand. Provide an alarm to indicate compressor failure that annunciates to the master medical gas alarm panel. All system components downstream of compressors must be sized for maximum combined compressor output. A DA generator package used to service an LA system must be supplied by a dedicated main located just downstream of the final package component and inside the equipment room.

9-5.16.3 LA System Demand.

Determine the LA system flow demand by the number of work stations and their function plus the requirements for laboratory equipment. The DoD Project Sponsor must provide this information. The designer in conjunction with the Design and Construction Agent must establish the flow rates. Medical LA system flow rate demand must be 1 SCFM (28 SLPM) per outlet. Dental LA system flow rate demand is determined by the sizing procedure shown in paragraph 9-5.15.3. The simultaneous use factors must be as listed in Table 9-9.

Table 9-9 Medical Laboratory Air (LA) System Demand

No. of Outlets	Use Factor	Minimum SCFM (SLPM)
1–2	100	
3–12	80	3 (1.4)
13–38	60	10 (4.7)
39–115	40	25 (11.8)
116–316	30	50 (23.6)
317–700	20	95 (44.8)

9-5.17 Instrument Air (IA).

An IA system is **\1** a Medical Support Gas intended to power medical and dental devices not related to human respiration, for example, surgical hand tools, surgical arms, surgical columns, and SPD support. This system may be utilized in lieu of a piped nitrogen (N) system. The DoD Project Sponsor in conjunction with the Design and Construction Agent must identify IA requirements. IA must not be used to satisfy medical air requirements. IA systems must be designed in accordance with the requirements of NFPA 99. System pressure must be determined within the range identified in Table 9-5 and coordinated with all intended uses.

Each individual use location, for example, individual OR, DTRs, must be provided with a local pressure control panel for the purpose of independently regulating pressure at that location. Provide additional pressure control panels where needed to meet the intended use. Where all end uses are determined to be uniform in pressure, pressure control panels may be eliminated with the concurrence of the DoD Project Sponsor and Design and Construction Agent. **/1/**

9-5.17.1 Air Quality Standard.

Air compressors used for IA must conform to the requirements of NFPA 99, UFGS 22 60 70 and these requirements. IA quality must be as defined in NFPA 99. System must include an air dryer of the desiccant type capable of drying the air to a dew point of -40

°F (-40 °C). Intake air must be direct from outdoors or from an HVAC supply air system operational 24/7 and in compliance with NFPA 99 paragraph 5.1.3.6.3.11(E) with the following clarification: HVAC supply air systems with motors or drivebelts in the air stream may be utilized as an air source provided that an intermediate filter of MERV 13 or better is located after the fan(s) and cooling coils.

Filtration of intake air must include redundant activated carbon filters with redundant pre-filters and final filters (located downstream of the carbon filters). System pressure regulators and filters must be duplexed with the ability to isolate any device.

9-5.17.2 IA System Components.

The number of compressors for an IA system must be a function of the application; however, at least two compressors must be provided. For stand-alone clinics, one compressor with a standby header may be provided. Coordinate the compressor arrangement with the Design and Construction Agent. The compressors must be sized such that if any one compressor fails, the remaining compressor(s) must provide 100 percent of maximum system demand. Provide an alarm to indicate compressor failure that annunciates at the master medical gas alarm panel. All system components downstream of the compressors must be sized for 100 percent standard system demand and be duplexed. The receiver must have an automatic drain feature and must be sized per manufacturer recommendation.

9-5.17.3 IA System Demand.

The number of workstations and their functions plus the requirement of any equipment must determine the IA system flow demand. The piping system must be suitable to deliver 15 SCFM (425 SLPM) per outlet, with a demand usage factor of 100 percent. System capacity must be determined using these equations:

Capacity (SLPM) = 340 + ([n-1] X 85) or

Capacity (SCFM) = 12 + ([n-1] X 3)

Where: n = number of locations or tools

9-5.18 Process Air (PA).

PA may be a centrally-piped system when warranted by the application, for example, medical service column adjustment, shop operations, door operators. The DoD Project Sponsor, in conjunction with the Design and Construction Agent, must identify PA requirements. When approved by the Design and Construction Agent, LA or IA may be used to satisfy PA requirements. PA is not required to be oil free, but must be suitable for the application as recommended by the equipment manufacturer.

9-5.19 Medical Surgical Vacuum (MV) System.

The MV system must be a centrally-piped, dry vacuum system containing two or more continuous duty pumps with a central receiver. The system must meet the requirements of NFPA 99 and must be sized so that if one pump fails, the remaining pump(s) can supply 100 percent of the total system demand. The system design must include automatic operation of the vacuum pumps including alternating lead and lag status. Provide an alarm to indicate vacuum pump failure that annunciates to the master medical gas alarm panel. Refer to Table 9-10.

Table 9-10 Medical Vacuum Source Sizing

Occupancy/Location	Diversity Factor	High Demand
Anesthetizing Locations:		
Special Surgery and Cardiovascular	A	Y
Major Surgery and Orthopedic	A	Y
Minor Surgery/Cystology	A	Y
Endoscopy	A	N
Trauma	A	Y
Veterinary Surgery	A	Y
Radiology	B	N
Cardiac Catheterization	A	Y
Ambulatory Care Locations:		
Recovery Room (PACU)	A	N
ICU/CCU	A	N
Emergency Room (ER)/Triage	A	Y
Neonatal ICU	A	N
Dialysis Unit	A	N
Postpartum Recovery	A	N
Infant Resuscitation (within Nursery)	A	N
Pediatrics ICU	A	N
Subacute Care Locations:		
Nursery	A	N
Patient Rooms	B	N
Decontamination Station	B	N
Exam/Treatment	B	N
Pre-Op Holding	B	N

Occupancy/Location	Diversity Factor	High Demand
Respiratory Care/Therapy	B	N
Pulmonary Function Lab	B	N
EENT, EEG, ECG, EMG	B	N
LDR & LDRP	A	N
Animal Research	B	N
Blood Donors	B	N
Cast Room	B	N
Airborne Infection Isolation Rooms and Protective Environment Rooms	B	N
Observation (within ER)	B	N
Pediatric/Adolescent Bedroom	B	N
Other:		
Anesthesia Workroom	B	N
Respiratory Care Workroom	B	N
Nursery Workroom	B	N
Equipment Repair	B	N
Med. Laboratory	B	N

9-5.19.1 Applications.

The MV must be used only for medical functions involving patient care, therapy, and diagnostic functions as described here. It may also serve DSV requirements for DTRs and oral surgeries, and small laboratories in patient care areas that function in direct support of medical functions. Analysis, research, or teaching laboratories located within a facility may also be served by the MV, provided that a separate system connection or main is located at the vacuum receiver, with a shut-off valve and trap with a drain valve. Laboratories not supporting medical functions must have a vacuum system separate from the MV.

9-5.19.2 Demand.

Size vacuum system pumps and piping in accordance with these equations:

$$\text{Demand Medical Vacuum} = \text{Demand}_A + \text{Demand}_B + \text{Demand}_C$$

Where: Demand_A = # Inlets for Diversity Factor A X 0.25 SCFM/inlet (7 SLPM/inlet) X Diversity Factor A

$Demand_B$ = # Inlets for Diversity Factor B X 0.25 SCFM/inlet (7 SLPM/inlet) X Diversity Factor B

$Demand_C$ = # Rooms with High Demand X 1.5 SCFM/room (42 SLPM/room)

It is important to note that $Demand_A$ and $Demand_B$ have a diversity factor determined by Figure 9-1, whereas $Demand_C$ assumes no diversity .

For example, the demand for a medical vacuum system for five **\1** Operating Rooms with 12 each medical vacuum inlets would be calculated as follows: ***/1/***

Demand Medical Vacuum = $Demand_A$ + $Demand_B$ + $Demand_C$

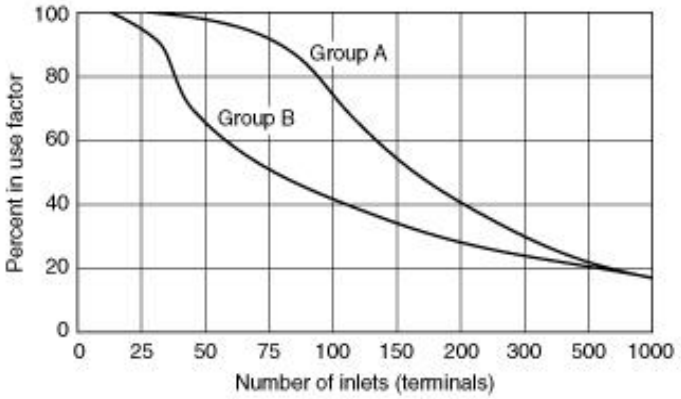
Where: $Demand_A$ = 12 medical vacuum inlets per OR per Appendix B X 5 ORs X 0.25 SCFM/inlet X 0.97 Diversity Factor for 60 inlets with “A” Diversity Factor = 14.55 SCFM

$Demand_B$ = 0

$Demand_C$ = 5 Rooms with High Demand X 1.5 SCFM/inlet
= 7.5 SCFM

Medical Vacuum Demand = 14.55 + 0 + 7.5 = 22 SCFM

Figure 9-1 Simultaneous Use Factors for Medical Vacuum



Note 1: If the medical-surgical vacuum system is to be used for the disposal of waste anesthetic gases, caution must be taken to ensure that the system is designed for the additional volume required. It is recommended that 4-3.3.1, Waste Anesthetic Gas Disposal, be consulted as well. It is essential that the design team consult with medical and hospital staff when determining the minimum number of station inlets.

Note 2: It should be understood that the percentage in use factors obtained from this figure represent an average hospital. Hospitals with heavier-than-average use can require higher use factors.

1. This graph is adapted from 1999 version of NFPA 99.
2. It is understood that percentage in use factors represent a typical hospital and may need to be increased, but must not be decreased without approval from the Design and Construction Agent.

9-5.19.3 Inlets.

The intended use of “Y-connectors” as a means of increasing available inlets is not recommended. A justified need for a vacuum inlet must be accommodated with another wall inlet, not a Y-connector. Verify with the DoD Project Sponsor that the number of vacuum inlets proposed must support the planned medical function operation without the use of Y-connectors.

9-5.19.4 Performance.

Design system pressure drop must be a maximum of 3 in-Hg (10 kPA) at the calculated demand flow rate. Performance is verified IAW NFPA 99 as follows: Flow each inlet (one at a time) at a flow rate of 3 SCFM (85 SLPM)) while maintaining 12 in-HgV (41 kPaV) at any adjacent station inlet.

9-5.19.5 Slide Brackets.

Vacuum bottle slide brackets must be provided for all medical vacuum inlets. Vacuum bottles must be used at all vacuum inlets to prevent liquids and solids from entering the piping network. Vacuum bottles must be provided with an overflow shut-off device to prevent carryover of fluids or solids into the piping system. Brackets must be positioned to provide proper clearance for flow meters and adapters and to eliminate conflict with electrical receptacles. Thus, it is recommended that the vacuum outlet be located at either end of a group of medical gas outlets, with the slide bracket to the outside, for example, in a healthcare station head wall unit. If two vacuum inlets are required at a given station, locate one at each end of the outlet group with the slide brackets to the outside. It is critical to coordinate vacuum inlet and slide locations with the designer and the DoD Project Sponsor to avoid interference with other items without compromising the medical function.

9-5.19.6 Exhaust.

Exhaust the medical vacuum system in accordance with NFPA 99 but do not combine with any other system exhaust.

9-5.19.7 Filtration.

Provide inlet filtration on central supply systems per NFPA 99. Filters must be sized for 100 percent of peak calculated demand while one filter or filter bundle is isolated. Ensure adequate space is provided at filters to allow clearance for maintenance personnel to access filter housings to replace filter elements.

9-5.20 Dental Surgical Vacuum (DSV).

A central DSV system may be supplied for areas in dental clinics where MV is required as specified in Appendix B. This system is also a dry system with a centrally-piped distribution system and receiver; no liquids or solids must be transported in the distribution system. Individual separators must be located in each applicable DTR. The

system must consist of two or more vacuum pumps and a central receiver. The system must be sized so that upon failure of one pump, the remaining pump(s) must maintain the minimum vacuum specified while providing 100 percent of the calculated demand. The system design must include automatic operation of the vacuum pumps including alternating lead and lag status. Provide an alarm to indicate vacuum pump failure that annunciates to the master medical gas alarm panel. For dental clinics located in a hospital, the MV system may be used in lieu of a DSV system.

9-5.20.1 Performance.

A minimum vacuum of 19 in-Hg (65 kPa) must be maintained at the receiver. System pressure drop must be such that the most remote inlet must have a minimum vacuum of 12 in-Hg (41 kPa) under peak demand conditions. System pressure drop must be a maximum of 3 in-Hg (10 kPa) at the calculated demand flow rate.

9-5.20.2 Demand.

Calculate system demand based on 2 SCFM (57 SLPM) for each DTR DSV inlet with the demand factors in Table 9-11:

Table 9-11 DSV Demand Factors

No. of DTR DSV Inlets	Use Factor
1–6	1.0
7–10	0.8
>10	0.6

9-5.20.3 Exhaust.

Exhaust the Dental Surgical Vacuum system in accordance with NFPA 99 but do not combine with any other system exhaust.

9-5.21 Oral Evacuation (OE).

A central low vacuum, high volume OE system must be installed in dental clinics to provide scavenging, collection, and disposal of liquids, solids, and aerosols from dental procedures. This is a wet system with liquids and solids transported through wetted piping from the collection point to one or more liquid or air separator tanks located upstream of two or more vacuum pumps. The tank serves as a collector for the fluids and solids and provides a means of automatic draining by indirect connection to the sanitary sewer. The tank draining system must include an automatic wash down feature for larger systems in a facility having greater than 10 DTR chairs. The vacuum pumps must be sized so that when one pump is inoperable, the remaining pump(s) must provide the required vacuum pressure and fluid flow for a minimum of 70 percent of the system demand. The system design must include automatic operation of the

vacuum pumps including alternating lead and lag status. Provide an alarm to indicate vacuum system fault, for example, pump failure, which annunciates to the master medical gas alarm panel. Protocol must include alarm initiation when a pump is not appropriately operating.

9-5.21.1 Components.

The service inlet normally is floor mounted in a utility center at the dental chair, or wall mounted with a means of connection to clinical end items, such as the high volume hose. The separator(s) must receive all liquid, air, and solids upstream of vacuum pump(s). Liquids and solids must be discharged from the separator(s), with piped gravity flow through an air gap into a trapped and vented receptor, for example, floor drains, sinks, standpipe receptors for small system suspended tank installations, connected to the sanitary waste system. Amalgam separators must be provided IAW paragraph 9-3.1.10 Mercury Control and must be configured centrally for a single point of collection at the vacuum producers. Additional point-of-use collection may be utilized where requested by the DoD Project Sponsor. The liquid/solid separator tank must discharge a minimum of once during a 24-hour interval for a one-tank system, when a high liquid level sensor activates for a two-tank system, or multiple daily discharges as recommended by the manufacturer. Separator overflow protection must be included to protect during periods of abnormal usage or when the automatic discharge malfunctions.

9-5.21.2 Performance.

The system operating range must be 6–8 in-HgV (20–27 kPaV). A minimum vacuum of 6 in-HgV (20 kPaV) must be maintained at the farthest inlet. System pressure drop must be a maximum of 1 in-Hg (3 kPa) at the calculated demand flow rate. A flow rate of 7 SCFM (200 SLPM) per inlet must be measured while maintaining 6 in-Hg (20 kPa) at the farthest inlet.

9-5.21.3 Demand.

Calculate the system demand based on 7 SCFM (200 SLPM) per inlet-nozzle orifice. The demand usage factor is normally 100 percent. Verify the specific usage factor with the Design and Construction Agent.

9-5.21.4 Separator Tank.

The separator and collector tanks must be sized per manufacturer recommendations but must be a minimum of 2.75 gallons (10.45 liters) per DTR chair. Multiple tanks must be provided for more than 20 chairs and must be considered for 20 or fewer chairs if continuous operation is necessary. Tank drainage piping must slope from the tank discharge point down to the discharge point at the floor drain or standpipe receptor.

9-5.21.5 Equipment Location.

The OE equipment must be located below the DTR floor level. Locate the separator tank adjacent to or stacked with the vacuum pump. Size the pipe to maintain system pressure loss within the maximum limit. The tank drain valve discharge must be a minimum 0.5 foot (150 mm) above the floor to accommodate the pipe slope, drain line turndown, and the indirect connection air gap to the sanitary drainage system receptor. The sanitary waste centerline of pipe must be a minimum 1 foot (300 mm) below the floor to accommodate the floor drain trap. The equipment room must be located as near the DTRs as possible to minimize distribution piping bends and pipe length. Equipment placement in the mechanical room must be arranged to provide the most direct connection to the distribution piping, the sanitary waste line, and the exhaust discharge point, in that order.

9-5.21.6 Piping Distribution.

Piping from each dental treatment chair must continuously slope back to the first separator at the vacuum source equipment to facilitate transportation of fluids and particulate. Minimum required slope is 1/4 in. per 10 ft (20 mm per 10 m). Distribution system piping must be a minimum 2 in. (DN50) in diameter. Where maintenance access is required, piping must be installed in accessible locations in covered trenches, tunnels, or crawl spaces. Provide cleanout fittings at every change of direction greater than 45 degrees and at every change in slope. Minimum clearances and access to cleanouts must comply with the cleanout requirements for sanitary piping in the International Plumbing Code, Section 708 Cleanouts.

In existing buildings, when piping must be routed above the dental treatment chairs or limited rise is necessary, observe the following requirements:

a. Minimize lift height.

b. Vertical pipe run from inlet to overhead pipe must be ½ in. (DN15) or in accordance with manufacturer's recommendation.

c. The vertical pipe must "tee" into the top of the overhead branch main.

d. The available vacuum level to satisfy performance requirements stated in paragraph 9-5.22.2 must be based on a reduction of the pump-generated vacuum at the rate of 1 in-Hg (3.4 kPa) for each 1.1 ft (335 mm) rise.

e. Provide cleanout fittings at the base of all risers.

9-5.21.7 Exhaust.

The exhaust pipe material and size, including the connection to the equipment discharge point, must be in accordance with manufacturer's recommendation. The number of bends and total length must be minimized. The exhaust piping must be a dedicated run from the equipment connection to the discharge point outside the facility, sloping back to the equipment and must not be connected to any other system exhaust. The exhaust discharge must be protected from backflow of air or liquids by detailing an

appropriate discharge arrangement, such as a gooseneck or shroud with screen with a check valve, or using a flapper valve approved by the manufacturer. The discharge point must be separated a minimum of 33 ft (10 m) from the DA or MA system intake and any HVAC system outdoor air intake.

9-5.22 High-Volume Laboratory Dust Evacuation (LDE).

The LDE system must scavenge and centrally separate, filter, and collect material trimmings, grinding debris (toxic and nontoxic), and particulates from polishing and finishing operations in the dental laboratory. Point-of-use dust collection may be provided for some operations per DoD Project Sponsor requirements.

9-5.22.1 System Components.

The LDE system for dental laboratories must consist primarily of one belt-driven vacuum pump complete with a preset, field-adjustable ingestion valve, exhaust silencer, and a central cyclonic separator with a filter bag system.

9-5.22.2 Performance.

The vacuum at the farthest inlet must be a minimum of 1.25 in-Hg (4.2 kPa). A flow rate of 60 SCFM (1700 SLPM) per technician work station inlet and 150 SCFM (4250 SLPM) per equipment item inlet must be measured while maintaining the 3 in-Hg (10 kPa) at the separator. Verify the equipment requirements with the DoD Project Sponsor.

9-5.22.3 Demand.

The system demand must be calculated based on the inlet flow rate requirement. Apply the usage factor values shown in Table 9-12 for the given number of inlets.

Table 9-12 LDE System Utilization Factors

Lab Size	Usage Factor	Separator Filter
# of inlets	percent	square feet (square meters)
1–4	100	60 (5.6)
5–10	80	120 (11.1)
11–15	70	160 (14.8)
16–24	60	220 (20.4)

9-5.23 Waste Anesthesia Gas Disposal (WAGD).

The WAGD system must be a centrally-piped, dry vacuum system containing two or more continuous duty pumps with a central receiver. It must meet the requirements of NFPA 99 and be sized so that if one pump fails, the remaining pump(s) can supply 100 percent of the total system demand. The system design must include automatic operation of the vacuum pumps including alternating lead and lag status. Provide an

alarm to indicate vacuum pump failure that annunciates to the master medical gas alarm panel.

For Veterinary Facilities, the design vacuum pressure must be carefully evaluated and established in coordination with the intended anesthetizing equipment and include provisions for pressure/flow rate adjustment and visual monitoring at each inlet.

9-5.23.1 Applications.

WAGD must be incorporated into the facility design. A dedicated WAGD system must be provided in accordance with NFPA 99. When permitted by NFPA 99, the DSV system may be used for WAGD in dental clinics. Inlets must be provided in anesthesia locations. Verify that the system vacuum pump is suitable for the high oxygen and nitrous oxide exhaust content associated with anesthetizing procedures.

9-5.23.2 Demand and Performance.

Base design on a demand of 1.8 SCFM (50 SLPM) per patient care station except for veterinary care which must be based on a demand of 0.18 SCFM (5 SLPM) per patient care station.

9-5.23.3 Exhaust.

Exhaust the WAGD system in accordance with NFPA 99 but do not combine with any other system exhaust.

9-5.24 Oxygen (O).

Oxygen (O) is used in the gaseous state to sustain life through direct delivery to the patient. Oxygen can be stored as a gas in cylinders or as a liquid in bulk tanks. The Federal Register (49 CFR 172) classifies oxygen primarily as a non-flammable gas with a secondary classification as an oxidizer; it can increase the range of flammability of other materials and gases when present in sufficient concentration. Its storage requires proper construction and ventilation in accordance with NFPA 99 and NFPA 55 for both a pressurized non-flammable gas and as a pressurized oxidizer gas. The oxygen system must not be used to supply non-patient uses with limited exceptions defined in NFPA 99 paragraph 5.1.3.5.2 Permitted Locations for Medical Gases. Separate point-of-use services must be used for such non-patient applications.

9-5.24.1 Provision of Central Systems.

When more than five outlets are provided and used on a routine basis, central oxygen storage and distribution systems must be provided, such as is typically the case with medical centers, hospitals, and large clinics. Point-of-use (“roll-in”) cylinders should be utilized for clinical applications involving few oxygen outlets and infrequent utilization.

9-5.24.2 Emergency Connections.

Provide an emergency oxygen supply connection (EOSC) on the building exterior as required by NFPA 99 except that an in-building oxygen reserve is not to be considered as a substitute for an EOSC. Provide an Auxiliary Source Connection as required by NFPA 99 except that it must be provided for all types of central supply systems, not just for cryogenic fluid supply systems. These connections may be used as a temporary auxiliary source of supply.

9-5.24.3 System Demand.

The piping system must be designed to deliver 0.7 SCFM (20 SLPM) at the outlet, utilizing a 100 percent usage factor for outlets in Category 1 Spaces and factors for outlets in other areas as defined in Table 9-13. Historical usage data from replaced or similar facilities may be used as a guideline when determining system demand instead of the method presented in 9-5.24.4. Reference paragraph 9-5.24.5 for additional design considerations for determining the required capacity of liquid bulk tanks.

Table 9-13 Oxygen System Utilization Factors

Number of Outlets	Percent Usage (%)
1–3	100
4–12	75
13–20	50
21–40	31
41–80	25
81 or more	15

9-5.24.4 Storage Capacity Sizing Method.

In the absence of available historical oxygen consumption data, Table 9-14 must be used in estimating required system storage capacity for inpatient MTFs. For facilities with predominantly outpatient functions, designers must work with the DoD Project Sponsor to estimate consumption rates and appropriate storage capacities.

Table 9-14 Cylinder Manifold Systems

Number of Beds	Minimum Number of Cylinders[1] [2]
1–50	8
51–75	12
76–100	16
101–125	20
126–150	24
1 Per bank of “H” cylinders	
2 Study must be performed that includes an analysis of an appropriate diversity factor and the cost-effective option between cylinder and bulk storage.	

9-5.24.5 Liquid Bulk-Tank Storage.

Designers must coordinate with the DoD Project Sponsor to consider the economic aspects of storage capacity. Excessive capacity translates to higher utilization costs due to boil off. Tank must be sized to account for boil off. Too little capacity may lead to higher costs because of more frequent tank refills, which includes vented oxygen cost as well as delivery fees. Designers must also consider the availability of an oxygen refill service. For remote locations, oversized capacity may be more practical and economical to minimize deliveries and provide for unexpected consumption increases. The selection between purchasing or leasing the bulk storage tank and ancillary equipment must be coordinated. Economic and logistic factors relative to the given supplier(s) must be considered. Consider provisions for future replacement of piping. The standard tank sizes are shown in Table 9-15.

Table 9-15 Oxygen Bulk Tank Sizes

Liters	Gallons
1,895	500
5,680	1,500
11,355	3,000
22,710	6,000
34,065	9,000
41,635	11,000
49,205	13,000
68,130	18,000
75,700	20,000

9-5.24.6 System Monitoring.

The central oxygen system design must facilitate oxygen system purity monitoring with an outlet placed in the biomedical maintenance area, or other area, as directed by the Design and Construction Agent. This outlet must be upstream (on the source side) of other oxygen outlets.

9-5.25 Nitrous Oxide (NO).

Nitrous oxide is an anesthetic gas capable of inducing the first and second stages of anesthesia when inhaled. It is classified as a nonflammable gas; however, it can increase the range of flammability of other materials and gases when present in sufficient concentration. Its storage requires proper construction and ventilation in accordance with NFPA 99. Nitrous oxide manifolds must not be located outside in cold climates due to the low vapor pressure of nitrous oxide at low temperatures.

9-5.25.1 System Demand.

The piping system must be designed to provide for a demand of 0.7 SCFM (20 SLPM) per patient care station. The system manifold must be sized to provide a minimum of 1/2 cylinder per week per patient care station (based on H-size cylinders). The minimum number of cylinders per header must be two.

9-5.26 Nitrogen (N).

Nitrogen is **\1** a Medical Support Gas primarily used as an operating or driving means for surgical hand tools and equipment. This system may be utilized in lieu of the IA system. The number of outlets must be the same as depicted for IA in Appendix B. The cylinder manifold system must be designed and installed in accordance with NFPA 99. System pressure must be determined within the range identified in Table 9-5 and coordinated with all intended uses.

9-5.26.1 Pressure Control Panel.

Each individual use location, for example, individual OR, DTRs, must be provided with a local pressure control panel for the purpose of independently regulating pressure at that location. Provide additional pressure control panels where needed to meet the intended use. Where all end uses are determined to be uniform in pressure, pressure control panels may be eliminated with the concurrence of the DoD Project Sponsor and Design and Construction Agent. **/1/**

9-5.26.2 Demand.

The piping system must be suitable to deliver 15 SCFM (425 SLPM) per outlet, with a demand usage factor of 100 percent. The system manifold must be sized to provide a minimum of 2 cylinders per week per orthopedic or neurosurgery OR and 1 cylinder per week per all other anesthetizing locations (based on H-size cylinders). The minimum number of cylinders per header must be two.

9-5.27 Carbon Dioxide (CO2).

Carbon dioxide is used during laparoscopic procedures to facilitate the insertion of surgical instruments into the body. It is pumped into the body to create space between the muscles and the organs, providing the surgeon a clear view of the area to be operated. Carbon dioxide is above its triple point under ordinary conditions of storage and is actually a liquid in the cylinders (but not a cryogenic liquid). It is classified as a nonflammable gas and its storage requires proper construction and ventilation in accordance with NFPA 99. The cylinder manifold system must be designed and installed in accordance with NFPA 99. Carbon dioxide manifolds must not be located outside in cold climates due to the low vapor pressure of CO2 at low pressure.

Design the piping system to provide a minimum demand of 2.0 SCFM (57 SLPM) per outlet with a 100 percent usage factor. In determining the storage capacity, designers must evaluate the CO2 demand of the equipment intended for each facility and in

consultation with the DoD Project Sponsor. At a minimum, the system manifold must be sized to provide a 1/2 cylinder per medical location (based on H-size cylinders). The minimum number of cylinders per header must always be two.

9-5.28 Process Gas.

Process gas is natural or propane that is used as a point-of-use heat or flame source. The process is typically found in laboratories and sometimes in other areas, such as equipment repair and DTRs, to support medical or dental functions. The gas system design must be in accordance with NFPA 54 and 58. **\1**

9-5.28.1 Process Gas Load and Outlet Demand.

/1/ The load is the sum of the consumption rates for the given apparatus or equipment to be serviced. Laboratory burners are typically sized at 5000 Btuh (1465 W) for small burners and 10,500 Btuh (3075 W) for large burners. For other equipment, such as casting ovens, use manufacturer's data.

Demand is based upon the number of outlets shown in Table 9-16.

Table 9-16 Process Gas Utilization Factors

Number of Outlets	Percent Usage (%)
1–8	100
9–16	90
17–29	80
30–79	60
80–162	50
163–325	40
326–742	35
743–1570	30
1571–2900	25
>2900	20

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CHAPTER 10 HEATING, VENTILATION, AND AIR CONDITIONING

10-1 GENERAL.

This chapter provides HVAC design requirements for applicable facilities. The primary requirement of the HVAC system(s) is the support of medical function and the assurance of occupant health, comfort, and safety. The HVAC system functions not only to maintain minimum requirements of comfort and ventilation, but is an essential tool for the control of infection, removal of noxious odors, dilution and expelling of contaminants, and establishment of special environmental conditions conducive to medical procedures and patient healing. Subject to these requirements, appropriate consideration must be given to the HVAC design to ensure system maintainability, economics and energy efficiency, and adaptability to future facility modification or expansion.

10-1.1 Applicability.

This criterion applies to new and existing facilities. Applicability to existing facilities is restricted to upgrade or replacement projects, and for those specific systems or services included in the scope of the project authorization. For existing facilities, when complete compliance with the technical criteria of this chapter is not economically practicable, consideration must be given to substitution of other recognized industry standards or criteria upon application to the DoD Project Sponsor as provided under Chapter 3. All facilities must comply with the applicable standards of the NFPA.

10-1.2 Supporting Documents.

This guidance may be supplemented by Design and Construction Agent, and DoD Project Sponsor publications, including project specific Medical Design Instructions, UFCs, Technical Manuals, ETLs, and other criteria. Minimum HVAC design criteria must be in accordance with the latest editions of the ASHRAE Handbook series, the American Conference of Governmental Industrial Hygienists (ACGIH) publication Manual of Recommended Practices for Industrial Ventilation, and NFPA Standards 45, 90A, 96, 99, 101, and 801, as well as applicable governmental regulations. Other industry and Government standards must be utilized for HVAC design as applicable.

10-2 DESIGN CONDITIONS.

10-2.1 Weather Data.

Weather data must be obtained from UFC 3-400-02. **\1** Obtain the outdoor humidification design conditions not included in UFC 3-400-02 from the ASHRAE Handbook of Fundamentals. If given Military Installations are not listed in the data above, or **/1/** have access to more recent or accurate information of weather conditions in their region, designers must coordinate use of this information with the Design and Construction Agent.

10-2.2 Interior Design Conditions.

Interior design conditions must be in accordance with Appendix B or as otherwise addressed in this chapter.

10-2.3 Space Ventilation.

Minimum total and outdoor air change rates must be in accordance with Appendix B. Supply higher air change rates as required to meet air conditioning or make-up air requirements as supported by engineering calculations. See 10-16, Ventilation Design, for additional guidance and requirements.

10-2.4 Ambient Outdoor Design Conditions.

10-2.4.1 Facilities Housing Critical Care and Other Inpatient Services.

a. Design the HVAC cooling based on the largest of the three following Total Cooling conditions: the 0.4 percent dry bulb temperature, and corresponding mean coincident wet bulb temperatures; the 0.4 percent wet bulb temperature and corresponding mean coincident dry bulb temperature; and the 0.4 percent humidity ratio and corresponding mean coincident dry bulb temperature.

b. Design the heating based on the 99.6 percent dry bulb temperature.

c. Design the cooling tower evaporation rate based on the 0.4 percent wet bulb temperature.

d. Design humidifiers based on the 99.6 percent humidity ratio and corresponding mean coincident dry bulb temperature.

10-2.4.2 Outpatient Facilities Not Housing Critical Care.

a. Design the HVAC cooling based on the largest of the three following Total Cooling conditions: the 1.0 percent dry bulb temperature and corresponding mean coincident wet bulb MCWB temperature; the 1.0 percent wet bulb temperature and corresponding mean coincident dry bulb temperature; and the 1.0 percent humidity ratio and corresponding mean coincident dry bulb temperature.

b. Design the heating based on the 99 percent dry bulb temperature.

c. Design the cooling tower evaporation rate based on the 1.0 percent wet bulb temperature.

d. Design humidifiers based on the 99 percent humidity ratio and corresponding mean coincident dry bulb temperature.

10-2.5 Critical Care Spaces.

Critical Care Spaces are identified in Appendix B.

10-2.6 Laboratories.

Space design and ventilation requirements for clinical laboratories are indicated in Appendix B. Research laboratories, to include animal holding facilities in research laboratory facilities, must be designed in accordance with the ASHRAE Handbook of Fundamentals, the Biosafety in Microbiological and Biomedical Laboratories, and Guide for Care and Use of Laboratory Animals.

10-2.7 Temperature during Smoke Control Operation.

When a supply air system is required to operate on 100 percent outdoor air during smoke mode operation, the system must be designed with sufficient heating capacity to maintain a minimum **\1** AHU discharge temperature of 45 ºF (7.5 ºC) **/1/** under the 99.6 percent winter design conditions.

10-2.8 Mechanical Equipment Rooms.

Mechanical equipment rooms must be conditioned as needed to meet the manufacturers recommended conditions for any sensitive electronic equipment, such as variable frequency drives, microprocessor-based controls or circuit breakers, or other electronic components unless those devices are installed in conditioned cabinets. Designer must confirm the requirements of such equipment and consider not only the manufacturers allowable conditions but also the potential degradation of performance within the allowable conditions in determining the room design temperature (for example elevated temperatures reduce the life expectancy of backup batteries). Mechanical equipment rooms without temperature sensitive equipment or where that equipment is otherwise installed in a conditioned cabinet must be designed to maintain temperatures within 10 degrees F of summer ambient design temperature. In humid climates, mechanical rooms that are contiguous with the occupied building must be conditioned to a humidity level equivalent to the occupied areas to minimize transfer of moist, unconditioned air to the interior of the building.

10-2.9 Humid Climate Definition.

A humid climate is a region that meets or exceeds both of the cooling load criteria indicated herein. The charts and tables referenced can be found in the region-specific climate data reports entitled Engineering Weather Data (EWD) available from the **\1** 14th Weather Squadron (14WS) **/1/** as referenced in UFC 3-400-02. Humid climates are defined as regions where the latent load is three times the sensible load AND where the monthly latent load exceeds the monthly sensible load for two or more consecutive months of the year. (Reference data field “Ventilation Cooling Load Index” and graph “Average Ventilation and Infiltration Loads”, as referenced in UFC 3-400-02.)

10-2.10 NFPA 99 Risk Assessment.

A Risk Assessment must be performed in accordance with NFPA 99 to establish the System Categories for all HVAC systems. See Appendix C for the timing and responsibilities of the Risk Assessment.

10-3 REFRIGERANTS.

Refrigeration equipment must utilize refrigerant having an Ozone Depletion Potential (ODP) of not greater than 0.0 (refer to the U.S. Environmental Protection Agency [EPA] Significant New Alternatives Program [SNAP] for acceptable refrigerants). Refrigeration room design must include the safety features, such as sensing devices and purge ventilation system, as required for the particular refrigerant in accordance with ASHRAE Standards 15 and 34.

10-4 LIFE-CYCLE COST AND ENERGY ANALYSIS.

Life-cycle cost and energy analysis required in conformance with this chapter, or necessary for the evaluation of building sustainability features or performance, must be in accordance with criteria referenced in Chapter 1 and Chapter 4.

10-5 ELIGIBILITY FOR AIR CONDITIONING.

10-5.1 Total Air Conditioning.

Air conditioning is required in all normally occupied facilities and spaces to meet the interior conditions listed in Appendix B. “Normally occupied spaces” include such spaces incidental to the facility as corridors and circulation areas. Normally unoccupied, or intermittently occupied, spaces, such as restrooms, locker rooms, soiled linen rooms, janitor closets, indoor stairwells, and similar spaces accessible to medical staff or the public and having exterior exposure, must be air conditioned (in addition to being provided with the required ventilation) to maintain reasonable conditions.

10-5.2 Food Service Area.

Design air conditioning of the kitchen areas to minimize energy costs including compliance with ASHRAE 90.1, while providing a reasonably comfortable environment for kitchen staff.

10-5.3 Medical Warehouses.

Base HVAC design upon the environmental requirements of the stored materials. Provide air conditioning for spaces within medical warehouses that are normally occupied, including Administrative or Break Rooms, as required to meet the design conditions listed in Appendix B. Provide air conditioning for any warehouse spaces housing computer or other environmentally-sensitive equipment.

10-6 MECHANICAL EQUIPMENT SPACE.

10-6.1 Mechanical Room.

Locate mechanical rooms for major mechanical equipment such as central station air-handling units, heat exchangers, central pumps, medical gas supplies, vacuum pumps, and air compressors within the facilities with direct access to the outside of the building.

Exceptions to locate AHUs in conditioned penthouse equipment rooms may be considered by the Design and Construction Agent if justified from a cost or functionality standpoint, provided that stairwell access, at a minimum, is provided. For multi-story facilities, direct access to rooftop AHU penthouses must be provided from an elevator. Rooftop mounted air handlers must not be used in any new facility in excess of 15,000 ft^2 (1400 m^2) gross **\1** area, **/1/** except for temporary or deployable facilities, due to the difficulty of maintenance access, and consideration of safety and working conditions for O&M personnel. Mechanical room location and layout must consider:

a. Sufficiency of space to enable access for operation, maintenance, and replacement of equipment.

b. Minimization of distribution runs.

c. Relative location to electrical equipment rooms: Consider NFPA 70 vertical clearance and dedicated space requirements for electrical equipment which may restrict or preclude the routing of piping and ductwork through these locations.

d. Do not locate adjacent to Communication Rooms: adjacency of mechanical rooms and Communications Rooms create congested above-ceiling conditions where cable trays and ductwork converge.

e. Adjacency to corridors, as a path for the routing of ductwork.

f. Adjacency to spaces having stringent noise control requirements, or spaces with high ceilings that may restrict duct distribution space.

g. Potential future expansion of mechanical system capacity.

Equipment rooms must be designed to provide a minimum of 24 in. (610 mm) clearance on all sides of AHUs. Sufficient access must be provided for removal and replacement of filters, coils, fans, motors, pumps, and other associated equipment, with piping, ductwork, and conduit installed such as not to block the access-way. Unions, flanged fittings, or other readily demountable connections must be provided at equipment piping connections to facilitate removal.

10-6.2 Energy Plant.

Chilled water, steam and hot water generators may be located in a separate energy plant. Install utility lines connecting the energy plant to the facility within a tunnel or other accessible enclosure providing maintenance access and protection from the elements. Provide access such that any valves, fittings, or equipment requiring periodic maintenance or inspection are accessible to workers without using lifting equipment. Accessibility to all other equipment within the enclosure may be accomplished with removable panels or coverings readily accessible to mobile cranes or rigging equipment. Where authorized by the Design and Construction Agent and DoD Project Sponsor, pre-fabricated direct-buried utility lines with closed-cell foam insulation, integral leak detection, and exterior sheathing may be utilized for water services only (for example chilled and heating hot water) provided that all valves or maintenance items are installed in man-holes.

10-7 HVAC SYSTEM DESIGN FOR FUNCTIONAL AREAS.

The primary considerations of the HVAC design are to provide the environmental conditions required to meet the functional requirements. Medical facilities must be primarily served by central-station AHUs using single duct terminal reheat, and variable air volume (VAV), or constant air volume (CAV) terminals, as appropriate for room conditioning and pressure control. Where electric resistance heating is utilized in accordance with UFC 3-410-01, provide with modulating capacity control (for example SCR technology). When utilized, VAV systems must be of the pressure independent, minimum air quantity type. Direct Expansion (DX) coils must not be used in VAV systems. Induction-type terminal units (for example chilled beams) may be utilized but only to meet sensible loads (non-condensing) and the air changes induced by these devices may not be counted toward the total air change requirement in Appendix B (see total air change definition in paragraph 10-16.1). With the exception of sensitive equipment spaces; mechanical, electrical, and plumbing (MEP) rooms, all-water (for example fan coil units), unitary, and fan-powered VAV systems are not acceptable, due to concerns with maintenance, noise, and limited ability to meet filtration and ventilation requirements.

10-7.1 Critical Care Spaces.

These spaces must normally be served by single-duct terminal reheat systems. Simultaneous temperature, humidity, and pressurization control requirements for these spaces preclude the use of other types of systems. Air handling systems serving Critical Care Spaces must be of the draw-through arrangement, in order to utilize the supply fan heat to avoid a saturated supply airstream.

10-7.1.1 Operating Room Air Systems.

The room air supply system for Operating Rooms (C-Section, Cystoscopic, Cardiothoracic, Integrated, Hybrid, Neurology, Orthopedic, and General) must be a ceiling supply type, located over the operating table or treatment area, using non-aspirating “low velocity” 25–35 cfm/ft^2 (124–178 L/s/m^2) diffusers that isolate the air over the operating or treatment area. Extend the area of the primary supply diffuser array a minimum of 12 in. (305 mm) beyond the footprint of the surgical table on each side. Use no more than 30 percent of the primary supply diffuser array area for non-diffuser uses such as lights, gas columns, etc. Room exhaust and return provisions must consist of a minimum of two exhaust or return registers, located at diagonally opposing corners of the room, mounted with bottoms of registers approximately 8 in. (200 mm) above finished floor. In addition to the required low return or exhaust registers, return or exhaust may be accommodated using registers placed high on the walls.

10-7.1.2 Continuity of Service.

The design for the HVAC systems serving Critical Care Spaces must include:

a. The AHUs serving OR suites must be separate, independent units serving only the respective Surgical or Obstetrical Department or portions thereof, to enhance the reliability of these systems and minimize demand on the EES. However, if justified from a cost or functional standpoint, and where authorized by the Design and Construction Agent and the DoD Project Sponsor, the AHU(s) serving each suite may also provide service to other Patient Care or support areas outside the respective Surgical or Obstetrical Department. A maximum of four ORs should be served by any single AHU. Where a Surgical or Obstetrical Department has four or fewer ORs, these should be served by at least two separate air handling systems, to enhance reliability.

b. HVAC equipment, including controls, that serve Critical Care Spaces (including ventilation and pressure controls for isolation/protective environment bedrooms) must be connected to the EES. This must include a sufficient number of chillers and boilers, with necessary supporting equipment, to meet critical design loads. Boilers must have dual-fuel burners that are not solely dependent on one source of fuel for ignition **\1** to support utility service interruptions. If two separate fuel sources are not reasonably available, the Design and Construction Agent may seek authorization from the DoD Project Sponsor to utilize one fuel source with onsite backup in lieu of a second fuel source. ***/1/***

c. Designs must include features to minimize HVAC service interruptions to Critical Care Spaces, without the provision of redundant AHUs or distribution systems. Provisions must be such that service interruption to any Critical Care Space, as a result of failure of an AHU component or its supporting electrical or controls systems, must be minimized. Such features may include the provision of multiple, isolatable, heating and cooling coils; spare stock of replacement motors, drive belts, and bearings in the immediate vicinity of the equipment room; multi-fan units; or other measures providing for continuity or expeditious restoration of service.

d. AHUs, with associated controls, that serve Critical Care Spaces and patient bedrooms must be connected to the EES.

10-7.2 Sensitive Equipment Areas.

These are spaces or areas in which equipment or processes require special environmental control, including continuous (24 hours per day, year-round) air conditioning and individual room temperature or humidity control. Examples include Telecommunications Rooms and closets, data storage equipment spaces, Data Centers, spaces housing computer equipment supporting imaging and special treatment systems. For those spaces which are critical to continued facility operations, backup or redundant features must be provided to ensure continuity of air conditioning in the event of primary air conditioning equipment failure or when the primary system includes night-setback or economizer features. This may also include the requirement for connection of air conditioning equipment to the EES. Where feasible, the main building systems

must be utilized for primary cooling/outdoor air and a redundant system utilized for back-up cooling.

10-7.3 Patient Bedrooms.

Normal-care patient bedrooms may be served by dual duct, VAV, or single duct reheat systems. All systems utilized must maintain minimum ventilation quantities under all conditions of operation. Perimeter heating systems may be considered in conjunction with these air systems.

Isolation bedrooms must be served by airflow systems that maintain a constant differential between supply and exhaust airflow rates to maintain the required relative pressurization of the space to the adjacent spaces and corridor. Refer to more detailed design guidance and requirements for isolation bedrooms under paragraph 10-17. Pressurization control equipment serving protective environment and airborne infection isolation bedrooms must be connected to the electrical EES.

10-7.4 Temporary and Deployable Facilities.

When considerations of logistics, equipment availability, limited O&M capability, or expediency dictate, deployable facilities may be served by unitary equipment meeting—to the extent practicable—the ventilation, filtration, and environmental conditions established in Appendix B. Temporary facilities may utilize unitary, all-water, or fan-powered VAV systems when authorized by the Design and Construction Agent and DoD Project Sponsor.

10-7.5 Rooms with Critical Pressurization Requirements.

All spaces in Appendix B with air balance requirements of “++” or “- -” (to include associated anterooms and toilet rooms) must be designed and constructed with the volume differentials and room construction integrity to maintain a differential pressure of 0.02 in. w.g. (5 Pa) between the subjected room and adjacent space, which must be demonstrated during commissioning. The volume differentials noted in Appendix B are a baseline and may need to be adjusted in order to achieve the required pressure differential. Designer must evaluate the room size, fixed openings (for example door undercuts) and anticipated construction integrity in establishing the design volume differentials. The Designer must also consider the need to increase the room differential pressure to provide sufficient margin above the alarm value of 0.01 in. w.g. (2.5 Pa) to minimize false alarms and ensure the integrity of the reading.

In order to prove the integrity of the air barrier, a leak-test of the room must be performed. Tests must be conducted with the room under positive pressurization, regardless of whether the end-state requirement is negative or positive. Provide temporary positive pressure high enough to ensure a valid test, approximately 0.05 in. w.g. (13 Pa). With the room under pressure, the test must consist of moving a smoke pencil at a rate of not more than 1 in/s (25 mm/s) along all construction seams and interfaces, to include floor and structural ceiling partition interfaces, outlet boxes, and all

partition penetrations by piping, conduit, cable, or other equipment. The visible passage of smoke at any point must be considered a failure, requiring resealing prior to repetition of the test. This test must be witnessed by the Government and commissioning team.

Rooms must be provided with a pressure indicating instrument or gauge, located on the outside wall near the door, that must visibly indicate that not less than a 0.01 in. w.g. (2.5 Pa) differential pressure (negative or positive according to room type) is maintained under static (door closed) conditions, and that must alarm if the pressure is not maintained for a period exceeding 30 seconds. In addition, the pressure differential and alarms must be monitored by the building control system. If the alarm can be disabled or silenced locally, the building control system must monitor whether the alarm has been disabled or silenced.

10-8 GENERAL DESIGN CONSIDERATIONS.

10-8.1 Plant Sizing and Optimization.

For all facilities justifying a degree of redundancy in the capacity of primary energy plants, the precise number, capacity, and configuration of primary heat exchangers and pumps must be determined in accordance with the requirements noted here.

10-8.1.1 Facilities with Critical Environments.

These facilities include all MTFs with inpatient functions, ambulatory surgery centers, and for selected research and laboratory facilities in which loss in ability to condition the facility would result in loss of critical research or animals at prohibitive cost to the Government. The plant must be sized and configured such that:

a. For inpatient MTFs, with one major heat exchanger or pump out of service, the remaining plant equipment is sufficient to serve all critical loads, including patient bedrooms and labor rooms, plus one-half of all remaining loads within the facility.

b. For ambulatory surgery centers, with one major heat exchanger or pump out of service, the remaining plant equipment is sufficient to serve all critical loads to include surgery, surgical delivery, surgical prep, surgical recovery, decontamination, and sterile preparation and storage, plus one-half of clinical area loads.

c. For research and laboratory facilities, with one major heat exchanger or pump out of service, remaining capacity must be sufficient to serve the critical environmental loads, plus all support spaces, such as computer records, critical to the continued operation of the facility.

d. For all facilities with critical environmental requirements, with one major heat exchanger or pump out of service for an extended period (one day or more) of maintenance, during the “off” season for such service, the remaining plant equipment must be sufficient to meet the entire facility’s maximum load.

e. For all such facilities, plant optimization must in addition be based on LCCA of the most life-cycle economical number, capacity, and configuration of prime heat exchangers and pumps.

10-8.1.2 Energy Plants for Other Facilities.

When energy plants consisting of multiple primary heat exchangers are justified, on a project by project basis, for large outpatient clinics or ambulatory care clinics without operating rooms, the plant must be designed on the basis of LCCA of the most life-cycle economical number, capacity, and configuration of prime heat exchangers and pumps.

10-8.2 Contaminant Removal.

HVAC systems must be designed to remove or reduce to acceptable levels volatile chemical and airborne microbiological contaminants within the facility. Systems must be designed to remove excessive moisture in facility spaces and to control moisture and dust accumulation in AHUs, distribution elements, and chases, to avoid conditions permitting the growth of pathogenic, allergenic, or otherwise objectionable microorganisms.

10-8.3 Interdepartmental Air System Restriction.

In general, individual facility departments should be served by dedicated air handling systems in order to increase system flexibility, energy conservation, facilitate comfort control, and reduce demands upon the EES. When laboratories, pharmacies, Emergency Department, or other facility departments are required to operate during normally-unoccupied areas of the balance of the facility, these must be served by dedicated air handling and distribution systems.

10-8.4 Air Filtration.

Individual space air filtration must be provided as indicated in Appendix B. MERV 8 “roughing” filters must be provided upstream of all coils, velocity sensing devices, or other devices requiring protection from dust accumulation. “Roll filters,” cleanable media, or other filtration systems requiring more intensive maintenance are not acceptable. Designers must carefully consider the location of filters relative to humidifiers to minimize the possibility of wetting the filter media. High capacity cartridge-type filters, in lieu of bag type filters, must be provided for units serving Critical Care Spaces due to the propensity for the latter to release particles during air handler startup and shutdown.

10-8.5 Balancing Ports and Features.

Necessary controls, instrumentation, and balancing ports and devices must be provided to establish and maintain the required space temperature, relative humidity (RH), and air changes rate, and to facilitate balancing procedures for all systems.

10-8.6 Additions and Alterations to Existing Facilities.

10-8.6.1 Site Investigation.

Designers must conduct thorough investigations of existing facilities to be upgraded or modified, to become knowledgeable with facility conditions as established by the terms of their design contracts. This includes the need to inspect concealed spaces, for example, above-ceiling plenums, equipment rooms, and chases, to permit evaluation and accurate depiction of as-built conditions that can affect new work. Design and Construction Agents must ensure that this requirement is met; it is advantageous that the expected scope of the site investigation be discussed in detail with the designer during project pre-negotiation and "kickoff" meetings. Generally, designers should be required to directly inspect all equipment rooms and all above-ceiling areas in such a number of locations as to reasonably establish the existing conditions. In facilities with "hard" ceilings, this may require the creation of a suitable number of inspection openings: Design and Construction Agents must define in the Project Design Instructions the responsibility for making and repairing such openings. Structural and architectural building elements, as well as existing equipment, that restrict equipment distribution space should be directly verified to the extent reasonably practicable. The design team must recognize the economic advantages of a detailed designer site investigation: if the designers do not verify conditions, the construction contractor must do so, normally at a cost premium reflected in higher bidding costs (unknown conditions) and change orders (changed conditions).

10-8.6.2 Modifications to Existing Systems.

Too often in the past, addition and alteration project design documents have failed to provide the detailed engineering guidance required to sustain operation of systems serving occupied areas, leaving this engineering responsibility in the hands of QA personnel or construction contractors. The results have included loss of critical services, inadequate system performance, project completion delays, and costly change orders. Therefore, it is hereby emphasized that it is the responsibility of the project designer to carry out all aspects of the design that can reasonably be accomplished during the design phase. Modifications to existing equipment and systems, including temporary connections, changes to system performance, or measures necessary to sustain service, must be shown and described in detail in project design documents. Designers must evaluate the impact on existing systems of extensions of service that increase system demand. The locations of new connections must clearly be shown or described, or both. The designer must determine, and document for the Design and Construction Agent's information, any project work that must necessitate a reduction or interruption of any service to an existing, occupied area. Consider and document Interim Life Safety Measures (ILSM) for use by the facility in accordance with Chapter 14.

10-8.6.3 Protection of Patients from Construction Contaminants.

For additions or alterations to existing hospitals, measures must be provided to minimize contamination of existing hospital areas during the construction period and the associated HVAC systems serving them. Measures to reduce the potential of contamination and nosocomial infections include but are not limited to: negative isolation of construction areas, construction of effective dust barriers (including double-barrier air locks at entrances and exits) separating construction from occupied areas, protection of air distribution systems serving occupied areas, and disinfection of any reused ductwork. Designers must consult with the facility's infection control representative during the design process to ensure thorough coordination of design features that may affect patient welfare. See also the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction.

10-8.6.4 Construction Phasing Plan.

Reference Appendix C.

10-8.6.5 Commissioning Considerations.

Reference Chapter 19 and Appendix C.

10-8.7 Cooling and Heating Load Calculations.

10-8.7.1 Heating Load Calculation.

Calculations used for determination of primary and airside (including reheat) heating equipment must not include credit for internal load sources, including lighting, people, and equipment. These loads are typically not present, or are much reduced, at night and on weekends. Heat calculations should also take into consideration morning warm-up loads when night setback temperatures are utilized in non-ward areas.

10-8.7.2 Equipment Heat Generation.

In many spaces within facilities, the primary component of cooling loads will be equipment heat generation. It is therefore necessary for accurate load determination that the HVAC designer coordinate on a project-by-project basis with the medical or research equipment designer, and with the individual DoD Project Sponsor, to identify all individual equipment items and the corresponding load contributions. To estimate equipment usage duration and frequency, designers must gather information from the DoD Project Sponsor, or if unavailable from that source the manufacturer, personal experience, or other sources. In performing load calculations, designers must consider the as-designed equipment provisions of each unique space. "Rules of thumb" loading assumptions are not acceptable for final design calculations.

10-8.7.3 Lighting Loads.

Lighting loads present a significant component of facility cooling loads and, as such, require consideration of the as-designed lighting fixture numbers and characteristics of each space. “Rules of thumb” lighting load assumptions are not acceptable as the basis for final design load calculations.

10-8.8 Piping Systems.

10-8.8.1 Pipe Routing.

Piping distribution systems should be routed above corridors whenever practicable, to minimize leaks, maintenance intrusion, and noise in occupied areas of the facility. Pipes must not be routed through Telecommunications Rooms and Electrical Rooms unless dedicated to serving that room.

10-8.8.2 Thermal Expansion.

Designers are responsible for designing all aspects of piping systems necessary for the control of thermal expansion, and for showing the necessary control features on design drawings. This includes showing and dimensioning, as applicable, the approximate locations of guides, anchors, expansion ells and offsets, and flexible couplings, as well as any other piping features that may affect expansions forces in the piping. The intent of this requirement is to ensure that this critical aspect of piping design is accomplished by the qualified mechanical engineer selected for the project design, and not by a construction contractor of unknown engineering ability or qualification. In the case of direct-burial, (for example pipe within a pipe, underground heat distribution systems) engineering of the expansion compensation features by the system manufacturer may be preferred or necessary. Designers must design piping systems such that piping expansion forces are isolated from equipment. Where piping systems subject to thermal expansion are seismically braced, coordinate the thermal expansion design with the seismic bracing. Include any seismic bracing in the expansion/flexibility analysis. Design and Construction Agents must ensure contractor’s shop-drawing layout drawings of piping systems subject to thermal expansion are reviewed by the designer or by an equally qualified engineer representative of the Government.

10-8.8.3 Steam and Condensate Piping.

Steam mains **\1** operating above a gauge pressure of 15 psi (100 kPa) **/1/** must not be distributed in above-ceiling areas of spaces normally occupied by patients or public within a facility, to include corridors. Designers must show the required direction and degree of line slope on drawings, and must provide and show the locations and details of drip traps and other drainage features. Piping for clean steam and associated condensate return must be stainless steel.

10-8.9 Insulation for Mechanical Systems.

Insulation thicknesses and thermal characteristics must be not less than cited per ASHRAE 90.1. Insulation with higher "U" values must be provided when shown to be life-cycle cost effective. Insulation materials must be as permitted by the UFGS; it is important to note that under no circumstances will mineral wool or fiberglass insulation be permitted on new chilled water systems or other systems handling fluids at a temperature below 60 ºF (16 ºC).

10-9 HVAC SYSTEM CONTROLS.

10-9.1 Energy Conservation.

All designs must comply with UFC 1-200-02. Additional information on energy conservation design is referenced at Chapter 4.

10-9.2 Temperature Control.

Individual room temperature controls must be provided for all Critical Care Spaces, sensitive equipment spaces, patient bedrooms, labor rooms, and laboratories, to closely maintain the room conditions provided in Appendix B. Utilize zoned temperature control for other spaces within the facility. Serve only rooms with similar exposures and load profiles by a single zone, with a maximum of six spaces per zone. Serve all conference rooms, classrooms, and other rooms with unique exposures or load profiles by individual zones. Unless a separate means of room heating (such as perimeter heating) is available, provide terminal reheat for all terminal units serving normally occupied spaces.

Wound Intensive Care (Burn Care Rooms) must be provided with room temperature controls to maintain temperatures up to 100 degrees F with humidity control as indicated in paragraph 10-9.4.

10-9.3 Control Precision.

Temperature controllers must maintain space temperature within +/-2 Fº (1 Cº) of active set-point, as provided for the individual spaces in Appendix B. The summer and winter design set-points normally differ. For some spaces, a temperature range is given as the summer or winter interior design condition in lieu of a specific temperature set-point. The HVAC system for such spaces must be designed with the capability, under design conditions, to maintain any selected temperature within that range.

10-9.4 Humidity Control.

Humidity controls must be provided as necessary to meet the requirements given for individual spaces in Appendix B. **\1** Provide central AHU humidifiers for units serving Critical Care Spaces, including patient bedrooms unless a psychrometric analysis demonstrates the space humidity will remain within the range specified in Appendix B.

/1/ If necessary to maintain the RH within the allowable range, humidity controls must be provided on a room basis for these Critical Care Spaces:

a. ORs

b. Cystoscopy Rooms

Humidity controls for Wound Intensive Care (Burn Care Rooms) must be provided on a room basis in order to maintain 35–50 percent RH +/-5 percent at room temperatures up to 100 ºF (38 ºC). Humidity controls for all other spaces may be provided on a zone or system basis as determined to be sufficient to maintain the required conditions.

10-9.4.1 AHU Humidifying Equipment.

Air handling system humidification must be achieved utilizing direct steam injection, with a steam source in accordance with paragraph 10-10.1 utilizing humidifiers of the rapid absorption, steam jacketed distribution type designed to deliver dry steam and accomplish complete re-evaporation within 3 feet of the discharge manifold, under the air velocity and temperature conditions designed. No equipment must be located in the AHU casing within the downstream re-evaporation distance, and the inner casing liner within this section must be constructed of stainless steel. Designers are responsible to designate the location of steam injectors relative to ductwork and AHU components, and so design them as to minimize concerns with moisture collection in or on the downstream elements. To minimize the risk of introducing condensation into the air stream, design humidifier control sequences such that the supply air relative humidity will not exceed 85% under winter heating load conditions. Provide safeties including but not limited to a dedicated air flow switch and duct high-humidity limit switch.

10-9.4.2 Trim Humidification for Critical Care Spaces.

Humidification must be achieved utilizing direct steam injection, with a steam source in accordance with paragraph 10-10.1. Humidifier must be separated a minimum 15 ft (5 m) upstream from high-efficiency final filtration, or any other duct equipment, elbow, or takeoff; when this separation cannot practicably be achieved, rapid-absorption-type humidifiers must be provided with design as indicated in paragraph 10-9.4.1. Ductwork within the downstream re-evaporation distance must be constructed of stainless steel with provisions for drainage of condensate.

10-9.5 Direct Digital Controls (DDC).

The DDC System must be a complete system suitable for the control of the HVAC system and other building level systems as specified. Reference UFC 4-010-06 for cybersecurity requirements. When a DoD Project Sponsor determines that communication between a facility's DDC system and a remote Utility Monitoring and Control System (UMCS) is required, the design must ensure that the DDC system is seamlessly compatible with the UMCS system.

No remote UMCS system, in other words not located in the facility or its associated energy plant, will be permitted to exercise control over any hospital HVAC system

equipment providing service to Critical Care Spaces. Remote UMCS systems may be provided with monitoring, alarm, and reporting capabilities as necessary to facilitate maintenance activities.

10-9.6 Air Handling Equipment Control.

10-9.6.1 Building Pressure Control.

All systems must maintain the building at relative positive pressure to the outside environment, with the exception of those spaces on perimeter walls required to maintain a negative pressure relative to contiguous spaces. For facilities in humid climates, and for all facilities of three stories or more in height, automatic controls must be provided to actively monitor and control building pressurization via pressure monitoring at strategic locations on each level, and manipulation of outdoor air, exhaust volume flow rates, or both. All systems that modulate outdoor air, including all VAV air handling systems, must include accurate airflow measurement arrays located in accordance with manufacturer's recommendations as part of their control system. Positive building pressure must be maintained at all times (24/7) for all facilities located in humid climates.

10-9.6.2 VAV AHU Controls.

All VAV systems must be provided with supply and return fans. Airside economizer must be provided where economically life-cycle cost effective. Fan speeds must be modulated by means of variable-frequency drivers (VFDs). For units utilizing multiple fans (for example fan arrays), provide each fan with a separate VFD. Supply fans must modulate based upon maintaining a fixed static pressure at a location remotely located in the ductwork sufficient to ensure operation of all VAV terminal devices. Supply, return, and outdoor airflow rates must be measured by the DDC control system, and the return fan must modulate to maintain a fixed differential airflow below that of the supply fan. A high supply duct static sensor and shutdown capability must be provided.

10-9.6.3 Variable Exhaust Controls.

HVAC controls for laboratories, treatment rooms with coughing booths, autopsy procedure rooms, and other rooms having equipment requiring variable or intermittent exhaust requirements, must be provided that maintain the required room relative pressurization and room conditions for all modes of operation of the equipment, for example, on or off, minimal to maximum sash height, according to the user's intended operation. Variable flow controls must be provided for the general exhaust of such rooms as well as for the equipment, to allow measurement and tracking of supply to exhaust flow differential by the DDC system.

10-10 STEAM SYSTEMS.

10-10.1 Humidification Steam Source.

Steam generated by heating system boilers (or any other steam) containing amines, oxygen scavengers, or other treatment chemicals must not be used for space humidification in any air handling unit or air distribution system serving Critical Care spaces. Separate steam generators for humidification must be provided for these systems and must be constructed throughout of 316 stainless steel.

In systems serving non-critical care spaces, if authorized by the Design and Construction Agent, central steam systems utilizing chemically treated steam generated under the following conditions may be utilized:

10-10.1.1 Water Source.

Water entering humidifiers or primary steam generators must originate from one of the following sources.

- Potable water
- RO water
- DI water

10-10.1.2 Treatment Chemicals.

With the exception of the three specific amines listed below, boiler treatment chemicals as regulated by 21 CFR 173.310 may be utilized. Chemicals and minerals must not be present in the steam in concentrations that are known to be hazardous to health or that might contribute to an indoor air quality problem. All chemical dosing must be accomplished with automated equipment. The specific chemicals listed below may be present in steam, but they must not exceed the following concentrations in the steam.

- Cyclohexylamine (CHA): 10 ppm
- Diethylaminoethanol (DEAE): 5 ppm
- Morpholine: 10 ppm

10-10.2 Sterilizer Steam Source.

Steam generated by boilers located in an onsite (hospital-dedicated) boiler plant may be utilized for sterilization steam subject to approval by the DoD Project Sponsor. As hospital authorities cannot normally exercise a reasonable degree of supervision or control over treatment chemicals utilized in base-wide or district systems, steam from these sources may not be utilized for direct sterilization. Unlike humidification steam, which is injected directly into the air supply, little sterilizer steam escapes into a facility's general environment. Under a reasonably responsible boiler treatment program, any steam that does escape typically will not result in dangerously high levels, for example,

Occupational Safety and Health Administration (OSHA) Recommended Exposure Limits (RELs), of treatment chemicals in the environment.

10-11 AIR HANDLING AND DISTRIBUTION.

10-11.1 AHU Requirements.

AHUs are to be double-wall, internally-insulated, readily maintainable units suitable for utilization in medical facilities. Draw-through units are normally preferred to utilize fan heat to increase the DB air temperature above the saturation point and minimize the possibility of wetting downstream filters, attenuators, or other components. If draw-through units are not provided, an alternative, energy-efficient heating source must be provided to ensure that supply air delivered from the AHU is at least 2 Fº (1 Cº) above saturation temperature. Provide for minimum 18 in. (460 mm) wide access doors **\1** to allow unobstructed access to both the upstream and downstream surface of each heating coil, cooling coil, and heat recovery device, to facilitate coil inspection, cleaning, maintenance, proper installation of the unit freeze stat, and calibration of control sensors. **/1/** When unit heating or cooling capacity are provided—in part or total—by heat reclaim devices, AHUs must be provided with conventional preheat and cooling coils sized for the total system load, to ensure continued service when heat reclaim equipment is out of service.

10-11.2 Energy/Heat Recovery Systems.

Where energy recovery systems are provided, design and construct such systems to comply with the following:

Locate energy recovery systems upstream of intermediate filters. For exhaust systems serving spaces without a "Y" in the exhaust column of Appendix B, provide systems that allow no more than 5% cross-contamination of exhaust air back to the supply airstream via purge, leakage, carryover, or transfer.

For exhaust systems serving any room that has a Y in the exhaust column of Appendix B, provide systems where the supply airstream components and the exhaust airstream components are fully separated by an air gap of adequate distance to prevent cross-contamination that is open to the atmosphere (for example run-around pumped coils).

10-11.3 System Shutdown Capability.

To the extent practical and cost effective, non-critical, non-bedroom area HVAC systems must be designed to permit shutdown (night setback and setup, outdoor air shutdown) of individual areas or departments not in operation on a 24-hour basis. In any facilities in which any spaces are exhausted during non-occupied hours, the HVAC design must provide for conditioned make-up air to prevent a negative pressure within the facility relative to the outside, and the admittance of unconditioned, unfiltered infiltration air. For facilities not located in humid climates and where no spaces are exhausted during non-occupied hours, negative building pressure may be prevented by

shutdown of the HVAC system and isolation from the outside by closing outdoor, relief, and exhaust air dampers.

Air distribution systems must comply with the requirements in UFC 4-010-01 except as modified herein. Due to the nature of operations in medical facilities, completely shutting down HVAC in areas that would risk the health of patients, visitors, and staff is not a decision to be made lightly, and inadvertent activation of the HVAC shutdown must be minimized. The quantity and locations for Emergency Air Distribution Shutoff Switches must be coordinated with the Design and Construction Agent. In any case a minimum of one (1) shutdown switch must be provided. All shutdown switches must be protected from accidental activation by a flip up cover or other double action device. Emergency Air Distribution Shutoff switches for systems serving any critical care spaces, spaces with critical pressurization requirements ("++" or "- -" in Appendix B), or other spaces where HVAC shutdown would pose an immediate danger, must be by keyed switches. These switches must be provided with the following signage “Danger! Critical Care HVAC Shutdown, Exposure Hazard”. Signage must be red background with white letters and be placed above any cover for each individual button. Keyed switches permit responsible personnel in leadership to weigh the risk associated with intentionally degrading a life preserving internal environment to protect against the introduction (or distribution) of an airborne hazard into the facility. Switches for systems serving only non-critical care spaces must be provided with the following signage “Emergency Use Only! Mechanical HVAC System Shutdown”. Signage must be red background with white letters and be placed above any cover for each individual button.

10-11.4 Outdoor Air Intakes.

Outdoor air intakes must be located as far as practical, but not less than 30 ft (10 m), from exhaust outlets of ventilation systems, cooling towers, combustion equipment stacks, MV systems exhaust, plumbing vent stacks, emergency generator exhaust, or from areas that may collect vehicular exhaust and other noxious fumes. Locate the bottom of air intakes serving central systems as high as practical but not less than the distance above ground level required by UFC 4-010-01, or if installed above the roof, at least 3 ft (1 m) above roof level. Outdoor air must not be drawn from equipment rooms. Designers must utilize judgment in the location of contaminant exhausts, and not simply apply the “9M rule” without further consideration of wind direction and velocity, building geometry, and characteristics of the contaminant stream. Appropriate consideration must be given to prevailing wind direction and the season, for example, summer or winter, as applicable; however, designers are cautioned not to rely on prevailing wind direction(s) as a primary factor in the avoidance of intake contamination. In particular, use extreme caution in locating outdoor air intakes in proximity to parking areas, ambulance garages, loading docks, exhaust air outlets, and equipment stacks. Where appropriate, the Design and Construction Agent will provide individual Project Design Instructions for special computational fluid dynamics (CFD) or wind tunnel modeling to provide greater assurance of the correct location of outdoor air intakes.

10-11.5 Noise Control.

Noise criteria for individual rooms and spaces in the facility are provided in Appendix B.

10-11.5.1 Room Breakout.

The HVAC designer must coordinate with the architectural designer to control equipment noise passing from mechanical rooms into adjacent spaces through the surrounding walls or partitions.

10-11.5.2 Crosstalk.

The compromising of patient privacy by transmission of audible speech from one room to another via ductwork is of great concern in medical facilities and must be addressed by HVAC designers. Examination rooms, physician's offices, and toilets require the designer's particular attention. Ductwork connecting adjacent rooms must have the necessary attenuating characteristics to eliminate audible speech transmission. Typically, this is addressed by the provision of well-separated "takeoffs" or several duct elbows in the intervening ductwork, or both.

10-11.5.3 Air Fixtures.

Air distribution supply, return, and exhaust fixtures, for example, diffusers or grills, must be sized to provide air inlet and outlet velocities consistent with room noise criteria level requirements as provided in Appendix B. Designers must be aware that diffuser manufacturer's published noise characteristics are based upon idealized inlet conditions. Poor installation of flex duct, abrupt branch duct connections, elbows located immediately at the diffuser collar, and similar poor connections may result in unacceptable noise levels. Spin-in or other 90-degree duct drop connections to diffusers must be equipped with equalizing grids as necessary to ensure uniform air distribution at the diffuser inlets.

10-11.5.4 Air Velocity.

Designers must limit air velocities in ductwork, air transfer grills, or door undercuts to values consistent with ASHRAE recommendations to control noise generation.

10-11.5.5 VAV/Constant Air Volume (CAV) Terminal Units.

VAV terminal units and constant velocity controllers are a frequent source of noise generation in air distribution systems. Designers must specify or schedule units with minimum inlet sizes for incremental ranges of flow and must indicate maximum sound power output for each unit, at the maximum inlet static pressure that the designer anticipates the unit will be exposed to. If integral sound attenuating devices are required, these must be indicated for the respective terminal unit(s) in specifications or drawing schedules.

10-11.5.6 Exterior Noise Sources.

Designers must evaluate the sound characteristics of exterior equipment provided as part of the project design (such as cooling towers and emergency generators) to ensure that such sources do not result in interior noise levels exceeding limitations provided in Appendix B.

10-11.6 Duct Design.

Design duct systems in accordance with the ASHRAE Handbook series, ACGIH Industrial Ventilation: A Manual of Recommended Practice, NFPA 96, and SMACNA HVAC Systems Duct Design. Maximum velocity in ductwork mains must not exceed 1,800 fpm (9 m/s) over occupied spaces, or a maximum of 2,500 fpm (12.7 m/s) elsewhere, and velocities in branch ducts and takeoffs must not exceed recommended levels in those references. Ductwork plans must indicate the static pressure class required for sealing and reinforcement for all types of duct. Access panels must be provided as necessary for access to fire dampers, smoke dampers, humidifying equipment, control equipment to include reheat coils, and other equipment requiring periodic inspection or maintenance. All supply air, with the exception of air transferred between spaces for the purpose of pressurization, and flexible terminal equipment connections must be provided in sheet metal ductwork.

10-11.6.1 Non-Corrosive Ductwork Material.

Ductwork installed downstream of high efficiency final filters (MERV 14 or greater, see Appendix B) serving Critical Care Spaces must be of stainless steel or aluminum, including all accessories such as dampers, fasteners, and turning vanes. This provision does not apply for ductwork downstream of high-efficiency filters when these are located at the AHUs (filters noted in the “intermediate” column in Appendix B). Stainless steel ductwork downstream from trim humidifiers must extend for the manufacturer’s cataloged re-evaporation distance. Exhaust ducts for glass washers, dishwashers, and cart washers must be non-corrosive and must have soldered or welded joints and must be pitched to drain.

10-11.6.2 Return Air Plenums.

Provide fully ducted return air systems for all facilities, except stand-alone administrative buildings or deployable facilities. Temporary facilities may be considered for plenum returns where authorized by the Design and Construction Agent and the DoD Project Sponsor. Corridors must not be used as return air plenums in any portions of a facility. Exceptions allowing transfer air for toilets and janitor closets, as provided in NFPA 90A and 101, will be permitted.

10-11.6.3 Duct lining.

The utilization of duct lining materials is prohibited in all medical facilities. These materials may harbor dust and moisture, providing an ideal environment for the propagation of pathogenic or noxious microorganisms. Factory fabricated sound

attenuators, packed type, constructed with a perforated inner steel liner and Mylar® or foil underlay separating the packing from the airstream, must be provided to attenuate noise. Such attenuators must comply with ASTM C1071 and UL 181.

10-11.6.4 Balancing Provisions.

Duct branches serving each individual space must be provided with a manual balancing damper, accessible above the ceiling, located as remote from the space supply or return fixture, for example, diffuser or register, as practicable. The balancing damper provided as part of air diffusers is not to be used for system balancing. Duct systems which are fully welded due to containment requirements (for example, Biosafety laboratories, compounding rooms etc.) must be provided with permanent taps to facilitate pitot-traverse airflow measurement at main duct branches. These permanent taps must consist of welded nipples of the same material as the ductwork, with threaded caps, gasketed with material suitable for the materials in the airstream. Similar permanent pitot-traverse taps must be provided in the exhaust ducts serving Neat and Dilute chemical agent laboratories, and in kitchen grease hood exhaust. For the latter, tap nipples must extend to an accessible location outside of the fire-resistant duct enclosure material.

10-11.6.5 Telecommunication Rooms.

Ducts must not be routed through Telecommunications Rooms in compliance with TIA-569.

10-11.7 Cleanliness of Air Handling and Distribution Equipment.

During project construction, protect all AHU and distribution equipment (including all ductwork and fittings exposed to the air stream) from contamination by dust and debris. Cover or seal the equipment until installation and keep open ends of ductwork covered until final connections to diffusers and registers are made. Thoroughly clean any AHUs that are operated during building construction and install new filters before beneficial occupancy of the facility. “Thoroughly cleaned” in this sense is defined as wiped clean of any visible dust or debris. Thoroughly clean any ductwork that has not been properly protected prior to installation or acceptance of the facility.

10-12 MAINTENANCE PROVISIONS.

10-12.1 General Personnel Access.

Safe and practical means of personnel access must be provided to, and within, all areas of the facility where equipment is located, to adequately provide for O&M and replacement of the equipment. Access to equipment rooms from outside the facility should be provided where feasible. Within equipment rooms, provide clearance to all service points to mechanical equipment to allow adequate personnel access and working space in accordance with equipment manufacturer’s recommendations; but as a minimum, maintain 30 in. (770 mm) at all service points and 5.5 ft (1.7 m) of overhead clearance for O&M access-ways. Proper clearance must be provided such that

personnel do not have to climb over equipment or crawl on hands and knees. When rooftop AHUs are provided on multiple story facilities, provide elevator access with direct means of transporting materials to the units via hydraulic handcart without damage to the roof.

Provide convenient stairway access when rooftop AHUs are provided on single story facilities; in addition, the HVAC designer must coordinate with the site designer to provide for a practical location for a mobile crane to approach within reasonable proximity of the AHU(s) for periodic transportation of maintenance or replacement parts and equipment.

10-12.2 Equipment Clearances.

Minimum clearances between electrical and mechanical equipment must be as required by NFPA 70. Ensure that practical means are provided for the removal and replacement of the largest and heaviest equipment item(s) located in the facility. Provide adequate pull space for all coils, heat exchangers, chillers, boiler tubes, and filters. Sufficient space must be provided in above-ceiling areas to facilitate equipment installation and O&M. For building designs utilizing interstitial floor distribution zones, further guidance is provided at Appendix E.

10-12.3 Suspended and Mounted Mechanical Equipment.

Where suspended and mounted equipment is installed, provide a minimum of 5.5 ft (1.7 m) of clearance for headroom as required. In refrigeration equipment rooms, provide overhead clearances required by ASHRAE 15. For any work station or location requiring maintenance access that is not readily accessible from an 8 ft (2.5 m) portable ladder, provide a fixed ladder or catwalk.

10-12.4 Air Distribution System Components.

Design outdoor air intake plenums, AHU casings, and distribution ductwork to permit access for periodic cleaning or disinfection.

10-12.5 HVAC System Balancing Provisions.

Adequate access must be provided to facilitate operation, adjustment, and testing at all HVAC balancing and measuring points and equipment, including automatic and manual damper operators, air terminal units, pilot tube ports, valves, and sensing devices.

Prior to Test and Balance (TAB) perform Duct Air Leakage Testing (DALT) in accordance with UFC 3-410-01 on all duct systems regardless of pressure class, to include all return, all exhaust, and all portions of supply upstream of terminal units.

10-13 VIBRATION CONTROL.

Provide mechanical equipment and systems designed in accordance with UFC 3-450-01 to prevent transmission of vibrations to the structure.

10-14 INTERDISCIPLINARY COORDINATION.

10-14.1 Architectural Coordination for Rooms with Critical Pressurization Requirements.

All spaces in Appendix B with air balance requirements of "++" or "- -" (and associated anterooms) must be designed and constructed with full height room partitions, extending from floor to structural ceiling, with all joints and penetrations sealed to prevent the passage of air.

10-14.2 Fire Protection Features.

Refer to Chapter 14 for fire protection features.

10-14.2.1 Smoke and Fire Dampers.

In support of defend-in-place evacuation, design HVAC service zones to coincide with smoke compartments whenever practicable. Ductwork penetrations of fire and smoke - rated walls should be minimized, to minimize the required number of smoke and fire dampers and complexity of controls. Coordinate with the architectural design to ensure that necessary access for inspection or service of these dampers is provided.

10-14.2.2 Ventilation for Commercial Cooking.

Air supply and exhaust systems must be of the mechanical ventilation type and must meet the requirements of NFPA 90A and 96. Grease-laden vapor exhaust ductwork must be in accordance with NFPA 96.

10-14.2.3 Smoke Management Operation.

Comply with Chapter 14.

10-14.2.4 Commissioning of HVAC Systems with Fire Alarm and Fire Detection.

Guide specifications typically do not contain provisions for the simultaneous testing of HVAC and fire alarm and fire detection features or systems, which can have complex, interwoven operational requirements in some facilities. For each project where applicable, designers must develop or modify specifications as needed to provide for testing of HVAC systems under fire alarm conditions, to permit verification not only of correct function, but of acceptable speed of response. In more complex systems involving smoke evacuation or compartmentalization and pressurization, or provisions of smoke/exhaust in support of defend-in-place evacuations, detailed testing protocols, system diagrams, or both, must be developed to clearly convey the required scope of the commissioning effort. (Reference Chapter 19).

10-14.3 Essential Electrical Service.

10-14.3.1 Capacity.

The HVAC system equipment serving Critical Care Spaces must be connected to the EES to ensure service continuation in the event of normal power disruption, in accordance with the requirements of NFPA 99. Cooling, as well as heating, must be maintained to Critical Care Spaces in the event of normal power outage.

10-14.3.2 Commissioning.

Service guide specifications do not adequately address testing requirements for HVAC and EES interoperability. HVAC systems connected to the EES must be shown to function as intended under conditions of normal power interruption. Testing of the EES must be conducted in conjunction with any components of the HVAC system required for support. For example, thermostatically operated louvers may be required in emergency generator rooms for make-up air, generator radiator cooling may be a function of such HVAC components as pumps or cooling tower. Testing must verify the actual connection of HVAC equipment to the EES in accordance with the design following normal power outage, in the priority sequence established by the design. Designers must supplement or modify guide specifications to ensure that such verification testing is adequately detailed and described. (Reference Chapter 19)

10-14.4 Seismic Design Requirements.

Refer to Chapter 7 for seismic provisions for the HVAC system equipment and components. Designers must be responsible for ensuring that seismic bracing of HVAC piping is coordinated by design with thermal expansion compensation features, to allow for the necessary pipe movement with temperature changes.

10-14.5 Design Coordination.

Designers are responsible to coordinate the HVAC with the electrical, communications, architectural, and structural aspects of the design to ensure that equipment can reasonably be installed by a contractor providing equipment, and following installation procedures, within the terms of his contract. For this reason, designers are instructed to base equipment room and distribution space designs upon spatial envelopes (including maintenance clearances) that must accommodate any of at least three manufacturers of major equipment. Routes of ductwork and piping must be carefully coordinated with other elements, considering required slope, insulation, bracing, reinforcement, slope, and maintenance access. This practice in no way infringes on or substitutes for the construction contractor’s responsibility, to be defined in project specifications, to coordinate the installation work of all trades and to provide detailed shop drawings showing the proposed construction.

10-14.5.1 Equipment Rooms.

To ensure adequate coordination, designers must consider not only the HVAC equipment, but the work requirements of other trades. Ensure adequate clearance around AHUs to permit bolting the units together and securing them to their housekeeping pads, meanwhile providing space for the general contractor to install wall partitions. Consider the locations of plumbing and medical gas equipment. Ensure it is possible for maintenance workers to access all controls, electrical panels, valves, and instrumentation. Be aware of NFPA 70 clearance and vertical dedicated space requirements for electrical equipment. Coordinate parameters such as ductwork and outdoor air plenums with the locations of lighting.

10-14.5.2 Above-Ceiling Plenums and Chases.

Designers must anticipate the worst-case insulation, duct reinforcement, equipment support, slope, and fitting characteristics associated with ductwork and piping distribution systems, and be careful to coordinate the location of these systems with other equipment, including in particular cable trays and lighting fixtures with their vertical access and clearance space requirements. Ensure that access space is considered for damper operators, low-point steam drip assemblies, VAV terminal units, reheat coil controls and instrumentation, service valves, and access doors for ductwork for cleaning or damper inspection.

10-15 FUEL STORAGE REQUIREMENTS.

Refer to paragraph 7-4 for requirements for assessing the extent of onsite fuel storage for facilities in seismic threat regions. Additional fuel storage guidance for boiler plants must be obtained from the individual service criteria.

Provide factory-assembled automatic particulate filtration, dewatering and fuel additive injection system to maintain the purity of fuel in storage. Design the system to circulate the fuel from the storage tank, through the system, and back to the storage tank with capacity to turn over the largest connected full tank one time within 72 hours. Provide pre-filter, coalescing filter, and fine particle filters as part of the fuel filtration system. Design the system to maintain water content of fuel to less than 10 ppm and include an automatic wastewater holding and removal system. Provide a fuel additive injection system that includes chemical storage tank and chemical pump that can automatically add chemicals to the fuel being circulated. Chemical storage tank to be sized to hold two years supply of additive recommended by additive supplier. Include biocide treatment, cetane boosters, stabilizers or other additives as recommended by the maintenance treatment system manufacturer.

10-16 VENTILATION DESIGN.

10-16.1 Ventilation Air Changes.

Provide the minimum air change rates for each space, for outdoor air and total air, required by Appendix B. Total air changes as established by Appendix B must consist

of the outdoor air changes, plus re-circulated airflow through a main AHU having the minimum filtration called out for that space in the appendix. For rooms with a positive pressurization requirement, calculate the total air changes based on the supply volume and for rooms with a negative pressurization requirement, calculate the total air changes based on the exhaust/return volume.

10-16.1.1 Occupied room requirement.

Whenever a room is occupied, the minimum air change rates must be provided.

10-16.1.2 Critical care requirement.

The minimum outdoor air change rate from Appendix B in Critical Care Spaces must be maintained at all times. Increase the minimum outdoor air calculated below as needed to ensure that the minimum outdoor air change rate is maintained for Critical Care Spaces.

10-16.1.3 Outdoor Air Correction Calculation.

Provide minimum outdoor air at the AHU equal to the corrected Outdoor Air Intake (Vot), per the following equation:

Equation 10-1. Vot = Vou / (1 + X – Z)

Where:

Vou = the sum of all individual space outdoor air requirements for spaces served by the AHU,

X = the ratio of Vou to total ventilation air calculated to be required, and

Z = the largest ratio of outside air to ventilation air for any of the spaces served by the AHU.

10-16.2 General Exhaust Provisions.

Provide exhaust systems for animal holding areas, autopsy and morgue spaces, laboratory fume hoods, radioisotope hoods, bacteriological cabinet, kitchens, laundry, toilets, isolation rooms, equipment rooms, and other areas as noted in Appendix B, or as designated on an individual project basis. Do not connect duct systems conveying potentially hazardous exhaust, for example, ethylene oxide (ETO) sterilizers and lab hoods, to any general or toilet exhaust system. Provide duct systems conveying isolation room exhaust dedicated to isolation rooms and their associated anterooms and toilet rooms, and not connected with other exhaust systems. Locate all exhaust discharge outlets to prevent short-circuiting to air intakes or other building openings. Locate exhaust fans at the end of the exhaust duct run (exhaust ducts to be under negative pressure).

10-16.3 Space Pressurization.

The required pressurization of individual spaces, relative to adjacent spaces or corridors, is indicated in Appendix B. Where a negative or positive pressurization are required for a given critical or patient bedroom space, that pressurization must be maintained by the HVAC system under all conditions of operation, including periods of reduced ventilation or night setback.

10-16.4 Laboratory Ventilation.

Exit corridors must not be utilized to directly supply or exhaust air from the laboratory, although “transfer” of air to and from corridors may be utilized to establish required room pressurization. Negative pressurization of laboratories in relation to surrounding occupancies must be maintained under all conditions of HVAC system and fume hood operation.

10-16.4.1 Exhaust Systems.

Provide independent exhaust systems for all laboratories. Laboratories containing hazardous chemical, microbiological, or radioactive airborne particles or gases must be provided with independent exhaust systems in accordance with NFPA 45 and should utilize high plume exhaust designed to remove and dilute the air so it does not contaminate the roof area or have the potential to be re-entrained into the building. Exhaust ducts from chemical fume hoods are permitted to be combined with general laboratory exhaust systems within the same laboratory unit in accordance with guidance in NFPA 99 and NFPA 45. Maintain air change rates within laboratories at all times to prevent the spread of airborne contaminants within the space. Where hood exhaust is used to meet the required air change rates, incorporate a bypass with the general exhaust system for times when the hood is not in use or is shut down for maintenance. Exhausts from hoods handling perchloric acid or other strong oxidizing agents, materials, or agents requiring high-efficiency particulate air (HEPA) filtration, or exhausts which, when combined, chemically interact or change the explosion or ignition limits, may not be combined with any other laboratory exhaust system. Additional guidance for hood and exhaust design is contained in the ASHRAE Handbook series, the Manual of Recommended Practices for Industrial Ventilation, NFPA 45, ASHRAE 15, and ASHRAE 62.1. Exhaust duct discharge height must be above the building recirculation cavity boundary. In all cases, exhaust discharge must have sufficient stack height, velocity, and distance from building openings, outdoor air intakes, or recirculating air currents, to preclude reentry into the building. Air velocity in exhaust ductwork must be sufficient to transport the contaminant vapors, fumes, dusts, or other particulate matter for which the fume hood(s) is designed. Refer to paragraph 10-11.6.4 for requirements for permanent pitot traverse ports in certain hazardous exhaust applications.

10-16.4.2 Laboratory Fume Hoods, General.

Fume hoods must be located in areas of minimal air turbulence, away from doors, windows, and traffic, to minimize disruption of required sash airflow. HVAC system and fume hood controls must be designed such that operation or shutdown of any fume hood in a given space must not disrupt the required room air balance or the required sash airflow at other hoods operating in the space. General-purpose laboratory fume hoods that control personnel exposure to chemicals and physical contaminants must have a minimum sash face velocity of 100fpm (0.50 m/s). Fume hoods must be provided with audible and visual alarms to indicate inadequate sash airflow conditions.

10-16.4.3 Radioactive Material and Radioisotope Hoods.

Duct systems serving hoods for radioactive material must be constructed of acid-resistant-type stainless steel for their entire length. Ductwork must be flanged with neoprene gasketed joints to facilitate dismantlement for decontamination. Fume hood exhaust must remain in constant operation and must be filtered with carbon or HEPA filters as required to meet Nuclear Regulatory Commission (NRC) requirements. The location of filters in the system must be chosen to best facilitate their safe removal, disposal, and replacement by maintenance personnel. All filters must be automatically monitored to provide indication that change-out is required. All hoods must comply with requirements of the NRC.

10-16.4.4 Canopy Hoods for Prosthetic Dental Laboratories.

Canopy hoods for Prosthetic Dental Laboratories, and exhaust ductwork extending for a distance 10 ft (3 m) downstream from the hood connection, must be fabricated of material that is corrosion resistant to the caustic fumes emanating from boil-out tanks and casting activities conducted in the laboratory.

10-16.4.5 Biological Safety Cabinets (BSCs).

Class, type, and location of BSCs must be as directed by the DoD Project Sponsor. Class II BSCs are provided with HEPA filtration of recirculated air or building exhaust, and are provided in such areas as Microbiology and Mycology. The required open door or sash face velocity for Class I and Class II Type A BSCs must be 75 fpm (0.38 m/s), and for Class II Types B1, B2, and B3, must be 100 fpm (0.51 m/s). For further information of biological safety hood class, type, application, and exhaust requirements, refer to the ASHRAE Handbook series, OSHA Part 1910, Biosafety in Microbiological and Biomedical Laboratories, and NSF/ANSI Standard 49.

10-16.4.6 Perchloric Acid Hoods.

Hoods for handling of perchloric acid and other strong oxidizing agents, and the associated exhaust ductwork, must be constructed of stainless steel. Internal water spray systems must be provided for hood and all ductwork to facilitate the periodic washdown. Joints must be welded and ground smooth, and all ductwork pitched back toward the hood to facilitate drainage. Welding must be in accordance with AWS D18.1

Hygienic Welding. More detailed guidance is provided by the ACGIH publication Manual of Recommended Practices for Industrial Ventilation.

10-16.4.7 Containment Laboratories BSL-3 and BSL-4.

These laboratories deal primarily with indigenous or exotic agents that may cause serious or potentially lethal disease as a result of exposure by inhalation. The HVAC design for these laboratories must ensure the continuous negative pressurization and exhaust of the space. The exhaust air from these spaces must not be recirculated to any other area of the building, but must be transported through dedicated exhaust ductwork to be directly discharged to the outside of the building. Design of BSL-3 and BSL-4 laboratory exhausts must comply with Biosafety in Microbiological and Biomedical Laboratories, DA PAM 385-69, and DoDM 6055.18-M.

10-16.5 Exhaust Canopies.

Exhaust canopies must be provided for equipment or appliances generating high heat or moisture (steam) loads, such as glassware washers, boil-out tanks, drying ovens, sterilizers, and stills. In some cases, specially designed canopy hoods may be necessary to control personnel exposure to hazardous chemical vapors. Canopy hood design must comply with the ACGIH data for “Canopy Hood” from the Manual of Recommended Practices for Industrial Ventilation.

10-16.6 Laminar Flow Clean Benches.

These horizontal flow hoods are used in pharmacy for preparing intravenous fluids and similar laboratory processes. Clean benches recirculate room air and do not require exterior air supply or exhaust systems.

10-16.7 Bench-Back Slot Hoods.

Slot hoods are typically built into the wall behind laboratory benches to exhaust vapors, gases, and odors that are released with little energy or velocity. Typical applications are laboratories, brace shops, and other spaces in which volatile chemicals are routinely used. Design of these hoods must be in accordance with ACGIH guidelines, with a slot velocity of 2,000 fpm (10 m/s).

10-16.8 Portable Bench-Top Hoods.

Portable hoods with glass viewing panels and interior lighting may be used to control chemical contaminants of minor toxicity and odors. They must be attached to built-in exhaust outlets with flexible ducts. Each built-in exhaust system outlet must provide a minimum of 160 CFM (76 L/s) or a face velocity of 75 fpm (0.38 m/s) at the hood, whichever provides the maximum mass flow of air. The exhaust duct opening must be provided with a blast gate and sealing plug to stop airflow when the unit is not in service.

10-16.9 Medical Equipment.

Reference Chapter 15 for special ventilation requirements of medical equipment.

10-16.10 Kitchen Hoods.

Equip all hoods over cooking service equipment with fire extinguishment systems, automatic washdown, listed grease extractors, and heat-actuated fan controls. Cleanout openings and required fire protective enclosures and separations must be provided in horizontal exhaust duct systems serving these hoods and grease exhaust ducts in accordance with NFPA 96.

10-16.11 Pharmaceutical Admixture Rooms.

Pharmacy admixture rooms must be in compliance with USP 797 and/or USP 800, Pharmacists' Pharmacopoeia. For each project, designers must interview DoD Project Sponsor personnel to evaluate the nature of drug compounding procedures, including risk level, for each compounding room, as the basis for determining required room air changes, filtration levels, protective equipment, and separation area (anteroom) requirements for the designated clean room level.

10-16.12 MRI Quench Exhaust.

Provide a dedicated cryogen quench vent run as directly as possible to the outdoors. Design the quench vent to meet the requirements of the MRI system manufacturer. Fully insulate the quench vent to the point of discharge. Provide a weather-head to prevent the introduction of horizontally driven precipitation, snow accumulation and animal intrusion at the discharge of the quench vent. Separate the quench vent discharge point from any air intake or operable window as specified in this chapter concerning outdoor air intakes. Clearly mark a 25 ft (7.5 m) radius exclusion zone around the quench vent discharge.

10-17 AIRBORNE INFECTION ISOLATION AND PROTECTIVE ENVIRONMENT ROOM DESIGN.

Isolation rooms consist of airborne infection isolation and protective environment rooms. The former is intended for the patient suffering from a known or suspected infectious disease and is provided with engineering controls that assist in preventing the spread of the disease from the room. Protective environment rooms are provided for the patient having an immune system deficiency and require engineering controls to assist in protecting the patient from contamination from outside the room. Rooms must be one or the other, and not "switchable" from airborne infection isolation to protective environment function, or vice versa. Provide rooms with pressure-monitoring alarms and gauges mounted on the outside corridor wall; when a central DDC control operator's station is provided, the alarm should in addition be connected to that system.

10-17.1 Airborne Infection Isolation Bedrooms.

Design airborne infection isolation bedrooms to incorporate requirements and guidance contained in the Guidelines for Preventing the Transmission of Mycobacterium Tuberculosis in Health-Care Facilities (the TB Guidelines), published in the Federal Register Vol. 59, No. 208. Provide negative pressure, exhaust to the outside, and minimum total and outdoor air change rates (12/2, respectively) as referenced in Appendix B. Connect the exhaust ductwork from isolation bedrooms, only with the associated toilet, anteroom (if provided), or other isolation rooms and their associated anterooms and toilet rooms. Where the design includes additional associated rooms that only open directly to the isolation bedroom, apply the Appendix B HVAC requirements for isolation bedrooms to these rooms, and connect the exhaust from these rooms to the isolation bedroom exhaust system. Power isolation bedroom exhaust systems from the EES. Supply bedroom suites by air systems provided with constant-volume control and measuring terminal units that automatically maintain the supply airflow rate set-point to each space. Provide constant volume exhaust systems maintaining a fixed exhaust flow rate for each space. Discharge isolation bedroom exhaust in a vertical direction no less than 10 ft (3 m) above the adjoining roof surface. Provide no less than 30 ft (10 m) horizontal separation from isolation bedroom exhaust and any outdoor air intakes, openable windows/doors, or areas normally accessible to the public. When bedroom exhaust is located such as to prevent re-entrainment into outdoor air intakes or other building openings, HEPA filtration of the exhaust is not required.

10-17.1.1 Existing Facilities.

In existing facilities, only those bedrooms designated by the facility specifically for use as tuberculosis isolation bedrooms are required to be designed in accordance with the TB Guidelines referenced in paragraph 10-17.1. TB Isolation bedrooms must be negatively pressurized, exhausted, and must be provided with 12 air changes per hour if economically or physically practicable. When not practicable to achieve this air change rate, TB isolation bedrooms must have a minimum of 6 air changes per hour, to be supplemented by HEPA filter or UV germicidal irradiation (UVGI) systems specifically designed for TB Room applications and providing the equivalent of an additional 6 air changes per hour. Fixed-in-place HEPA filtration units are preferable to portable units, and upper-level UVGI systems are preferred over duct-mounted units, to enhance reliability. Room exhaust must be conducted to the outside of the building; when designed to avoid re-entrainment into outdoor air intakes or other building openings, HEPA filtration of the exhaust is not required.

10-17.1.2 Isolation Suite Relative Pressurization.

When an anteroom is provided for the isolation bedroom interposing between the bedroom and corridor to provide a “buffer” airspace for additional protection, there are several recognized design approaches for corridor-anteroom-bedroom relative pressurization. A recommended design is to provide for the anteroom to be under

negative pressure relative to the corridor, and positively pressurized relative to the bedroom.

10-17.2 Protective Environment Rooms.

The air supply to the protective environment room and associated anteroom and toilet room must be constant flow and must be provided with HEPA filtration. 12/2 total and outdoor air changes, respectively, are required for these rooms. As with airborne infection isolation bedrooms, there are several recognized approaches to the relative corridor-anteroom-bedroom pressurization; a recommended approach is to establish the anteroom positively pressurized relative to the corridor, and negatively pressurized relative to the bedroom.

When upgrading existing protective environment bedrooms to this criteria, 12/2 air changes per hour must be provided if economically and physically practicable. When impractical, these bedrooms must be provided with a minimum of 6 total air changes per hour and supplemented by HEPA filtration or UVGI systems to provide the equivalent of 12 air changes.

10-17.3 Airborne Infection Isolation Exam or Waiting Rooms.

Airborne infection isolation exam or waiting rooms, including pediatric and emergency waiting rooms, must be provided with a minimum of 12 total air changes, as provided in Appendix B. Exhaust ductwork from these rooms must only be connected to the exhaust from other isolation rooms and their associated anterooms and toilet rooms, and not be connected with other exhaust systems.

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CHAPTER 11 ELECTRICAL

11-1 GENERAL.

11-1.1 Scope.

This chapter provides policy and guidance for planning, design, and construction of electrical power and illumination systems for applicable facilities. Criteria is noted throughout the chapter and included in Appendix B and Appendix I. Criteria also include the General Building Requirements established by UFC 1-200-01, including the core electrical engineering UFC's. The core electrical engineering UFC's, of which UFC 3-501-01 is the top-level, in conjunction with criteria in this chapter, establish minimum design requirements. In the event of conflict this UFC is the ruling criteria.

11-1.2 Supplemental Criteria and Standards.

This chapter may be supplemented with individual MilDep criteria, including installation-specific requirements, as established by the Design and Construction Agent.

11-1.2.1 Seismic.

Design essential electrical systems to function after a seismic event occurs. Provide seismic design in accordance with Chapter 7.

11-1.2.2 Durability.

Provide a minimum rating of continuous full design load for installed electrical systems and electrical equipment, except where other criteria mandate larger ratings, to meet the facility reliability requirements.

11-1.2.3 Maintainability.

Provide a means in the design to remove and maintain equipment and field-install wiring without interruption to essential electrical system loads. Provide standard equipment and sizes to the extent practical to allow interchangeability and simplify parts stock. Provide a removal path for all installed equipment. Where draw-out equipment is utilized, provide means to rack equipment in and out, and provide space for maneuverability during servicing.

11-1.2.4 Efficiency.

Provide power factor correction if the power factor is less than 0.95. Provide balanced three-phase loading such that phase unbalance at nominal voltage does not exceed 5% between A, B, and C phases.

11-1.2.5 Economy.

Evaluate alternative system configurations, and component types and sizing for economic value consistent with other criteria factors.

11-1.2.6 Power Conditioning.

Systems that incorporate solid-state devices are susceptible to electrical system transients that may cause system malfunction or equipment component damage. Do not install power conditioning equipment at the utilization point of the building electrical system, unless explicitly required for specific items of equipment by the MilDep or by an A-E or designer evaluation of solid-state requirements for intensive care areas and approved for installation by the DoD Project Sponsor. Provide transient and surge protection for CFCI systems that utilize solid-state devices. Normally provide static UPS with the equipment and system being served. However, determine UPS requirement or provisions on a project-by-project basis. Determine provisions for future installed power conditioning equipment on a project-by-project basis.

11-1.2.7 Voltage Tolerance.

Provide nominal voltage ratings and operating tolerances in compliance with maximums and minimums established by ANSI C84.1. Consider all system voltage drops and supply variation in order to ensure voltage levels are met, from the high voltage main electric supply substation to the low voltage point of utilization. Provide voltage regulators within the facility when the tolerance to demand peaks is not met through conductor sizing or automatic load tap changers in the high voltage main electric supply substation transformer. Provide voltage drop on branch circuits and feeders in accordance with UFC 3-501-01. Base load current for calculation of voltage drop on the circuit capacity as required by UFC 3-501-01; except for feeders, the load current may be based on the frame size of the replaceable plug unit in an adjustable breaker.

11-1.2.8 Risk Assessment for System Categories.

Perform a risk assessment in accordance with NFPA 99 to determine risk categories for activities, systems, or equipment; and the essential power requirement. Use the results of this assessment in conjunction with paragraph 11-4.14 and B-6.2 below to determine loads served and sizing of the alternate power source. The results of the assessment are in addition to the equipment otherwise prescriptively required within this UFC to be served by the essential electrical system. See Appendix C for the timing and responsibilities of the risk assessment.

11-1.2.9 Growth.

Provide the following growth factors:

a. Load Capacity. Provide a minimum 20% spare load growth at 100% demand throughout the electrical system, to include primary feeders, transformers, generators, secondary feeders, and distribution equipment.

b. Bus Space. Provide a minimum of 20% empty bus space in all switchgear, switchboards, and panelboards.

c. Wall Space. Provide a minimum 20% horizontal wall space, to include floor space for cubicle gear, within each separate electrical room for system expansion.

d. Spare Breakers. If the design includes draw-out breakers and the facility includes Category 1 space or is 24/7 or is in-patient; provide one spare draw-out in each frame size on the normal power side and essential power side.

11-1.2.10 Elevators.

Provide design for elevators in compliance with ASME A17.1 and UFC 3-490-06.

11-1.2.11 Containment Laboratories BSL-3, BSL-3+, and BSL-4.

Design BSL-3, BSL-3+, and BSL-4 laboratories in compliance with Biosafety in Microbiological and Biomedical Laboratories, DA PAM 385-69 and DoDM 6055.18-M.

11-1.2.12 Alternative Energy Sources.

If alternative energy sources such as fuel cells or photovoltaics are provided, connect to the normal power system.

11-1.3 OCONUS Criteria.

Comply with requirements herein, except where alternative design standards have been developed and approved in accordance with Chapter 1, to achieve the intent of criteria without compromising safety or property.

11-1.3.1 Federal Republic of Germany.

Incorporate the Hospital Electrical Code Study (U.S. versus German Codes) into Federal Republic of Germany projects to provide equivalent safety to U.S. construction and aid in Joint Commission certification. The study consists of a series of recommendations by subject. Each recommendation is to be considered a design or operational requirement, which either supplements or replaces criteria of this chapter. The study provides for the use of German codes, standards, equipment, materials, and construction practices; through the imposition of the more stringent requirement or the analysis of equivalent safety. The analysis of equivalent safety is based upon specific O&M procedures identified at the Landstuhl Regional Medical Center. These procedures include a comprehensive maintenance program through in-house forces, complete and annual testing of all systems, and a safety program. Consequently, the study only applies to facilities meeting these O&M requirements as identified within the study. A copy of the study is available on the World Class Facilities Toolkit or upon request from CEHNC-EDX.

11-1.4 Campus and Other Large Facilities.

Medium voltage may be approved for the central utility plant, where essential power demand exceeds capacity of commercially available distribution gear, or where facilities are separated from the central utility plant over a distance impractical to transmit power. Submit life cycle cost analysis to include staffing of medium voltage engineers, for approval by the Design and Construction Agent. If medium voltage is approved by the Design and Construction Agent, provide a primary selective, secondary radial system design; which is otherwise in compliance with this chapter.

11-2 AREA DESIGNATIONS.

11-2.1 Patient Care Space.

NFPA 70 and NFPA 99 establish minimum safety practices and requirements for patient care spaces. “Critical”, “general”, “basic” and “support” patient care spaces are identified in Appendix B by NFPA 99 category code 1 through 4. For medical research facilities, laboratories, and veterinary facilities, provide the essential electrical system in compliance with NFPA 99 and NFPA 70 article 517 even though an exclusion is provided in these codes for care not rendered to human beings.

11-2.2 Wet Locations.

Wet locations are those patient care areas that are normally subject to wet conditions, including areas with standing water on the floor or areas where routine dousing or drenching of work spaces is performed, and those areas defined in NFPA 99 and NFPA 70. However, wet conditions as a result of routine housekeeping procedures or an incidental spill of liquid are not considered wet locations.

11-2.3 Wet Procedure Locations.

Wet procedure locations are defined in NFPA 99. They include operating and C-section rooms, but not labor and delivery rooms. Define wet procedure locations in the project requirements documents.

11-3 EXTERIOR ELECTRICAL.

11-3.1 Primary Voltage.

Common primary distribution voltages for military installations are 4.16 kV, 12.47 kV, 13.2 kV, 13.8 kV, and 34.5 kV. However, 12.47 kV, 13.2 kV, and 13.8 kV are the normal primary distribution voltages serving medical facilities.

11-3.2 Normal Source Site Investigation.

Provide exterior electrical systems in compliance with IEEE C2, except where technical criteria are more stringent. Provide site electrical evaluations in accordance with the requirements within this document. Coordinate electrical utility siting with other utilities.

Provide underground distribution on site and visual screening by location or landscaping elements where appropriate for the project to improve overall site aesthetics.

11-3.3 Hospital Normal System.

11-3.3.1 Primary Feeders.

Provide hospitals with two primary feeders, each serving one end of a double-ended substation or to a selector switch serving a multi-ended network substation (Reference Annex B Multi-Ended Network Substation and Annex C Expandable Dual-Ended Substation for additional criteria related to substation design). Size each feeder to carry the full hospital demand, plus 20% spare load growth at 100% demand. Install each feeder in an underground, concrete-encased duct bank within the hospital site. Connect primary feeders to different power sources (main electric supply substations) if available, and differently route the two primary feeders such that they are electrically and geographically separated. Where two main electric supply substations are not available, the service feeders may be connected to two different sections of a true open loop system.

11-3.3.2 Open Loop System.

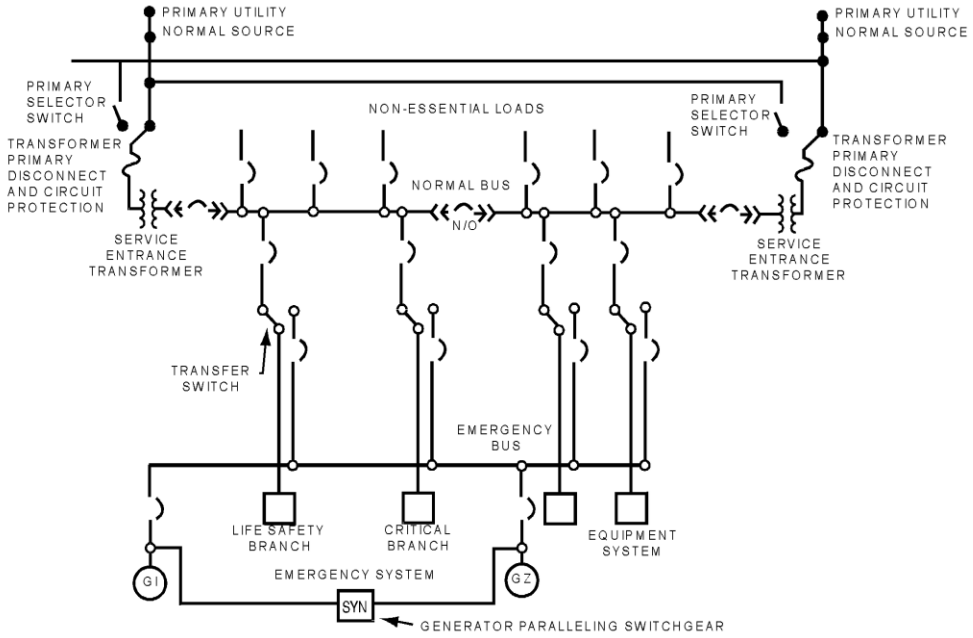
A true open loop system configuration is a utility primary feeder where both ends originate from different main electric supply substations or switching stations, or different breakers and transformers in the same main electric supply substation, and have the capacity to serve the total loop load from either end. Consider both the main electric supply substation primary (high voltage) and secondary (medium voltage) loop configuration, redundancy within the main electric supply substation design (for example, double ended), and outage history in the overall reliability determination. The Government and Public Utility each have defined responsibilities (ownership), and where reliability does not meet standards, provide normal power back up of systems to sustain operations if requested by the DoD Project Sponsor.

11-3.3.3 Transformer Substation.

Provide a manually-operated primary selector switch and fused load break disconnect switch for each transformer as indicated in Figure 11-1. Transformers should normally be located outside the hospital but may be located within the building where practicable and economical. Design double-ended unit substation distribution systems for hospitals, medical centers, and specially-designated facilities. Arrange the double-ended substation for easy expansion from each end. Provide identical and interchangeable tiebreaker and main feeder breakers of double-ended substations. Provide draw-out power class breakers (tie, main feeder, and sub-feeder) for all double-ended and single-ended substations. Size each transformer in the double-ended unit substation to serve approximately 60–70% of the substation demand load (linear and nonlinear) before forced air cooling is initiated, at 100% of demand load plus 20% future load growth with forced air cooling initiated. Provide Impedance-matched transformers. Provide coordinated transient/surge and fault protection for double and

single-ended unit substations. Provide selective system protection. Design all double-ended substations for normal open tie breaker operation, which is interlocked with the main breakers, so that all three breakers “main-tie-main” cannot be closed simultaneously. Upon loss of a single transformer or its feeder, the main breaker is automatically opened and the tie breaker is automatically closed to add its load to the remaining transformer.

Figure 11-1 Hospital One-line Traditional Diagram



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11-3.3.4 Fire Pump Controller.

To prevent unnecessary generator starting due to loss of only one of the two normal power sources, provide an ATS connected to both normal sources to supply normal power to the fire pump controller.

11-3.3.5 Grounding.

Provide adequate system ground for safety and for reliable operation of sensitive users and facility equipment. Typical communications system equipment used in hospitals requires 5-ohm system ground for proper operation. Bond all grounding systems together as required by NFPA 70.

11-3.4 Ambulatory Care Clinics Normal System.

For ambulatory surgery centers, provide dual sources of normal power as described in paragraph 11-3.3. For other ambulatory care clinics, provide normal power as

described in paragraph 11-3.3 Hospital Normal System, except provide only a single primary source and single-ended substation(s).

11-3.5 Medical and Dental Clinics Normal System.

For medical and dental clinics, provide normal power as described in paragraph 11-3.3, except provide only a single primary source and **\1** single transformer. **/1/**

11-3.6 Medical Research Facilities and Laboratories Normal System.

For medical research facilities and laboratories, provide dual sources of normal power as described in paragraph 11-3.3, except a single primary source and single-ended substation(s) is permissible if requested by the DoD Project Sponsor.

11-3.7 Veterinary Facilities Normal System.

Design veterinary facilities as described in paragraph 11-3.3, except provide only a single primary source and **\1** single transformer. **/1/**

11-3.8 Other Medical Facilities Normal System.

Other facilities include blood donor facilities, medical warehouses, or other facilities which do not include patient care space. Design other facilities as described in paragraph 11-3.3, except provide only a single primary source and single transformer, unless described otherwise in programming documents.

11-4 ESSENTIAL ELECTRICAL SYSTEM.

11-4.1 Facility.

11-4.1.1 Hospitals.

Hospitals must be provided with an essential electrical system in compliance with this chapter.

11-4.1.2 Ambulatory Care Clinics.

Design ambulatory surgery centers and ambulatory care clinics with Category 1 spaces in compliance with the requirements of paragraph 11-4.1.1. Design ambulatory care clinics without operating rooms or other Category 1 space in compliance with paragraph 11-4.1.3.

11-4.1.3 Medical and Dental Clinics.

Justification for an emergency generator is required in the planning and programming phase in order to authorize funding. An essential electrical system, with an alternate source of power, will be required if the facility contains Category 2 space; refer to the

patient care space categories in Appendix B. Design the electrical system in accordance with paragraph 11-4.1.1, except as described otherwise in this section.

11-4.1.3.1 System Configuration.

If an essential electrical system is required, provide the system in compliance with NFPA 99 for the space category. If the facility contains Category 2 space, but not Category 1, provide a generator or battery system for the alternate power source; and perform a life cycle cost analysis no later than concept design, to select the economic choice in coordination with the DoD Project Sponsor. For the intent of this section, the battery system only provides for cessation of procedures upon loss of normal power. For either system, provide a permanent switching means to connect a portable or temporary alternate source of power in accordance with NFPA 70 article 700.

11-4.1.3.2 Generator.

If a generator is selected for the alternate power source, a single diesel generator may be used. Locate the generator indoors within a separate room or outdoors in an exterior enclosure with skid mount tank. The fuel supply is to be no less than 8 hours at full load. Provide leak protection system. If an exterior enclosure is used, provide architectural screening compatible with the building and grounds; force protection in accordance with UFC 4-010-01; a sound attenuating enclosure; and hospital grade silencer.

11-4.1.3.3 Battery System.

A battery system for the alternate power source is not allowed for Category 1 space, but is permitted for Category 2 through 4 spaces. If the battery system is used, provide capacity to sustain full connected load at rated voltage for a minimum of 1½ hours. Design the system in accordance with NFPA 111, NFPA 855, and UFC 3-520-05. Provide a separate room for the system if required by the battery type.

11-4.1.3.4 Essential Loads.

Arrange the system to automatically connect the alternate power source to the load within 10 seconds. Design the essential electrical system to supply life safety and task illumination, outlets related to patient safety, and mechanical equipment as determined by the NFPA 99 risk assessment. This typically includes but is not limited to surgical vacuum, medical air, waste anesthetic gas disposal, and any other system or equipment which is necessary for safe and orderly cessation of procedures and all related anesthesia and resuscitation equipment. The critical branch of the essential electrical system is omitted for an NFPA 99 Type 2 system; and in this situation, adjust branch loads as described in paragraph 11-4.14. Provide a minimum of one normal and one essential power circuit in Category 2 spaces or provide separate essential circuits originating from separate essential branch transfer switches.

11-4.1.3.5 Miscellaneous.

Electric driven fire pumps may be connected to the normal power supply if an analysis in accordance with NFPA 20 and UFC 3-600-01 proves the supply is reliable. Normal power may be supplied by a single primary feeder and single ended substation. Draw-out construction is not required for circuit breakers and automatic transfer switch(es). A separate room is not required for automatic transfer switch(es) if the location complies with NFPA 110. If the load is 150 kVA or less, a single transfer switch may be used as permitted by NFPA 70. An interior door for the main electrical room is not required.

11-4.1.4 Medical Research Facilities and Laboratory Facilities.

Justification for an emergency generator is required in the planning and programming phase in order to authorize funding. Provide an emergency and or standby system with an alternate source of power if included in the programming documents.

11-4.1.5 Veterinary Facilities.

Justification for an emergency generator is required in the planning and programming phase in order to authorize funding. An essential electrical system with an alternate source of power will be required if the facility contains Category 1 or 2 space; refer to the patient care space categories in Appendix B. Provide the essential electrical system in compliance with NFPA 70 and NFPA 99, even though an exclusion is provided in these codes for veterinary care. Design the electrical system in accordance with paragraph 11-4.1.3, except if the facility contains Category 1 space, provide a generator for the alternate power source and the fuel supply of no less than 24 hours at full load. Dual sources of critical power, originating from separate critical branch transfer switches are required in some spaces by Appendix B; and the dual sources may be critical and normal.

11-4.1.6 Other Medical Facilities.

Other medical facilities include blood donor centers, medical warehouses, and other facilities which do not include patient care space. Provide an emergency and or standby system with an alternate source of power if included in the programming documents. Justification for an emergency generator is required in the planning and programming phase in order to authorize funding.

11-4.2 General.

Provide the alternate power source in conformance with NFPA 70 and NFPA 99, except where technical criteria from the DoD Project Sponsor is more stringent. Provide adjustable trip spare circuit breakers, raceway, and buss bar connection box for load bank testing. Size load bank breaker for 100% capacity of one generator set; and provide a second breaker, 100 A, 3-phase, for the load bank fans. Cable to be provided by user after turnover. Provide additional load capacity to those hospitals assigned mobilization or mass casualty response missions as identified in the project DD Form

1391. Design the emergency power source as a separately derived power source. Provide true root mean square (RMS) metering for load monitoring.

11-4.3 Alternate Power Source.

Provide an alternate power source to supply the essential electrical system during interruption of the normal source as required by NFPA 70 and NFPA 99. Provide parallel operation by two or more generator sets in accordance with Figure 11-1 (see Annex B and Annex C for alternate configurations); except where the essential electrical system load is 150 kVA or less, one generator set may be considered. Consider factory service, parts, and supplier support in the design.

Provide generator sets of equal capacity and rating when operated in parallel with matched impedance and loss characteristics, and designed to carry in parallel or through priority transfer equipment the maximum demand load (linear and nonlinear) of the essential electrical system. Evaluate motor starting and X-ray unit momentary kVA loads when sizing generator sets. Size each generator set for the capacity to serve all non-sheddable loads (life safety and critical branches, medical air compressor, medical-surgical vacuum pumps, jockey pumps, fire pumps, generator set fuel pumps, other generator set accessories, and non-sheddable helipad loads) plus 20% future load growth at 100% demand. Provide generator set performance class and transient limits in compliance with UFC 3-540-01, and include block loading calculations in the project documentation. Hospitals built under the 1971 version of NFPA 70 may have a life-support branch that is the second critical branch supplied by a separate ATS.

11-4.4 Generator Sets.

Provide diesel-electric generator sets in conformance to Table 11-1. The preferred generating voltage is the highest utilization voltage proposed for the facility. Normally, 480Y/277 V, 3-phase, 60 Hz, 4-wire system is the highest utilization voltage. Higher voltages may be generated where line losses would otherwise be excessive. Include automatic start-and-stop equipment, solid-state battery chargers, fuel storage tanks, remote NFPA 110 panel and audible and visual warning devices to alert of less than four hours of fuel supply, and day tanks and radiators (as required) all as part of the generator set design. Provide the generator set with a hospital grade exhaust silencer and the ability to start and assume its full electrical loads within 10 seconds from the interruption of the normal source. Provide protective relaying for generator sets and related equipment in accordance with the recommendations of IEEE STD 242, including reverse power relays in accordance with NFPA 110 to prevent damage from commercial power or other onsite generators. Equip all generator sets with an isochronous governor to ensure stable voltage, frequency, and power by preventing erratic load operations and allowing computerized equipment to operate directly from the essential electrical system.

11-4.5 Location of Generator Sets.

Locate generator sets in the central utility, provided it is sufficiently close to minimize line losses and cable runs. When the central utility plant is remote from the medical structure, locate generator sets in a building adjacent to or within the medical structure. Locate generator sets and related switch gear rooms (auxiliaries) near the building exterior to facilitate installation and replacement of equipment. Arrange generator sets and auxiliaries so minimum facility modifications are required for future installation or replacement. Do not install service entrance transformers and other equipment not supporting the essential electrical system in the same area (room) as the generator sets. Provide a view window in, or adjacent to, the entrance door.

Do not locate generator sets and auxiliaries below finish-grade level. Locate generator sets and auxiliaries directly accessible from the facility's interior and exterior to a vehicular way. In regions subject to flooding, locate equipment above the Design Flood Elevation and provide flood proofing in accordance with paragraph 11-5.4.4.

Table 11-1 Continuous and Emergency-Rated Diesel-Electric Generator Sets

Power Class Categories:
1. **Prime Power Class** engines are for use with diesel-electric generator sets expected to provide power on a continuous basis, that is in excess of 4000 hours annually or in excess of 40,000 hours during the initial 10 years of operation, to serve as the sole or primary source of power.
2. **Standby Power Class** engines are for use with diesel-electric generator sets expected to provide power on a standby basis for a significant number of hours each year, that is between 1000 and 4000 hours annually or between 10,000 and 40,000 hours during the initial 10 years of operation.
3. **Emergency Power Class** engines are for use with diesel-electric generator sets expected to provide power on an emergency basis for a short period of time, that is less than 1000 hours annually or less than 10,000 hours during the initial 10 years of operation.
DESIGN APPLICATION:
1. For 50-Hz power, the indicated speed limits should be reduced to the nearest synchronous speed for that frequency.
2. Hospital and ambulatory care center diesel-electric generator sets are normally Emergency Power Class.
3. For diesel-electric generator sets used for co-generation in hospital and ambulatory care center, provide either Prime Power Class or Standby Power Class.

11-4.6 Engine Starting.

Provide electric or pneumatic starting for generator sets in conformance to NFPA 70, NFPA 99, and NFPA 110. Where electric start is used, provide dual heavy-duty electric starters on generator sets above 1,250 kVA.

11-4.7 Manual Test Switches.

Provide manual test switches for each ATS of the essential electrical system. Provide a group of test switches at a single point in the generator set control area, and one test switch with each ATS. Wire the two test switches associated with each ATS in series to allow testing at either location. Provide capability to test either individual ATS or the entire essential electrical system. Upon depressing any test switch a simulation of a normal power source failure is to occur. The simulation is to automatically cause the generator sets to crank, to attain rated frequency and voltage, and to transfer associated essential electrical system loads from the normal source to the alternate power source; and after 30 minutes of operation in the emergency mode, automatically transfer essential electrical system loads back to the normal source. If for any reason during the simulation, the generator sets experience difficulty while in the emergency mode, immediately transfer load to the normal source automatically. During this simulation, continue serving nonessential hospital loads from normal source without interruption. Install a manual override switch that can be actuated to keep essential hospital loads on the alternate power source as long as desired and which permits generator sets to operate indefinitely beyond the 30-minute automatic transfer restoration time.

11-4.8 Generator Set Operation.

11-4.8.1 Generator Starting.

Design generator sets to function as discussed here. After one second following interruption of the normal source, each generator set is to receive the starting signal simultaneously from the ATS, whereupon each generator set is to automatically crank and attain normal speed and voltage. Do not bundle the starting signal together or series connect between ATS’s. Voltage for sensing devices to start generator sets is to be taken from each phase of the incoming normal power terminal of each ATS and hardwired back to the generator set start controls. The first generator sets to reach preset voltage and frequency conditions are to be automatically connected to the emergency bus.

11-4.8.2 Paralleling and Load Transfer.

Provide system protection to prevent simultaneous connection of non-synchronized generator sets to the dead emergency bus. Provide a priority selective device programmed or preset to transfer the non-sheddable loads from the normal bus to the emergency bus within 10 seconds from time of normal source interruption. The remaining generator set(s) are to automatically synchronize with the emergency bus,

close the respective generator SET breaker, and connect the generator sets in parallel for normal operation. After this, automatically transfer the equipment system loads to the emergency bus by programmed or preset incremental steps.

11-4.8.3 Load Shedding System.

Where two or more units are paralleled, provide a load management system in compliance with NFPA 99 and 110. For such system, provide automatic load shedding with manual override that will commence should one or more of the generator sets fail to crank or is shut down for any reason during the operation, or if the total load were to exceed a preset value beyond which a cascading shutdown could occur. Schedule the remaining generator set(s) to serve only the non-sheddable loads, and if possible, highest priority equipment system loads until the failed unit(s) is energized and connected to the emergency bus. For such a condition, provide a programming device to shed all or part of the equipment loads to keep the remaining generator(s) within its kW rating. Design the system in accordance with UFC 3-540-01 and provide for load prioritization by operation and maintenance. Provide a system with redundant processors with wiring and control not shared with other building systems. Provide load priority, sequence, and time delay.

11-4.8.4 Manual Override.

Provide a manual start switch to override the automatic start of the generator sets so they can be cranked, synchronized, and connected on the emergency bus. Provide manual controls to allow the synchronizing and paralleling of the generator sets.

11-4.8.5 Return to Normal Power Source.

Thirty minutes following the return of a stable, normal source, automatically transfer essential system loads to the normal source. Provide an automatic timer for this transfer, having an adjustable time range from 2 to 30 minutes (set at 30 minutes). Following transfer of the loads, generator sets are to continue to run unloaded for a period of not less than 15 minutes for cool-down before shutdown; after which controls automatically reset for a new cycle. Provide a manual start switch to override the automatic start of generator sets so they can be manually cranked, synchronized, and connected to the emergency bus if automatic controls fail.

11-4.9 Automatic Transfer Switch (ATS).

Provide double-throw, open-transition, ATSs with draw-out construction. Use 4-pole ATSs when serving line-to-neutral loads or a combination of line-to-neutral and line-to-line 3-phase loads. Use 3-pole ATSs when serving only 3-phase line-to-line loads. Provide ATSs which are UL tested with the main up-stream breaker to ensure coordinated withstand compatibility between the ATS and the interruption time of the breakers. Circuit-breaker-type transfer switches are not acceptable. Provide green indicator lights to identify normal power and red to identify emergency power in each ATS. Provide each ATS with at least three normally open and three normally closed

spare shaft contacts. Equip each ATS with a load break bypass isolation switch (BP/IS) to maintain normal or emergency power while the ATS is being repaired or maintained. Provide for BP/IS operation with not more than two movements of the hand to either position regardless of the position or condition of the ATS. **\1\ /1/** Provide an in-phase monitor to prevent an out-of-phase transfer in each ATS feeding high efficiency motors rated 25 hp (18.6 kW) or larger. Provide in-phase transfer without control of the frequency of either power source to prevent excessive motor in-rush current. Use of closed-transition switching for facilitating essential system testing **\1** or paralleling with utility requires DoD Project Sponsor authorization, approval by the Installation Management Organization (IMO), and approval by the utility as described in UFC 3-540-01 **/1/**. The BP/IS for the ATSs serving nonessential equipment can be optional.

11-4.9.1 ATS and BP/IS Location.

For hospitals and ambulatory surgery centers, locate the ATS and BP/IS equipment in a separate room with 2-hour fire-rated construction having direct access from the normal main power equipment room and the alternate power source equipment room.

11-4.9.2 ATS and BP/IS Testing.

Provide for conduction of laboratory testing, for example, UL, Factory Mutual (FM), or other nationally recognized authority, on the ATS and BP/IS equipment, unless it was completed on a previous randomly selected standard production unit of the same model and capacity as the specified ATS and BP/IS equipment. Conduct the overload, endurance, and temperature tests (in sequence) as listed here:

a. General
b. Normal Operation
c. Overvoltage
d. Under-voltage
e. Overload
f. Endurance
g. Temperature Rise
h. Dielectric Voltage – Withstand
i. Contact Opening
j. Dielectric Voltage – Withstand (Repeated)
k. Withstand
l. Instrumentation and Calibration of High Capacity Circuits
m. Closing
n. Dielectric Voltage – Withstand (Repeated)
o. Strength of Insulating Base and Support.

It is important to note that no deviations from the test sequence are permitted. Approval is not granted to deviate from the overload, endurance, and temperature test sequence.

11-4.10 Ground Fault Protection Equipment.

Do not provide ground fault protection devices on the essential electrical system. Provide ground fault detection features, when required, to indicate a ground fault and sound an audible alarm but not trip the breaker, for the generator circuit breaker and essential electrical main distribution board circuit breakers. Provide activation level for each ground fault alarm sensor when the ground fault current is 10% of the breaker rating or 50 A, whichever is less.

11-4.11 Remote Alarm Annunciator.

Provide a remote alarm annunciator that receives power from a storage battery in a location readily observed by operating personnel at a regular workstation. Indicate alarm conditions on the annunciator of the alternate power source, as indicated in NFPA 99 and NFPA 110, and include (but is not limited to): battery and battery charger malfunction, engine generator run status, engine generator alarms, and less than a 3-hour fuel supply in the day tank and 24-hour supply in the main storage tank. Provide a separate audible and visible derangement signal within the hospital at a continuously monitored location. Reference Chapter 12 for details. This derangement signal need not display individual alarm conditions; however appropriate labeling is required.

11-4.12 Fuel Storage System.

11-4.12.1 Fuel Tanks.

Provide fuel storage tanks and installations in compliance with NFPA 30 and local, state, and Federal Environmental Protection Agency (EPA) policies and regulations. Provide a 4-day capacity at full load for the fuel oil tank sized to the nearest standard size. For remote locations OCONUS and for prime power projects, fuel storage capacities may be larger based on mission requirements or risk analysis as determined by the DoD Project Sponsor. If underground fuel storage tanks are required, provide double-walled with leak detection in accordance with EPA standards. Provide separate day tanks for each generator set, sized for not less than four hours of operation at full load, with an overflow back to the main storage tank. Base fuel usage at full load on manufacturer's full load test data. Follow NFPA 37 for fuel tanks inside of structures.

11-4.12.2 Transfer Pumps and Fuel Filtration.

Provide at least two transfer pumps arranged such that all pumps are capable of drawing from and returning fuel to any selected main storage tank. Provide quantity and sizing of pumps such that should any pump be out of service, the remaining pump(s) will meet the total fuel demand of all boilers (if applicable) and generators. Provide fuel filtration system per recommendations of the generator set manufacturer, to meet NFPA 110 and maintain the integrity of on-site fuel for up to 10 years. Include

automatic particulate filtration, dewatering, and fuel additive injection in the fuel filtration system. Fuel filtration system does not apply to systems with 8 hours or less capacity.

11-4.12.3 Fuel.

\1 Design engine-generators to operate on No. 2-D diesel conforming to ASTM D975. **/1/** Do not use natural gas or comparable gas fuel as an operating fuel for hospital emergency power generation.

11-4.13 Loads on the Alternate Source.

Provide a capacity in the alternate power source to supply the facility's essential electrical system as outlined in NFPA 70 and NFPA 99, as modified herein, and as required by items listed in Appendix B. Do not oversize generator sets such that load banks are necessary for testing under load as required by accreditation authorities. It is important to note that operating generator sets at low loads leads to fouled combustion and unreliable performance. Supplying a mixture of normal, critical, and equipment branch power to critical care areas is more reliable and is recommended in NFPA 99. Additional loads may be added to the critical branch or equipment system by the DoD Project Sponsor as needed to improve the facility's operations. Do not connect other loads to the life safety branch other than those loads identified in NFPA 70 and NFPA 99.

11-4.14 Essential Loads.

Essential loads are divided into three branches: life safety, critical, and equipment. These loads receive both normal and emergency power. Essential branch assignment is specified for medical gas in Chapter 9, and for telecommunication systems in Chapter 12. An NFPA 99 Type 1 system has life safety, critical, and equipment branches; while an NFPA 99 Type 2 system only has life safety and equipment branches. The branch assignment provided in this UFC is for an NFPA 99 Type 1 essential electrical system. For a facility without Category 1 space which has an NFPA 99 Type 2 essential electrical system, map critical branch loads to life safety and equipment branches in accordance with NFPA 70 and 99.

11-4.14.1 Life Safety Branch Loads.

The life safety branch provides emergency power to ensure patient and personnel safety during the interruption of normal power source. The lighting, receptacle, and equipment limitations listed here are defined by NFPA 70 and NFPA 99. Life safety branch provides power to the following:

a. Egress illumination, which includes 25% of corridor and 50% of stairway illumination, plus 25% of assembly areas, such as dining rooms.

b. All battery chargers for emergency battery-powered lighting units used in the event of a life safety branch outage.

c. Exit signs for marking of egress.

d. Fire alarm systems and piped medical gas alarm systems, including smoke detectors, medical vacuum system alarms, and alarms for ventilation for smoke evacuation for those areas where patient evacuation is not feasible.

e. Emergency communications used to notify the general population (radio paging [RP] and intercom systems) including telephone system, power and lighting for communication closets and crisis control centers, and associated equipment. Various related systems are included as directed.

f. Selected power, task lighting, and receptacles at generator set locations; in transformer, switchboard, mechanical, and electrical equipment rooms; repair shops and other equipment rooms; and charger for battery-powered emergency light sets.

g. Elevator cab lighting, control, communication, and signal systems.

h. Electric-powered doors used for building egress.

i. Auxiliary functions of fire alarm mass notification systems complying with NFPA 72.

j. Fuel transfer pump, battery charger, jacket water heaters, alarms, controls, air compressors for pneumatic start, and other similar generator systems accessories essential for generator operation.

11-4.14.2 Critical Branch Loads.

The critical branch provides essential electrical system alternate power to supply task illumination, fixed equipment, selected receptacles, and special power circuits serving areas and functions related to patient care during the interruption of normal power as listed here, derived from NFPA 70 and NFPA 99. The critical branch provides power to the following:

a. NC, telephone equipment rooms and closets, and selected computer equipment and selected data outlets.

b. Oxygen and medical gases equipment, MV pumps, and medical surgical compressed air system, and surgical vacuum pumps.

c. In patient rooms (on inpatient nursing units), provide one duplex receptacle per bed, including mobilization beds, located in the patient service console. Provide two additional wall-mounted duplex receptacles in single bedrooms and pediatric bedrooms.

d. Receptacles in nursery isolation rooms, cystoscopy, intravenous pyelogram (IVP) rooms, cardiac catheterization room, radiographic special procedure rooms, **\1\ /1/** and recovery rooms as indicated in Appendix B.

e. All receptacles and hard wired equipment in selected rooms in the surgery suite, the delivery suite, nursery, coronary care unit, ICUs, hemodialysis, and emergency department rooms/spaces as required by Appendix B.

f. All equipment for the refrigerated storage of blood, biological, and pathology specimens, and medicines.

g. Two X-ray rooms (including one fluoroscopic room) **\1\ /1/**.

h. Laboratories, incubators, analysis, blood bank, bone and tissue banks, chemistry, hematology, plus selected receptacles.

i. One flash sterilizer in each surgical suite and delivery suite cluster core and in central sterilization.

j. Selected receptacles in admitting and disposition, pharmacy, treatment rooms, nurse stations, **\1** oral surgery dental treatment rooms, comprehensive dental treatment rooms and periodontic dental treatment rooms. **/1/**

k. Medication preparation stations and nourishment stations.

l. Electronic data equipment for patient records.

11-4.14.3 Equipment Branch Loads.

Equipment branch feeders and branch circuits connected to the emergency and alternate power source automatically supply loads in a delayed selective order through ATSs. The equipment list noted here is derived from NFPA 99 and NFPA 70. The equipment branch provides power to the following:

a. One passenger type and one hospital service elevator per hospital wing (or section if applicable) to operate on a selective basis.

b. Fire pumps, jockey pumps, and controls (non-sheddable loads); with own listed controller and configured for 10-second start-transfer. See exception, paragraph 11-4.1.3.

c. Food service refrigeration, morgue refrigeration, pharmacy, laboratory, research, and other locations as determined by risk analysis of the DoD Project Sponsor.

d. Essential power for auxiliaries and controls to provide safe operation of the heating plant.

e. Medical vacuum, waste anesthesia evacuation, and medical air system.

f. Dental vacuum, dental air, and waste anesthesia gas disposal serving Category 2 spaces for oral surgery and comprehensive treatment as determined by the DoD Project Sponsor and NFPA 99 risk assessment.

g. HVAC systems, including cooling and heating equipment and controls for all critical care areas per Chapter 10.

h. Domestic water, sump, and sewage equipment necessary for continuous hospital operations.

i. Special purpose exhaust systems, hoods in laboratories including radioisotope hoods, and isolation room exhaust fans.

j. The pneumatic tube system (PTS).

k. Helipad lighting and visual navigational aids. Note: If night/twilight operations are required, provide 15 minutes of battery backup to obtain no-break system and connect as a Priority 2 load. Where helipad operations are essential, provide a Priority 1 non-sheddable equipment connection.

11-4.15 Alternate Source Testing.

Test alternate power source essential electrical systems for proper operation before final acceptance, as required by NFPA 99 and 110. Prior to testing, make all connected loads operational and operate within normal demand load tolerances. Design alternate power systems to facilitate periodic system-wide and component testing and inspection.

11-5 INTERIOR ELECTRICAL SYSTEMS.

Conform to NFPA codes, except where technical criteria from UFC 3-520-01 and this document are more stringent. Use only copper conductors. Use only copper bus in switchgear, switchboards, panelboards, and for grounding points.

11-5.1 System Voltage.

Systems with 480Y/277 V, 460 V, 208Y/120 V, 240 V, and 120 V low voltages, and 4.16 kV and 6.9 kV medium voltages are common utilization voltages found at military installations. However, 480Y/277 V and 208Y/120 V are the standard utilization voltages for new and existing medical facilities. Only chillers may be served by medium voltage, and when so, provide separate generators to supply them that are not part of the essential electrical system.

11-5.2 Interior Distribution.

11-5.2.1 Utilization Voltage.

Serve interior lighting and power loads at the highest voltage practicable. Supply fluorescent and high intensity discharge (HID) lighting systems and building power loads by a 480Y/277 V system. Use dry-type transformers to furnish 208Y/120 V power for receptacles and small equipment loads. Provide a 208Y/120 V system where the use of higher voltage is not cost effective.

11-5.2.2 Transformers.

Provide dry-type transformers in accordance with UFC 3-520-01 and TSEWG TP-5, using de-rating or harmonic mitigating transformers for non-linear loads. Analyze non-linear loads in each building area using Table 11-2 Sample Nonlinear Load Analysis Matrix. Where transformer-type voltage regulators are used to maintain nominal voltage within plus or minus 5% (see paragraph 11-1.2.7), use an automatic step or induction

transformer regulator with adjustable high and low-voltage limit controls and a voltage meter.

Table 11-2 Sample Nonlinear Load Analysis Matrix

Service Module Type	Total Recept. kVA	Estimated Non-Linear kVA	Module XFMR Size	Non-Linear Percent of Total kVA	XFMR Rating
Clinic					
Logistics					
Dentistry					
Pulmonary					
ICU					
Surgery					
Food Service					
Labor/Delivery					
CCU					
ICU					
Orthodontics					
Physical Therapy (PT)					
CMS					
Nuclear Medicine					
Emergency					
Waste Management					
Materials					
Radiology					
Collecting Labs					
Pathology					
Chemistry Laboratory					
Pharmacy					
Social Work					
Auditorium					
Patient Services					
Nursing (3 Mods)					
Administration					

11-5.2.3 Switchgear, Switchboards, and Panelboards.

In this chapter switchgear, switchboards, and panelboards conform to definitions in NFPA 70. Switchgear below 1000 V is metal enclosed and above 1000 V metal clad per IEEE C37.20 series of standards. **\1**

11-5.2.3.1 General.

Provide solid-state, adjustable trip circuit breakers as required to meet the overcurrent protection coordination requirements of paragraph 11-5.3. Provide ground fault protection, including ground fault protection of the essential electrical system, in accordance with NFPA 70 and NFPA 99.

11-5.2.3.2 Draw-out.

Provide draw-out breakers in hospitals, ambulatory surgery centers, and 24/7 patient care facilities for unit substations, service entrance equipment, equipment with buss work 2000 A or greater, and the essential electrical system down to the first level below an ATS. An exception is the first level below an ATS supplying motor control centers or panel boards 600 A or less. Provide draw-out breakers similarly in other facilities in which buss work is 2000 A or more. **/1/**

11-5.2.4 Power to Fire Alarm Fire Detection Mass Notification.

In lieu of providing dedicated distribution panel(s) to supply the fire alarm detection mass notification system as required by UFC 3-520-01; provide dedicated circuits from life safety branch panels and comply with the power supply requirements of NFPA 72. Follow UFC 3-520-01 if no essential electrical system is available.

11-5.2.5 Power to Telecommunication Spaces.

\1 UFC 3-580-01 requires a dedicated distribution panel in each TR. In an MTF that has an essential electrical system, a TR my require circuits from multiple panels, but space is limited to one panel only. If the building has a Type 1 essential electrical system, provide a critical branch panel in the TR. If the building has a Type 2 essential electrical system, provide an equipment branch panel in the TR. Serve the remaining loads in the TR with dedicated circuits from the normal panel or other essential electrical panels in the electrical room in accordance with Table 12-1 power branch assignments. **/1/** Follow UFC 3-580-01 if no essential electrical system is available.

11-5.3 Short Circuit, Selective Coordination, and Arc Flash.

Conduct short-circuit, protective devices coordination, and arc flash studies in accordance with UFC 3-501-01 and NFPA 99. Conduct the studies in the design stage and again in the construction stage with the actual equipment installed. Provide protective devices settings within the studies. Base the selection of protective devices and equipment for a new electrical system on the study analysis. For additions or modifications to an existing system, include all the protective devices affected in the

existing system in the analysis. Coordinate all protective devices for **\1** the period of time that a fault's duration extends beyond 0.1 second. **/1/** Series rated protective equipment or devices is not allowed. Incorporate transient/surge protection in the selective coordination analysis.

11-5.4 Electrical Rooms.

11-5.4.1 Main Electrical Rooms.

Main electrical rooms include service points, rooms with generators or other large equipment assemblies such as substations and feeder panels; in which direct access is required for initial installation, for removal and replacement, for maintenance, or for ease of access by maintenance staff. Provide main electrical rooms with direct exterior access to a vehicular pathway and loading point. Provide main electrical rooms additionally with access from the facility's interior if any of the following apply:

a. The facility is 24/7.

b. The electrical service is 1,200 A or more.

11-5.4.2 Branch Electrical Rooms.

Branch electrical rooms include electrical closets and related distribution. Provide a minimum of one branch electrical room for each smoke compartment. Provide a minimum of one branch electrical room for each 22,500 ft^2 (2,090 m^2). Do not feed loads beyond the smoke compartment in which the branch electrical room is located. Do not exceed three percent voltage drop on branch circuits. Do not oversize branch circuits such that junction box jumpers are required.

11-5.4.3 Location and Layout Considerations.

Consider the following impacts for electrical room location and layout:

a. Provide access off of a primary through corridor. Swing entry door(s) out 180 degrees, so as not to impede traffic flow in the corridor or violate clearance requirements of NFPA 70 within the room.

b. Consider relative location to mechanical rooms, in order to minimize above ceiling congestion of raceway, cable trays, ducting, and piping. Pipes and other equipment foreign to electrical equipment are not permitted to be located in, enter, or pass through electrical rooms or spaces.

c. Do not locate electrical rooms adjacent to TRs.

d. Locate electrical rooms to minimize runs, but not interfere with patient care areas. Locate panelboards in critical care areas in the vicinity of their loads. Provide access to operating staff only.

e. Do not locate electrical rooms adjacent to spaces having stringent noise control requirements. Locate dry-type transformers and automatic transformer type regulators away from noise-sensitive areas.

f. Provide adequate ventilation to maintain an ambient temperature not to exceed 86 ^{o}F (30 ^{o}C).

g. For facilities with more than one floor, stack electrical rooms vertically.

h. Provide sufficiency of space to enable access for operation and maintenance, or equipment replacement. Show the footprint for each piece of equipment with working space and NFPA 70 clearance requirements on the drawings submitted.

i. **\1** Locate electrical panels in electrical rooms in new construction. There are two exceptions. First, TRs, due to special circuiting requirements, follow paragraph 11-5.2.5. Second, **/1/** limited dedicated panels provided in the room served such as X-ray, server, mechanical, and operating rooms; where all of the following apply:

- Ready access to the panel is required by the room function or the room equipment is subject to frequent change.
- All branch circuits in that panel serve that specific room only and the room provides access to only qualified individuals.

11-5.4.4 Flood Proofing of Electrical Rooms.

Base flood elevation (BFE) and design flood elevation (DFE) are defined in ASCE 24. The former is one percent chance of occurrence in any given year; latter is the datum specified on community flood hazard map. Electrical rooms should be above grade for access and reliability of equipment; though may be located below grade, provided the location naturally drains above the DFE and flood resistant construction is provided below DFE in accordance with International Building Code (IBC) Section 1612 and ASCE 24. DFE is to be no less than two feet above BFE, except where higher elevation is required by ASCE 24. For the intent of this paragraph, natural drainage is defined as not dependent upon a sewer line, which may back up; and where impractical to provide natural drainage, slope floors to sumps affixed with alternating duplex pumps on essential power and elevate equipment on pads 8 inches above floor level. Provide a hoist shaft for equipment removal and a stairwell for direct access for main equipment rooms located below grade. Provide anti-desiccant strip heaters in electrical equipment located below grade. Protect exterior openings from in-flow, such as stairwell, hoist shaft, drive, or loading dock. Provide sump pump capacity to meet predicted precipitation events. Provide seals in raceway exiting the building 5-foot line designed for the number and size of cables enclosed.

11-5.5 Isolation Power System.

Provide an isolation power system in Category 1 spaces designated wet procedure locations (see paragraph 11-2.3). Provide each operating room with a minimum of two

single-phase panelboards. Connect isolation power panels to the same phase. Locate isolation power panels and the line isolation monitor in the room served. Do not use ground fault circuit interrupters (GFCI)'s. Design isolation power system in accordance with NFPA 70 and 99. Provide grounding in accordance with paragraph 11-5.11.

11-5.6 Conduit, Cable Tray, and Wire.

In this chapter, conduit and raceway conform to definitions in NFPA 70. Provide insulated copper conductors in metallic raceways installed in accordance with NFPA 70 and UFC 3-520-01 except as noted below. Run a green insulated copper ground conductor with all feeders and branch circuits. Provide an independent neutral in addition to the separate green insulated grounding conductor in all single-phase circuits. In new construction, provide uniformly sized branch circuits from the branch circuit breaker to point of utilization; do not upsize conductors where a junction box and jumpers are required to make the final connection. The use of metal-clad and armored cable is prohibited inside the facility, except where integral to listed assemblies. PVC conduit may only be used below slab on grade in accordance with NFPA 70 and applicable UFCs, in which grade transitions are required to be metallic. Additional requirements are as follows:

a. Serve each electrical room on each floor of multi-story facilities by separate or independent feeder risers of insulated copper conductor in steel conduit. Locate the equipment serving the risers in these facilities in ATS rooms for the essential electrical system and the main electrical rooms for the normal power system.

b. Use only steel compression fittings with electrical metallic tubing (EMT). Do not use die-cast fittings.

c. Do not install conductors to furnish emergency power in the same raceway with normal power conductors.

d. Install all normal and emergency power junction boxes, pull boxes, and similar parts in order to be readily accessible. Install clearly identified access panels as necessary for proper maintenance and operation of the electrical distribution system.

e. Install low voltage control wiring, typically used for lighting and receptacle control, in non-flexible metallic raceway or cable tray separate from telecommunications cable tray.

f. Terminate horizontal telecommunication raceway at the cable tray with a fitting specially designed to clamp the raceway to the tray (for solid type tray) or a specially designed clamp to bond the raceway to the tray (for welded wire type tray).

g. Bond TR ground bars in accordance with TIA-607 with ground conductors placed in raceway.

11-5.7 Branch Circuits.

Provide circuits for patient care areas in compliance with NFPA 70 and NFPA 99, except where applicable criteria require more stringent standards.

11-5.8 Radiology Provisions.

11-5.8.1 X-Ray Rooms.

Supply radiological equipment by a 3-phase, 5-wire neutral and ground 480Y/277 V feeder from the main distribution switchboard to an enclosed circuit breaker disconnect located adjacent to the associated X-ray control room. Do not include X-ray loads in the demand load. Evaluate effect of X-ray unit momentary kVA load on transformer voltage regulation. Increase transformer size as necessary and size feeders for satisfactory system performance. Do not provide separate service transformers to the X-ray units. Provide a single-phase 120/208 V branch circuit panelboard in each room for X-ray unit peripheral equipment. Additional requirements for Universal X-ray rooms are contained within Appendix D.

11-5.8.2 Mobile X-Ray Unit Outlets.

Mobile X-ray equipment in nursing units are normally battery operated. Provide duplex receptacles rated 20 A, 125 V for battery recharging in designated areas and connect to the equipment branch of the essential electrical system. Receptacles.

\1 In this chapter, receptacles conform to definitions in NFPA 70. A receptacle is a single contact device unless stated otherwise. ***/1/*** Provide specification grade receptacles, heavy duty, normally straight blade type, rated 20 A, 125 V, 2-pole, 3-wire, grounded type. Provide no less than 20 A rating for all other receptacles including those dedicated to medical equipment. Provide 20 A rated general purpose multi outlet branch circuits to serve receptacles. Do not place more than four duplex receptacles on a circuit serving desk locations (work stations) and provide a non-shared neutral. Do not place more than six duplex receptacles on a circuit in other locations, including patient care spaces, and more stringent requirements follow in the paragraphs below. Where a power receptacle is incorporated in the same metal box with a television or data outlet, provide a partitioned metal box with separate power and signal conduits as required. Offset outlets in adjoining room walls to isolate airborne sound as specified in Appendix B and as required by the Fire and Smoke Protection Features chapter of the IBC. Coordinate special purpose receptacles with the equipment to be provided.

11-5.8.3 General Purpose Receptacles.

Provide a minimum of one duplex receptacle per wall in each room or interior area, except as noted below. Do not exceed 12 ft (3.6 m) spacing. In rooms where partitions exceed 10 ft (3.0 m) in length, provide an additional duplex for each additional 10 ft (3.0 m) feet of wall space or fraction thereof. Provide minimum of one duplex within 12 in. (300 mm) of each telecommunication outlet. Provide two duplexes at each desk location (work station), including future desk locations in offices which have a second

telecommunication outlet. Provide six duplex in offices; except provide eight duplex in offices with a plumbing connection box (for future conversion to an examination room). Provide one duplex every 3 ft (900 mm) of casework in nurse stations, nurse substations, reception counters, and control counters. Provide one duplex every 50 ft (15 m) in corridor walls. In alcoves fronting corridors in which equipment may be located, provide duplex receptacles in addition to corridor receptacles, so no point on the wall is more than 3 ft (900 mm) from a receptacle. Provide one duplex within 25 ft (7.5 m) of installed equipment requiring maintenance. Do not provide receptacles in public toilets, staff toilets outside of command areas, closets, janitor closets, and scrub rooms. Do not use floor receptacles where the wiring device extends above the floor. Provide general purpose receptacles in addition to special purpose and dedicated outlets for special equipment. See DoD Project Sponsor to identify receptacles in special areas.

11-5.8.4 Hospital-Grade Receptacles.

Provide hospital-grade receptacles where required by NFPA 70, including all Category 1 and 2 locations, and any location with either a patient bed or patient service console.

11-5.8.5 Telecommunication Rooms.

\1 Provide TRs with receptacles as described in Chapter 12 and at least one duplex receptacle on each wall. **/1/**

11-5.8.6 Tamper-resistant Receptacles.

Provide tamper-resistant receptacles in locations required by NFPA 70 and 99 and as follows. Provide tamper-resistant receptacles in all areas where children may be present to include corridors, waiting areas, and examination rooms. In pediatrics, also provide tamper-resistant receptacles in patient rooms, bathrooms, playrooms, and activity rooms. In behavioral health, provide tamper-resistant receptacles in accordance with Appendix A. Use receptacles designed to prevent shock hazards from metallic objects that might be inserted into the receptacle slots; do not use tamper-resistant receptacle covers.

11-5.8.7 Ground Fault Circuit Interrupters.

Provide Class A, GFCI receptacle protection in wet locations and where required by NFPA 70. See paragraph 11-2 for definition of wet locations and wet procedure locations. Do not provide GFCI on circuits serving critical life support equipment where interruption of power could cause injury or death, for example, wet procedure locations in operating rooms. GFCI breakers are not permitted, except as noted. Provide a dedicated Class A, GFCI circuit breaker and circuit for each behavior health in-patient room in which receptacles are located controlled by a single switch outside the room under staff control. Wet locations include the following:

- Hydrotherapy

- Therapeutic pool areas
- Patient toilet areas with or without showers
- Staff lockers with toilet or shower areas
- Staff lounge with kitchen facilities
- Outdoor receptacles
- Other locations required by NFPA 99 and NFPA 70
- Receptacles accessible from a building roof
- Crawl spaces
- Emergency Shower/Emergency Eyewash

11-5.8.8 Patient Bedrooms.

Provide critical care patient bed locations (patient headwalls) with a minimum of 14 duplex receptacles. Provide general care patient bed locations (patient headwall) with a minimum of eight duplex receptacles. Do not place more than two duplex receptacles on a separate 20 A, 125 V circuit in critical care patient bed locations.

11-5.8.9 Renal Dialysis Units.

Within renal dialysis units, provide four hospital-grade duplex receptacles on each side of the patient bed or lounge chair. Provide normal and critical branch power.

11-5.8.10 Nurseries.

Provide each intensive care nursery with 16 simplex receptacles. Provide each intermediate care nursery with eight simplex receptacles. Provide each nursery in admission, observation, and continuing care with four simplex receptacles. Provide each normal care nursery with one simplex receptacle. Provide 20 A, 125 V, 2-pole, 3-wire, straight blade, grounded type receptacles. Do not use floor-mounted receptacles. Ceiling-mounted receptacles or groups of receptacles should be considered for nursery locations not adjacent to a wall or column. Provide a minimum of one flush-mounted receptacle for mobile fluoroscopy units in each nursery, with these characteristics: 60 A, 250 V, 2-pole, 3-wire, twist lock, grounded type.

11-5.8.11 Operating Rooms.

\1 Provide not less than six duplex receptacles on each wall mounted three feet above the floor. Provide each service column with not less than 12 simplex or six duplex receptacles. Do not place more than four (simplex) wall receptacles on a 20 A, 125 V circuit. Do not place more than two (simplex) service column receptacles on a 20 A,

125 V circuit. **/1/** Provide switch class rated circuit breakers and 20 A, 125 V, 2-pole, 3-wire, straight blade, grounded type receptacles. Provide one 60 A, 250 V, 2-pole, 3-wire, twist lock, grounded-type, flush-mounted receptacle in each operating room for a mobile fluoroscopy unit or laser photo coagulator. Arrange the 20 A, 125 V duplex wall receptacles such that adjacent receptacles are served from a different isolation power panel and equally divide the patient service column receptacles circuits between isolation power panels.

11-5.8.12 Laboratory Receptacles.

Laboratory benches are supplied as casework or furniture, fixtures, and equipment (FF&E) depending upon programming and the project design. See FF&E in Chapter 15. For casework benches, provide strip mounted duplex receptacles 18 in. (450 mm) or less on center and connect adjacent receptacles to different circuits. For FF&E benches with prefabricated wiring, estimate load and determine connection requirements. Provide raceway and wiring with the required number of circuits to a connection point adjacent to the FF&E bench, to enable the IO&T contractor to complete the connection.

11-5.8.13 Examination and Treatment.

Provide examination and treatment rooms with no less than eight duplex receptacles.

11-5.8.14 Automatic Receptacle Control.

Provide automatic receptacle control in accordance with ASHRAE 90.1 for offices, conference rooms, reproduction rooms, break rooms, classrooms, and individual work stations. Do not provide automatic control in any area which may endanger the health, safety, or security of patients, staff, or visitors; such as examination, diagnosis, treatment, laboratory, nurse stations, patient care, emergency department, or utility. Provide split circuit type (half-controlled) receptacles. Provide a hard wired system that does not use flexible cords.

11-5.9 Receptacle Identification.

Identify receptacles connected to the life safety, critical, and equipment branches with red bodies to identify essential power and mark the device plate “EMERGENCY”. Also identify the panelboard and circuit number on the device plate for all receptacles, both normal and essential. Mark device plates with steel stamped or silk-screened letters, by laminated plastic nameplates with contrasting color center core, or by embossed aluminum or stainless steel tape. Provide letters not less than ¼ in. (6 mm) high. Do not use pressure sensitive or thermal tapes. In behavioral health, pediatrics, and other areas where it is necessary to protect against the label being removed and ingested, use silk screened letters.

11-5.10 Patient Care Grounding.

Provide a grounding system in general care areas and critical care areas, including all anesthetizing locations, as required by NFPA 99 and NFPA 70. Include grounding system design and initial testing in the contract documents.

11-5.11 Inhalation Anesthetizing Location.

Flammable anesthetics are no longer used in the United States, but if their use is re-instituted an isolation power system would be required in these locations in accordance with NFPA 70 (see paragraph 11-5.5).

11-5.12 Electromagnetic Shielding for Medical Instrumentation.

Designated areas of hospitals and health research laboratories may require electromagnetically shielded enclosures. Base the degree of the attenuation required for the enclosure on the manufacturer's recommendation for the instrumentation to be used in the designated space. Specify the type of enclosure and the class of attenuation in the final design. When shielded enclosures are not provided, take other measures to limit RFI and EMI in rooms that contain sensitive medical equipment, for example, electroencephalography (EEG), eye LASIK/PRK, and electron microscope rooms. For example, select lighting in which the ballast does not emit electromagnetic radiation. Do not locate such rooms near or directly above or below electrical equipment or mechanical rooms. Do not route high-voltage feeders in the vicinity of these rooms.

11-6 LIGHTING.

11-6.1 Design.

11-6.1.1 General.

Design lighting in accordance with Appendix B, Illuminating Engineering Society (IES) Lighting Handbook, and IES RP-29. This UFC governs where conflicts exist. Do not use electronic ballasts and drivers in the facility which generate electromagnetic fields or radio frequencies that interfere with life support equipment or patient implant life support devices (for example, pacemakers, heart monitors). Provide electronic ballasts and drivers in the facility which are electromagnetically compatible with the operating environment. Do not use ballast or drivers with inverters which operate in the 20-25 kHz, 32-39 kHz, and above 60 kHz range because of interference. For the intent of this section, lighting is designated general illumination and task illumination. General and task illumination are generally in-ceiling mounted and maintained illumination levels meet criteria specified in Appendix B within plus or minus 10%.

Task illumination is also provided by FF&E lighting equipment, but the illumination from this equipment does not contribute to the levels specified in Appendix B. This lighting equipment is identified in the PRC, see Chapter 15, and is characterized by being either moveable (adjustable arm or focus) or is part of the equipment (integral to or an

accessory). For example, ceiling mounted surgical task lights, floor (wheeled) surgical task lights, and under shelf work station lights.

11-6.1.2 Control.

Provide lighting controls in accordance with Appendix B and UFC 3-530-01 subject to the functional and operational intent of the facility. Do not provide automatic control in a manner which could endanger the health, safety, or security of patients, visitors, or staff. Do not use time-scheduled controls in patient care or utility spaces. Provide override devices where automatic controls are installed. Where occupancy/vacancy controls are used, provide dual technology type. Do not use occupancy/vacancy controls in treatment or utility rooms, as turning lights off in these areas could create a safety hazard. Where day lighting strategies are employed for energy conservation, accomplish de-lighting with automatic lighting controls utilizing photo sensors to provide continuous dimming of the electric lighting system. Do not use de-lighting in patient care rooms and areas. Where Appendix B lighting controls result in general illumination levels which exceed the allowable lighting power density, provide individual control of lamps/arrays within fixtures, to split illumination into an allowable general level and a separate task level, to meet applicable exemptions.

11-6.1.3 Sources.

Provide fluorescent or light emitting diode (LED) lighting to the maximum amount practicable. Do not mix sources; use either all fluorescent or all LED luminaires within a project. An exception is allowed to mix sources for violet fraction, as described in paragraph 11-6.6, and also for low level luminaires which have a negligible contribution to overall illumination and color variation, such as exit sign, information sign, step, night, FF&E task, and accent lighting. For exterior lighting see paragraph 11-6.9. Provide recessed luminaires in rooms with lay-in acoustical tile ceilings and recessed or surface-mounted luminaires in rooms with gypsum board on plaster ceilings, except where other types are required by the functional design. Generally, use industrial type or open strip type luminaires in rooms with unfinished ceilings and protect each from breakage. Mount luminaires in large storage and supply rooms to readily permit relocation within **\1** 6 ft (1.8 m).**/1/** In locations subject to occasional wet or damp conditions, such as near emergency showers, provide requisite listing. Tandem wiring, where ballasts or drivers in one luminaire supply lamps or arrays in another, is not permitted. In unconditioned buildings or spaces, specify a luminaire that has been UL listed for 140 ^{o}F (60 ^{o}C) or above. Use of HID lamps in patient care areas is not permitted. “U” shaped fluorescent lamps are not permitted. Tubular LED (TLED) lamps are not permitted. Base the fluorescent lighting system baseline energy efficiency on the use of 28-watt T5 and 32-watt T8 lamps. Provide LED luminaires with a 5-year warranty by the manufacturer. Minimize types of luminaires and lighting sources as far as practical to simplify operation and maintenance.

11-6.1.4 Color.

The same color requirements apply to fluorescent and LED sources. Provide 4000K correlated color temperature (CCT) throughout the facility. This single CCT is used to maintain consistency and to coordinate with task lighting provided as FF&E.

11-6.1.4.1 Chromaticity.

Provide chromaticity of lighting products to fall within an ANSI C78.377 4-step quadrangle centered at 4000K. Chromaticity for different units in the production is required to be enclosed by a 3-step MacAdam ellipse. Compliance is to be verified by the manufacturer or an independent photometric testing laboratory with a minimum test size of 10 units and warrantied by the manufacturer. The chromaticity of every unit in the test sample is required to be contained in the ANSI 4-step quadrangle. The entirety of the MacAdam ellipse, centered at the mean chromaticity of the samples, need not be fully contained in the 4-step quadrangle. For all units in the test sample, change in chromaticity from the zero-hour measurement to the 6000 measurement hours is required to be within a total linear distance of 0.003 on the International Commission on illumination (CIE) 1976 Uniform Chromaticity Scale (UCS) (u', v') chromaticity diagram. All interior lighting products are to comply with the following performance criteria, which are based on IES TM-30. The light source spectral power distribution (SPD) and the IES TM-30 color vector graphic are required submittals.

a. Fidelity Index: Rf ≥ 80,

b. Relative Gamut Index: 97 ≤ Rg ≤ 110,

c. Fidelity Index, Hue-Bin 1: Rf,h1 ≥ 78,

d. Chroma Shift, Hue-Bin 1: -9% ≤ Rcs,h1 ≤ +9%.

11-6.1.4.2 Violet Fraction.

In areas defined in Appendix B and as described in paragraph 11-6.6, where color matching is a critical function, provide the violet fraction for LED general lighting products between four and six percent. Violet fraction is computed as the optical radiation from 360 to 430 nm divided by the optical radiation from 360 to 830 nm. This criterion is in addition to the criteria for chromaticity, CCT, color shift, and color rendition.

$$\text{Violet fraction } (\%) = \frac{\text{Optical radiation from 360 to 430 nm}}{\text{Optical radiation from 360 to 830 nm}} \text{ x } 100$$

11-6.1.4.3 Exceptions.

The following exceptions are allowed during the transitional period for industry to adapt, produce, and document a variety of products meeting the TM-30 metrics. Exceptions only apply if products from three manufacturers are not readily available meeting TM-30 metrics. The TM-30 metrics are fidelity index, gamut index, hue-bin one fidelity, and

hue-bin one chroma shift; plus violet fraction. All other lighting requirements specified herein must also be met.

a. Exception No. 1, Decorative Lighting: Decorative lighting, as defined in ASHRAE 90.1, is not required to meet the gamut index and hue-bin one metrics; but is required to meet the fidelity index. If fidelity index products are unavailable; color rendering index (CRI) 80 or greater will be considered an acceptable alternative.

b. Exception No. 2, Unusual Location: Architectural focal points and utility spaces are not required to meet the gamut index and hue-bin one metrics; but are required to meet the fidelity index. If fidelity index products are unavailable; CRI 80 or greater will be considered an acceptable alternative. Architectural focal points are defined as entry and atrium (but not to include patient waiting). Utility spaces are mechanical and electrical rooms, elevator pits, tunnels, etc.

c. Exception No. 3, LED Luminaires: If TM-30 metric products are unavailable, CRI 90 or greater LED luminaires will be considered an acceptable alternative to the fidelity index, gamut index, and hue-bin one metrics.

d. Exception No. 4, Fluorescent Lamps: If TM-30 metric products are unavailable, CRI 85 or greater lamps will be considered an acceptable alternative to the fidelity index, gamut index, hue-bin one metrics, color consistency, and color shift; except provide CRI 90 lamps where indicated in Appendix B.

e. Exception No. 5, Violet Fraction: If LED luminaires are unavailable to meet violet fraction, CRI 90 or greater will be considered an acceptable alternative.

11-6.1.4.4 Submittals.

Confirm the list of factors in Annex D Luminaire Design Review Checklist, through catalog cuts or manufacturer letters, in both the design and construction phases. Annex D is not all inclusive and is intended to be used in conjunction with the UFGS. TM-30 submittal data will not be required for the metric for which an exception above applies.

11-6.1.4.5 UFGS Coordination.

Modify the UFGS to accommodate the minimum requirements contained herein. After the transitional period the UFGS and other criterion will be updated.

11-6.1.5 Glare.

Provide indirect LED lighting or utilize a refractor to eliminate glare. Shield LED light sources in the luminaires with physical separation or refractors to avoid a direct view of light sources and the resultant glare. Avoid placing non-exam lighting directly over a location where a patient lying supine or angled in a bed or gurney will be. Consider

illuminance of the point source in LED lighting designs, in relationship to the ambient background, and eliminate glare though higher mounting heights or using more luminaires at lower lumens. Do not locate luminaires utilizing T5HO lamps below 8 ft 6 in. (2.6 m) unless specifically designed to control brightness.

11-6.1.6 Uniformity.

Design illumination to meet IES uniformity. For rooms in which the furniture or equipment layout is changeable, for example office and examination rooms, include the entire room in the task area. In rooms with ceiling curtains or other partitions, for example examination rooms, meet uniformity within the entire room with curtain or partition closed.

11-6.1.7 Flicker.

Provide LED fixtures in compliance with IEEE 1789. Limit the maximum percent flicker to less than or equal to the flicker frequency x 0.08. For dimmable LED products, comply at full output and throughout the dimming range.

11-6.1.8 Nameplates.

Identify luminaire driver/array/lamp replacement by an appropriate marking on the fixture reflector. Marking should indicate replacement with the original equipment by name only and should not be visible through the fixture lens.

11-6.1.9 Life.

Provide LED luminaires with a minimum L70 lumen maintenance value of 60,000 hours.

11-6.1.10 Illumination of means of egress.

Provide illumination of means of egress in both the normal and emergency modes of operation in accordance with NFPA 101. Illuminate egress paths with the minimum NFPA 101 illumination at all times the building is occupied, controlled by a switch class circuit breaker, with higher illumination level(s) motion controlled, as required by UFC 3-530-01. Hallways adjacent to sleeping rooms and nursing stations are an exception; manually switch higher illumination level(s) to avoid disturbances to patients and staff. Provide emergency lighting in all electrical rooms, mechanical rooms, and TRs.

11-6.2 Battery-Operated Lighting.

Provide 25% of the general and task lighting in the operating rooms, emergency treatment rooms, cystoscopy, cardiac catheterization rooms, and any other room with invasive procedures with 1½-hour battery backup for general ceiling-mounted luminaires that provide general or task illumination that operates without interruption during periods of normal and emergency power lapse. Provide not less than 500 lux of maintained illumination measured at floor level in these rooms with luminaires which fully illuminate when on battery backup or UPS. Provide all permanently installed

surgical task luminaires with a minimum of 1½ hours of no-break power to bridge the power interruption due to loss of normal power or essential electrical system failure. Locate batteries for lights in operating rooms outside those rooms. Provide 15% of lighting in nurseries with 1½-hour battery backup. Provide a minimum of two battery-powered lights in each generator set location and emergency switchboard location and central Communications Room. Provide a battery-backup luminaire above each blood draw station unless lighting is connected to essential power.

11-6.3 Patient Bedrooms.

In patient bedrooms, provide one wall-mounted direct or indirect, or ceiling mounted indirect luminaire or a medical wall module system, with lighting features as described herein, at each bed for task (reading) and general illumination. Each wall unit is to provide upward directed light for general illumination and downward light for patient use. Each ceiling unit is to have separate general and patient use illumination. Control general illumination at the door and at the wall unit with a three-way switch. Control patient's use lighting at the bed. Provide quiet-operating switches. Consider use of low-voltage switching utilizing the nurse call handset. Provide night-lights mounted in the patient service console at each bed which are photo cell controlled and manually controlled at the corridor door. Provide an additional task (exam) luminaire located over the patient bed and switched at the patient head wall.

11-6.4 Special Location Requirements.

Comply with the following location requirements:

a. Mounting. Provide recessed luminaires in nurseries, surgery, obstetrical suites, emergency treatment rooms, examination rooms, and laboratories.

b. Nurse stations. Provide selective switching at nurse stations to achieve 33%, 66%, and 100% illumination levels for fluorescent and full range dimming for LED.

c. Supine patients. Provide low-brightness diffused lighting in recovery rooms, coronary and ICUs, and X-ray therapy rooms where patients may be in a supine position for extended periods. Where indirect sources are not feasible or not desirable, locate luminaires outside of direct view of patients.

d. Electroencephalogram. Provide electroencephalogram rooms with dimmable luminaires.

e. Examination. For examination purposes in ICUs, isolation rooms, single patient bedrooms, labor rooms, and recovery, provide an exam luminaire operated by a conveniently located switch above each bed.

f. Behavioral Health. Provide lighting in behavioral health unit in compliance with Appendix A. Provide recessed, anti-ligature, of tamperproof construction, with impact-resistant lenses, for all fixtures including night

lights. Control night lights with a photocell, with a manual switch outside the room.

g. X-ray. Provide X-ray rooms with indirect lighting; in other radiographic procedure rooms, coordinate the location of the room lights with the X-ray equipment. Provide “In-Use” warning lights for universal X-ray rooms and therapeutic X-ray rooms in accordance with Appendix D. Do not provide diagnostic X-ray rooms with “In-Use” lights. Refer to Chapter 15 for more details.

11-6.5 Corridors.

Illuminate wayfinding signage by the corridor lighting system or provide separate fixtures to insure visibility. For corridor lights which are adjacent to intensive care bedrooms and nursing units, provide one-third increment switch controlled for fluorescent and full range dimming for LED.

11-6.6 Dental Clinic.

Arrange ceiling-mounted luminaires symmetrically within all dental treatment rooms and provide full range diming. In oral surgery provide dimmers that default to full intensity and function as an on/off switch in the event a dimmer fails.

11-6.6.1 Violet Fraction.

In areas such as prosthetics laboratory and dental treatment rooms, that involve the visual matching of human teeth to resins, crowns, veneers, or other restorations; provide violet fraction for general illumination as specified in paragraph 11-6.1.4.2. Violet fraction is generically met with fluorescent sources, therefore this requirement only applies to LED sources.

Currently, limited LED products are available which meet the violet fraction requirement. Therefore, if LED lighting is a project requirement, a sole source waiver for LED luminaires in dental areas approved by the Contracting Office in the Geographic District, may be required before commencing design. However, if the waiver is not sought and fluorescent lighting is used in dental areas instead, as an exception, the remainder of the project may still be LED.

11-6.7 Eye LASIK/PRK Rooms.

Provide ceiling-mounted shielded luminaires in eye LASIK/PRK rooms which are fully dimmable and with ballast or driver filters integral to the luminaire assembly. Provide one filter per ballast or driver in the luminaire assembly to suppress/eliminate electromagnetic and radio frequency interference with the LASIK equipment. Provide UPS power for the LASIK equipment and lighting in each room that provides a minimum of 1½-hour of no-break-power in addition to the critical branch of the essential electrical system. Provide an “In-Use” warning light outside each eye LASIK/PRK room.

11-6.8 Exterior Signage.

Provide stencil-faced with red trans illuminated letters exterior signage for "EMERGENCY SERVICES" which is readily visible, identifiable, and legible at all entrance drives. Provide contrast level of illuminated signage which is symmetrical and does not deviate more than plus or minus 5%. Provide trans illuminated letters indicating the facility name in signage for facilities having after-dark operations. Design illuminated signs for rapid replacement (not to exceed 15 minutes). Coordinate sign locations with illumination of access roads, parking areas, and building entrances to minimize requirements for additional illumination of signage.

11-6.9 Exterior Lighting.

Provide exterior lighting in accordance with UFC 3-530-01 and as follows. Provide lighting for the safety of patients, visitors, staff, and for operation and maintenance. Illuminate parking areas and walks, including accessible areas intended for night use, to an average of no less than 10.8 lux , measured on 12 in. (300 mm) intervals of incident light on the area served. Illuminate other areas, including roadways and utility areas, in accordance with the recommendations of IESNA and UFC 3-530-01, following the more stringent requirement. Provide a CCT not less than 3000K or more than 4000K, a CRI not less than 70, and an LED product L70 lumen maintenance life equal to or greater than 50,000 hours. Design lighting to eliminate glare and trespass between site-structure-surround areas; by complying with IES Model Lighting Ordinance (MLO) lighting zones and backlight, uplight, and glare (BUG) ratings; and by complying with ASHRAE 90.1 lighting power density (LPD).

11-6.10 Dimming.

Furnish eye lane, eye examination and eye LASIK/PRK rooms, and group therapy observation room illumination with recessed and full range dimmable luminaires. Locate dimmers for eye lanes and eye examination rooms close to the examination chair and on/off switches at the room entrance. Maximum illumination level in group therapy observation rooms with respect to illumination level in group therapy (mirror) rooms should not exceed manufacturer's recommended ratio for one-way mirrors utilized. For general lighting in fluoroscopic and radiographic special procedures rooms, provide dimming at the control stand or at the door entrance, as required (in the event a dimmer failure, lights are to default to full intensity and the switches function as an on/off switch).

11-6.11 Ultraviolet (UV) Filters.

Provide UV filters for fluorescent lighting in infant care areas to prevent retina damage to premature infants, and other areas where cataracts are a major concern. Provide indirect lighting in premature infant areas for all new construction.

11-6.12 Maintenance Area Lighting.

Illuminate interior utility tunnels and walk-in pipe chases by 10.8 lux of incident light for the safety of maintenance personnel. Provide pilot light equipped switches for these fixtures and locate switches in areas that are normally occupied. Illuminate elevator shafts in accordance with UFC 3-490-06. Locate receptacles for temporary work lights as determined by the Design and Construction Agent.

11-6.13 Auditorium.

Control the down light luminaire over the podium from the podium and the entrance.

11-6.14 Continuity of Service.

Provide spares in the initial procurement to insure color matching for the LED lighting system serving critical care spaces. For each luminaire in a critical care space served from either the essential or emergency branch within a facility, including battery backup luminaires not connected to the branch, provide a 5% stock of replacement matching LED arrays and pre-programmed LED drivers, with a minimum of one per fixture type.

11-6.15 Accessibility.

Provide maintenance access to luminaires by placing them where they can be reached, by the use of lowering devices, or by built-in access provisions such as catwalks or trolleys. Where specialized equipment is used to gain access, provide said equipment with the fixture and provide adjacent built-in storage. Only step ladders may be considered for portable ladders and height is limited to 20 feet by OSHA. Do not consider moveable machinery such as scissor lifts as meeting this requirement.

11-7 HELIPAD LIGHTING, MARKING, AND CONTROLS.

Provide helipad marking, lighting, and controls in accordance with UFC 3-535-01 and UFC 3-535-02. Design facilities for hospital configuration, visual meteorological conditions (VMC), non-instrument, to include those listed in Table 11-3. Provide retro-reflective markings per UFC 3-535-02. Provide capability to control lighting locally at helipad, remotely within facility, and radio controlled by pilot (see Annex A).

Provide a 2-box Chase Helicopter Approach Path Indicator (CHAPI) visual glide slope indicator when needed based on site conditions described in UFC 3-260-01 and UFC 5-535-01. Provide the usual CHAPI glide slope angle of six degrees unless a steeper glide slope is needed to avoid obstacles. If required, provide a waiver request to UFC 3-535-01 to adjust the glide slope angle.

Table 11-3 Medical Helipad Visual Facilities Requirements

Facility	VMC Day Non-Instrument	VMC Night Non-Instrument	Remarks
Perimeter Lights	NA	R	
Wing Lights	NA	R	
Landing Direction Lights	NA	OPT	
Approach Direction Lights	NA	OPT	
Helipad Floodlights	NA	R	
Visual Glide Slope Indicator	OPT	R	
Helipad Beacon	R	R	
Wind Direction Indicator	R	R	Provide obstruction light and illuminate sock
Retro-reflective Marking	R	R	
Local and Remote Control	R	R	
Essential Power	R	R	

Legend: NA = Not-applicable, OPT = Optional, R = required

11-8 LIGHTNING PROTECTION.

Provide lightning protection in accordance with UFC 3-575-01. Provide a risk assessment in accordance with NFPA 780 and provide a lightning protection system if protection is recommended by the assessment. If the system is required, provide it in accordance with NFPA 780, with components meeting UL, and with a UL Lightning Protection Inspection Certificate certified to NFPA 780 upon completion. In order to obtain the UL inspection certificate, A UL listed installer is required in construction phase; therefore, clarify in bid documents and list three Contractors for OCONUS locations. For additions to existing facilities with a lightning protection system, the existing system is required to be recertified before the new portion can be connected to the existing lightning protection system.

Annex A. Hospital Helipad Radio Control Operation

Provide the radio controller in accordance with AC150/5345-49C and function as noted here:

a. The pilot can activate the hospital helipad lighting by keying the microphone from the helicopter after tuning to the assigned frequency.

b. The pilot can key his microphone three times within a 5-second interval and on the third pulse a relay is energized, which turns on the wind indicator illumination, CHAPI, and the perimeter light pattern.

c. The floodlights can be activated by keying the microphone five times.

d. The lights are to remain on until the pilot keys his microphone seven times. This is to activate the turn off time delay relay, which de-energize the lights at the end of the 15 minute delay.

e. When the lights have been activated by the radio controller, the “OFF” function of the remote “ON-OFF” switch in the manual controller, located in the hospital emergency room (ER) is bypassed.

f. The brightness of the CHAPI, floodlights, and perimeter lights can only be controlled from the manual control panel in the ER.

g. If the microphone has been keyed seven times (floodlight turn off signal), the radio controller can be reset by keying the microphone three or five times.

h. The hospital ER is to be equipped with the manual controller and a base radio station capable of manual or radio operations.

Annex B. Multi-Ended Network Substation

1. GENERAL.

The multi-ended network (fully automatic) substation (see Figure 11-2) design philosophy eliminates many switching time delays; simplifies the monitor and control functions; standardized equipment; reduces equipment size; provides expansion capability for future load growth; and maintains reliability, durability, and maintainability. When using the multi-ended network or the double-ended substation to replace an existing substation, all downstream equipment requires short circuit current validation and power system coordination.

2. NORMAL HOSPITAL SOURCE ALTERNATE DESIGN CONFIGURATION.

For electrical design criteria related to power supply, see documents listed in Appendix I. Provide hospitals with two primary service feeders, each connected to one side of the automatic (with alternate manual operator) load break primary selector switch with manual load break BP/ISs that serves a multi-ended network substation. Provide each feeder with the capacity to serve the full hospital demand plus 20% spare load growth. Install each feeder underground within the hospital site. Provide the primary selector switch with BP/ISs with the capacity to serve not less than the sum of the 3-transformer kVA ratings and have load limiting equal to the full hospital demand plus 20% spare load growth. Monitor both primary feeders with an automatic function. If power is lost to the feeder serving the load, transfer the load to the other feeder in not more than 30 Hz (cycles) if power exists on that primary feeder. Connect service feeders to different power sources, if available, and to two differently routed distribution system feeders. Where two power sources are not available, the service feeders may be connected to two different sections of a true loop system.

Transformers should normally be located outside the hospital, but may be located within the building where practicable and economical. Design multi-ended network substation distribution systems for hospitals, medical centers, and specially designated facilities. Size each transformer in the multi-ended network transformer substation to carry 50% of the full hospital demand and spare load (linear and nonlinear) growth capacity. Use identical and impedance matched transformers. Provide all multi-ended network transformer substations with coordinated surge and fault protection and selective system protection. The capacity of the main feeder panel bus is to be not less than the sum of the transformer capacity.

3. AUTOMATIC PRIMARY FEEDER SELECTOR SWITCHES (APFSS).

The APFSS (not to be construed as an ATS) may be double-throw with draw-out construction. The APFSS rating is to be not less than the sum of the three 3-transformer kVA ratings and have adjustable load or fixed limiting control (the loading control may limit the capacity to that of two transformers). Contacts may have viewing ports for ease of contact inspection. Provide indicator lights for the APFSS to identify

which normal primary feeder is connected to the load (green in color). Load transfer to either **\1** of the normal primary feeders **/1/** is to be achieved with not more than 30 Hz (cycles) of load interruption. Provide the APFSS with a load break BP/IS to maintain normal primary service feeder connection for when the APFSS is being repaired or maintained. The BP/IS can be initiated with not more than two movements of the hand to either position regardless of the position or condition of the APFSS. Two vacuum power circuit breakers with load break BP/IS may be used.

4. **TRANSFORMERS.**

a. Each service entrance transformer of the multi-ended substation with fans is sized to carry 40% of the design load as to utilize standard off-the-shelf units and increase transformer efficiency. Each of the three transformers are equipped with forced air-cooling fans to increase the continuous capacity rating of each transformer by 34–50% of the design load when activated. The fans are automatically activated when the load on any transformer exceeds the no fan rating by a temperature indicator and current relay. If the fans are not activated when the temperature indicator or the current relay exceed the manufacturer's setting, provide alarms so load shedding can be initiated. Each transformer is to have the ability to carry a 10% overload for short periods of time without fans.

b. If a service entrance transformer fails, is offline for maintenance, or the normal bus receives no power from any one of the service entrance transformer feeders, automatically activate the fans on the remaining two service entrance transformers to allow 100% of the total hospital load to be assumed. There is no time delay in the load shifting to the remaining two transformers.

c. Where each transformer of the multi-ended network substation is sized for no fan application, size each transformer to carry not less than 50% of the full hospital demand and spare load (linear and nonlinear) growth capacity. Each transformer feeder serving the normal bus is to be equipped with an alarm to indicate power loss from that feeder to the normal bus.

d. Each transformers in the multi-ended network substation is to be identical and impedance matched.

5. **52 DEVICES.**

Size the 52 devices (AC power circuit breaker devices, draw-out type) to support the transformer capacity.

a. Lay out equipment in a manner that allows load center expansion without requiring replacement. New sections can be added to either end of the load center.

b. Size the main load center bus for not less than the sum of the 3-transformer kVA ratings.

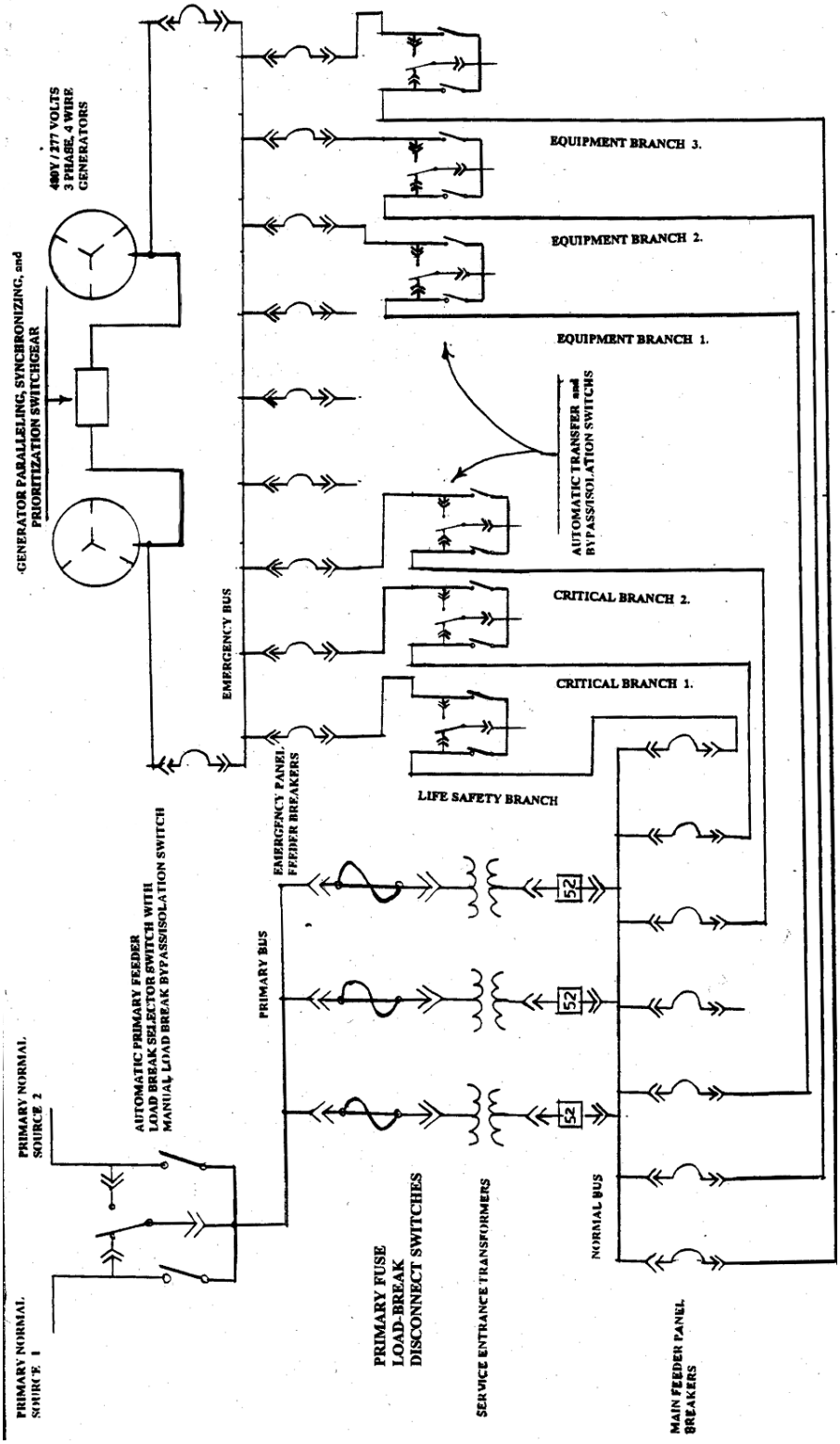
6. GROUND FAULT.

Provide ground fault protection for the facility in conformance to the requirements in NFPA 70, NFPA 99, and this document.

7. STANDARDS.

Provide true RMS reading metering and protective relays and devices in compliance with Institute of Electrical and Electronics Engineers (IEEE) standards.

Figure 11-2 Multi-Ended Network Substation System Diagram



Annex C. Expandable Dual-Ended Substation

See Figure 11-3 and the following requirements:

a. The bus for the substation is sized for the total substation capacity at 100% demand.

b. Generators “1” and “2” do not operate in parallel with each other or the normal power source (utility), but are separate and independent.

c. The normal power side of the ATSs is the default position when power is available and when there is no normal or alternate power available.

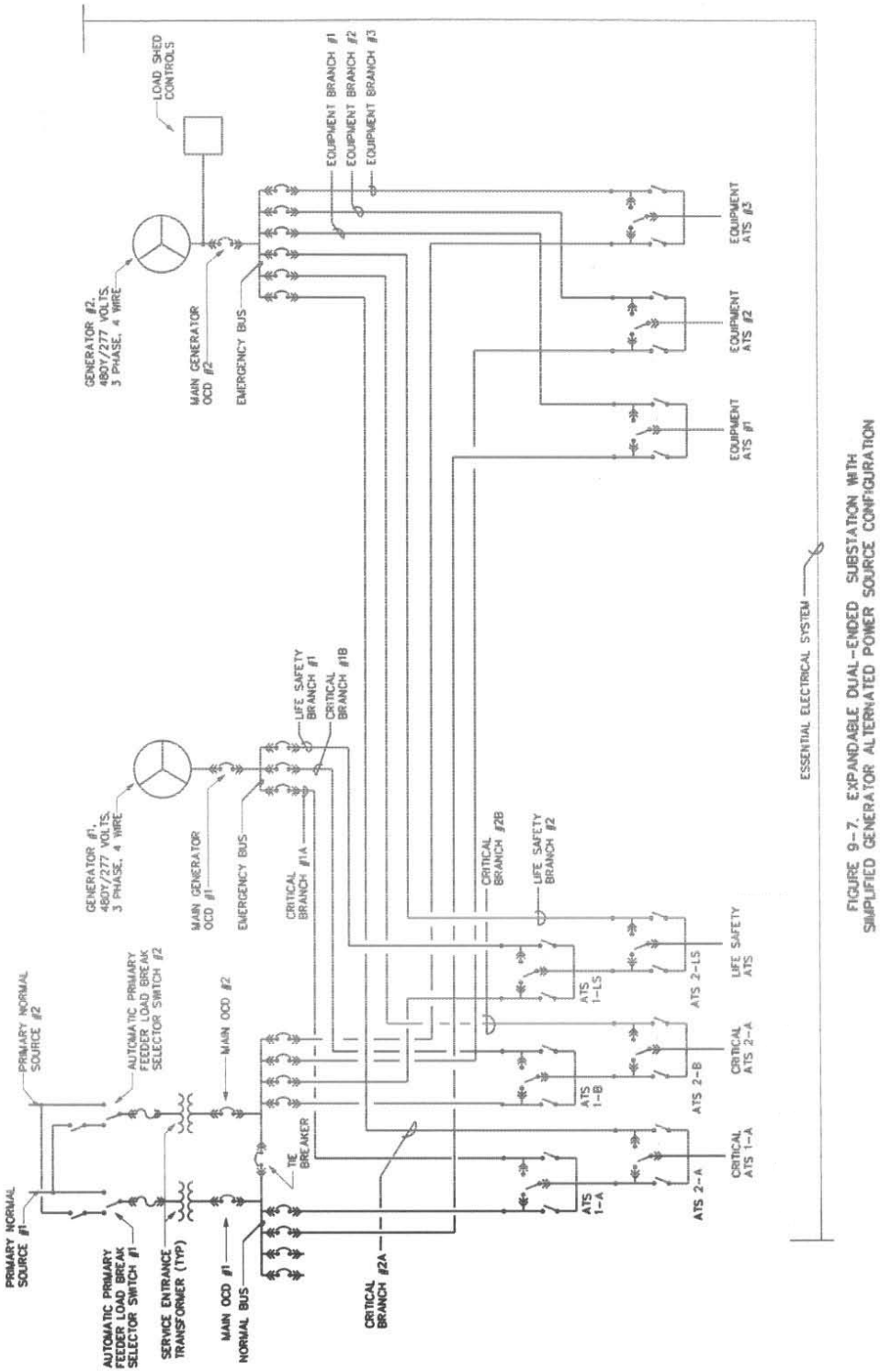
d. Generator “1” is sized to support all loads that cannot be shed plus 20% future load growth at 100% demand.

e. Generator “2” is sized to support all sheddable equipment loads of the essential electrical system, non-essential loads plus 20% future load growth at 100%, or the loads addressed in item “4” here, whichever is greater.

f. Load shed controls shed the lowest priority loads (first) on generator “2” when ATS 2-A, 2-B, and 2-LS are transferred to generator “2.” The AC equipment for non-delayed automatic connection are non-sheddable loads.

g. BP/IS is 4-pole, double-throw construction with normal power, open, and emergency power positions.

Figure 11-3 Expandable Dual-Ended Substation



Annex D. Luminaire Design Review Check List

Confirm the factors in Table D-1 Luminaire Factors, as applicable to the design, through catalog cuts or manufacturer letters, in both design and construction phases. This list is not all inclusive and is intended to be used in conjunction with the UFGS.

Table D-1 Luminaire Factors

- Color Consistency: Within a 3-step MacAdam ellipse contained within the ANSI 4-step quadrangle. (Note: May be on cutsheet, otherwise need letter from manufacturer. A 4-step MacAdam ellipse is required in the current specification)
- Color Shift: Du'v' < 0.003 at 6000 hours of operation (Note: Letter from manufacturer)
- Fidelity Index (Rf): ≥ 80 (Note: Likely will eventually be on cutsheet, but currently need letter from manufacturer)
- Gamut Index (Rg): 97≤ Rg ≤110 (Note: Likely will eventually be on cutsheet, but currently need letter from manufacturer)
- Hue-Bin One Fidelity (Rf,h1): > 78 (Note: May eventually be on cutsheet, but currently need letter from manufacturer)
- Hue-Bin One Chroma Shift (Rcs,h1): between -9% and 9% (Note: May eventually be on cutsheet, but currently need letter from manufacturer)
- Violet Fraction: Where white matching is required, provide violet fraction between 4% and 6% (Note: Letter from manufacturer and possible sole source justification, as limited LED products. If LED luminaires are unavailable, use CRI 90 instead.)
- Life: LED Luminaires are to have a minimum L70 lumen maintenance value of 60,000 hours. (Cutsheet – note increase from the L70 of 50,000 hours required in the current specifications)
- CCT of 4000K. (Cutsheet)
- Flicker: Comply with IEEE 1789 (Note: Letter from manufacturer)
- Warranty: 5-year (Note: Cutsheet)

CHAPTER 12 COMMUNICATIONS

12-1 GENERAL.

The planning and engineering of communications systems for applicable facilities must conform to the design criteria contained in this chapter. These facilities use various integrated voice, data, imaging, visual, video information, electronic security, and telemedicine systems to provide quality healthcare. Not all systems listed in this chapter apply to all projects. The DoR must consult with the Design and Construction Agent to establish the systems that are required for each specific project.

12-1.1 Design Criteria.

Communication systems, equipment, and facilities must be designed in conformance with ABA, NFPA 70, NFPA 72, NFPA 99, NFPA 101, Telecommunications Industry Association TIA-568, TIA-569, TIA-606, TIA-607, TIA-758, DHA Technical Requirements-Guidance LAN-WLAN Modernization, DHA Server Room, Computer Room, and Telecommunications Room Design Criteria, and applicable DoD Project Sponsor and DHA standards and criteria. In the event of a conflict with any Standards, this UFC take precedence. This UFC does not take precedence over Code Requirements.

Exception: DoD Project Sponsors other than DHA-FE may have other criteria which should be followed instead of the DHA criteria. However, if DHA-FE will be responsible to operate the facility, follow the DHA criteria.

12-1.2 Approved Product Lists (APLs).

Electronic equipment included with the various systems must utilize, to the greatest extent practicable, equipment listed on the General Services Administration (GSA) APL, Joint Interoperability Testing Committee (JITC) APL and the Defense Information Systems Agency (DISA) Unified Capability (UC) APL. Contractor must review and comply with annual NDAA Guidance on approved products and manufacturers and source restrictions. Facility Related Control System equipment not on an APL and meeting the requirements of an existing Risk Management Framework Authority to Operate may be approved for use by the Design and Construction Agent.

12-2 COMMUNICATIONS SPACES.

12-2.1 Telecommunication Rooms (TRs) (COMC1).

TRs must be located central to the area served and not located on exterior walls. TRs must not share walls with electrical rooms or mechanical spaces. TRs must not have exterior doors. TRs may be combined with Entrance Facilities EF. **\1** Special consideration for TR location must be coordinated with the DoD Project Sponsor for single story facilities less than 10,000 sf (929 sm) and non-healthcare facilities. **/1/** The Communications DoR is to design space requirements and layout of each TR based on the following:

a. **\1** The minimum size of TRs will be the greater of the following: 130 square feet (12 sq m) or 1.1 percent of the area served. The TR serving area must be sized so as to not exceed the maximum cable length in TIA-568.2 and TIA-569.

b. **/1/** Equip the TRs with utility support in accordance with TIA 569, DHA Technical Requirements-Guidance LAN-WLAN Modernization, DHA Server Room, Computer Room, and Telecommunications Room Design Criteria, and Table 12-1 below.

c. Floor space is to be square or rectangular in shape and have no minimum dimension less than 10 ft (3 m) in length. Door must be 180 degree outswing with no window. For Security requirements, see Chapter 5 Antiterrorism (AT) and Physical Security.

d. TRs are to be vertically stacked with a common footprint to route risers from the bottom TR to the top TR without horizontal offsets. Locate slab penetrations along interior of TR walls.

Exception: TR locations are to accommodate the functional layout. **\1** If **/1/** approved by the Design and Construction Agent, and with the concurrence by the DoD Project Sponsor, the requirement for vertical stacking may be relaxed as needed to accommodate clinical functionality.

e. Pipes, plumbing, and other equipment foreign to the TR are not permitted to be located in, enter, or pass through TRs, or be in the walls which enclose the TR.

f. Floor space is to be reserved for Network and Wireless Local Area Network (WLAN) equipment in accordance with TIA 569 and will accommodate the number of WAO and WLAN outlets to be served within the service area of the specific TR.

g. DoR is to account for all additional equipment to be installed within each TR and adjust the floor space requirements to accommodate the additional non-network equipment.

h. DoR is required to maintain a 3 ft (1 m) minimum clearance on the front and rear of all equipment racks. A maximum equipment depth of 30 in. (760 mm) will be planned for two-post TR closet racks. This equates to 3 ft (1 m) clearance in front of the two post rack and a minimum of 5 ft - 6 in. (1.7 m) behind the two post rack. **\1** A minimum of a 3 ft (1 m) clearance at one end of each row is required for unobstructed passage and maintenance. **/1/**

i. TRs are three dimensional spaces and utilize the total volume for equipment and maintenance. In accordance with the above criteria, there must be no plumbing, ductwork, conduits, or other materials within the TR unless they directly support the TR. If ceiling surface is a roof, condensate protection must be provided and installed to the extent required for the protection of room contents.

j. Circuits serving equipment in the Telecommunications Room must be connected in accordance with Table 12-1 below and must be provided to serve each TR for each branch of the electrical systems (normal and essential electrical systems) required for service in each TR. Coordinate electrical requirements with Chapter 11.

k. Electrical services and outlets are to be installed for the Network racks as directed in the DHA Server Room, Computer Room and Telecommunication Room Design Criteria. Power for other equipment must be as required by the network manufacturer. A minimum of two dedicated NEMA L6-30R outlets and four NEMA 5-20R with two receptacles per circuit must be installed for each network rack in the TR. TR network rack receptacles are to be installed overhead.

12-2.2 Communications Radio Equipment Room (COM04).

A separate communications head end equipment room with sufficient space for personnel circulation and equipment maintenance must be provided in inpatient facilities for antenna-based systems such as cable television (CATV), public address and program distribution (PAPD), Emergency Medical Service (EMS), Network Time Synchronization (NTS), Internal Cellular Antenna Systems (IRES), and Radio Page (RP) System. Design the room, including utility support, in accordance with TIA-569. The room must be equipped with weatherproof conduit penetrations to the exterior locations to support the physical interfaces such as coaxial cables and emergency power required by the equipment in accordance with Table 12-1. Pathways must be provided from the 24-hour monitoring location to the headend room to support the EMS radio coaxial or control cables as required for the facility. In addition, the room must be designed as a server room (CMP01) with infrastructure and services as required, to include including fiber and copper cabling and utilities. **\1** Pipes, plumbing, and other equipment foreign to the space are not permitted to be located in, enter, or pass through space, or be in the walls which enclose the space. **/1/**

Systems operating in a client server environment, such as Interactive Television (ITV), Nurse Call and Electronic Security Systems (ESS) must have the server component of the system located in the Server Room (CMP01).

When the design of the facility limits the implementation of a headend room, the equipment associated with these systems must be within the room that is located at the highest elevation available (for example penthouse). Design the room, including utility support, in accordance with TIA-569. The designated room must meet the same design requirements for the head end room. The DoR must coordinate the use of a penthouse to house headend equipment with the DoD Project Sponsor.

Table 12-1 Essential Electrical System Branch Assignment for Communication Systems

Communications Systems	Branch Assignment
Telephone Switching System (TSS)[1]	Life Safety (517.33.D)
PAPD	Life Safety (517.33.D)
Radio Paging (RP)	Life Safety (517.33.D)
Physiological Monitoring (acute areas)	Critical (517.34.A[2], a-d)[5]
EMS Radios	Life Safety (517.33.D)
Local Area Network (LAN) Electronic Equipment at TR[2]	Critical[5]/Life Safety[3] 517.34.A(6)/517.33.D
NTS System	Critical (517.34.A[10])[5]
Nurse Call (NC), including subsystems[4]	Critical (517.34.A[4])[5]
Telephone Rooms and TRs, other than data switch	Critical (517.34.A[6])[5]
Internal Cellular Antenna Systems (IRES)	Life Safety (517.33.D)
Electronic Security	Equipment
Wireless Access	Power over Ethernet (PoE) supplied from LAN electronic equipment in TR
1. When installed within the facility. If installed in separate structure, telephone system must have a properly rated Emergency Power System (EPS) designed in accordance with NFPA 70 Section 700 with the operational characteristics and requirements of the served facility. Provide one quad power outlet near every data outlet in all facilities.	
2. For the purposes of this document, LAN electronic equipment does not include workstations. Workstation requirements are to be addressed on a case by case basis with the DoD Project Sponsor. Provide racks in the appropriate communications spaces to support Telecommunications switches. Media Converters locations for analog devices must be coordinated with the DoD Project Sponsor.	
3. LAN electronic equipment at the TR will be treated as part of the TSS in facilities with Voice over Internet Protocol (VoIP)-based TSS or facilities utilizing telephone instruments that are VoIP PoE and rely on TR primary power for functionality.	
4. Includes infant or patient tracking systems and door access systems interfaced with the NC System.	
\1 5. The branch assignment provided in this table is for an NFPA 99 Type 1 essential electrical system. For a facility without Category 1 space which has an NFPA 99 Type 2 essential electrical system, map critical branch loads to the life safety and equipment branches in accordance with NFPA 70 and 99. **/1/**	

12-2.3 Integrated Monitor and Alarm Room.

A central communication room must be provided in inpatient MTFs and ambulatory care clinics. The central communication room size must be based on the quantity of wall-mounted graphic displays, annunciator displays, and other monitor and control equipment. Install monitors, annunciators, and control equipment in the room for any or all of these systems:

a. Fire detection and alarm system with mass notification controller.

b. Generator monitor and alarm system.

c. Medical gas monitors and alarms.

d. Electronic security operator workstations for security monitoring and control of access control and video surveillance.

e. Public address master microphone and paging zone selector panel.

f. RP console.

g. NC failure alarm and Code Blue and other Code Call Annunciator Stations.

h. Elevator Emergency Phones.

i. Infant Protection Alarm System (IPAS)

\1 Pipes, plumbing, and other equipment foreign to the space are not permitted to be located in, enter, or pass through space, or be in the walls which enclose the space. **/1/**

12-2.4 Refrigerator Monitoring.

Refrigeration alarms for the morgue, pharmaceuticals, vaccines, blood bank, and other mission critical refrigerators must be addressed by the DoD Project Sponsor. DoR must comply with DHA PI 6205.01 for Temperature Sensitive Medical Monitoring Systems, Chapter 11, and Safety Risk Assessment. DoR must provide infrastructure to support the refrigerator Monitoring System.

12-2.5 Server Room (CMP01).

A separate main Information Systems Server room must be provided in accordance with the DHA Server Room, Computer Room and Telecommunications Room Design Criteria. DoR must coordinate with the DoD Project Sponsor and local IT Staff to determine the correct size of the server room based upon its RPIE and PP contents. The room must be sized to accommodate the equipment planned for installation in the space. The designers must provide power distribution, HVAC with temperature and humidity controls, access control, fire detection, alarm, suppression, uninterruptable power supplies (UPSs), and voice and data cables to support the GFGI and CFCI equipment. The Fiber Main Distribution Frame (FMDF) must be located in this room and all fiber backbone cables in the facility must be terminated on the FMDF. Fiber from each Building Distribution Frame (BDF) must also terminate on this frame. Cables must be distributed via racks above the equipment cabinets. For systems physically

located in the building, the server component must be located in the Server Room (CMP01). If the facility does not have a Server Room (CMP01), the DoR will coordinate with the DoD Project Sponsor to identify the parent facility and/or approved location for each systems server component. **\1** Pipes, plumbing, and other equipment foreign to the space are not permitted to be located in, enter, or pass through space, or be in the wall which enclose the space. **/1/**

12-2.6 Service Entrance Facility (EF) (COMC2).

Provide a separate entrance facility (EF). The entrance facility is the space housing the point of entrance of the telecommunications service. It is the demarcation point between the outside plant cabling and the inside plant distribution cabling. Inpatient MTFs and ambulatory surgery centers require two separate EFs with physically separate feed paths in accordance with NFPA 99. **\1** Pipes, plumbing, and other equipment foreign to the EF is not permitted to be located in, enter, or pass through, or be in the walls which enclose the EF. **/1/**

12-3 OUTSIDE PLANT INFRASTRUCTURE AND CABLING.

12-3.1 Outside Plant Purpose.

Provide connectivity to the Installation Wide Area Network (WAN), the Installation telephone system, and other Installation systems via a system of underground ducts and cables.

12-3.2 Outside Plant Duct Work.

All outside plant cabling must be installed in underground ductwork. A system of maintenance holes and or hand holes must be provided at distances and bend radii meeting TIA 758. All buried ducts provided by the project must be encased in concrete from the nearest manhole or hand hole.

Each project must have a minimum of two ducts, each 4 in. (100 mm) in diameter. All of the ducts must be fully populated with inner ducts, except for duct banks with more than one spare duct must provide one spare duct with no inner duct. Fabric mesh inner ducts are acceptable. All unused or inner ducts must be provided with a nonmetallic pull cord.

12-3.3 Outside Plant FO Cable.

Each project must be provided with single-mode fiber optic (FO) cable. The FO cable must connect to the nearest connection point available to the Installation WAN. Provide a minimum of two physically separate pathways for inpatient MTFs and ambulatory surgery centers, each with 48 strands of single mode fiber. The two fiber paths must be connected to two different Installation WAN nodes and be routed into two different service entrance facilities in the project. Provide other projects with a single path consisting of a minimum of 12 strands of single-mode FO cable.

12-3.4 Outside Plant Twisted Pair Copper Cable.

Twisted pair copper cables must be provided when required by the DoD Project Sponsor for telephone, life safety systems, devices inoperable with VoIP technologies and other project-required connectivity to their various Installation systems. The number of twisted pairs must be based on the facility requirement plus 50 percent spare capacity rounded up to the next larger standard cable size.

When twisted pair copper cables are required for inpatient MTFs and ambulatory surgery centers, provide with two diverse, physically independent, and redundant pathways with twisted pair copper connectivity. The two redundant paths must be routed into the entrance facilities.

12-3.5 Outside Plant CATV Cable.

CATV outside plant cables must be coordinated with the CATV provider on the Installation. A single connection to the Installation CATV service from a single service entrance facility must be provided. The CATV cable must be installed underground. It is not a requirement for it to be installed in the underground duct system.

12-4 RMF AUTHORIZATION PROCESS REQUIREMENTS.

All information systems must be assessed for compliance with DoD security requirements and authorized for operation by a designated DHA Authorizing Official (AO). If the system is not owned by DHA, the DoD Project Sponsor's AO must authorize the system. The Risk Management Framework (RMF) process is a standard process under which all DoD information systems must achieve and maintain their Authority to Operate (ATO). Reference UFC 4-010-06 for requirements.

12-4.1 Information Technology Systems.

Information Systems (ISs)/Platform ITs (PITs) and Local Area Networks (LANs) that access, transmit, process, store, and/or display DoD information, regardless of classification or sensitivity, and/or connect to any DoD IS/PIT and/or LAN must be Authorized to Operate. The RMF process is initiated by the DoD Project Sponsor's local Information Technology and Cybersecurity personnel with the information being provided by the system vendor or provider. Medical systems must be authorized according to the manner in which the system will be used by the Medical Treatment Facility. The DoD Project Sponsor will determine the RMF authorization process requirements. The RMF process will require input and possible system modifications by the system's vendor or provider and support from the DoD Project Sponsor. The DoD Project Sponsor's Information Systems Security Manager (ISSM) office is the point of contact for all RMF authorization requirements.

12-4.2 Stand-alone Information Systems.

Information Systems (IS) and Platform Information Technology (PIT) Systems that are disconnected from the rest of the DoD Information Network (DoDIN) or Medical

Community of Interest (Med-COI) must be authorized through the RMF Process. Reference the DHA RMF SIS and CRN AA Guide for Stand-alone Information Systems (SIS) and Closed Restricted Network (CRN) implementations.

12-4.3 MIL-STD 1691.

MIL-STD 1691 provides a reference list of existing systems that must be reviewed for RMF requirements. Information Systems, including Medical Systems, are generally defined as those containing administrative and/or clinical information. Building Control Systems, Medical Systems, and Information Systems typically found in healthcare facilities are identified in **\1** MIL-STND 1691 **/1/** Table 6-1.

12-5 NETWORK TIME SYNCHRONIZATION (NTS) SYSTEM.

12-5.1 Purpose.

Provide a NTS in projects if there are systems that require precise time synchronization and no existing NTS capability is available. Provide an NTS System that receives precise date and time data from a global positioning system (GPS) satellite, or location specific approved alternative, and distribute this data to all Telecommunications Systems in the facility requiring precise date and time synchronization. The DoR must work with the ISSM to identify the NTS system's security requirements, placement within the networks, and configuration to ensure secure operation within the accreditation boundaries of the networks connected. **\1** Provide all interconnecting hardware, software, and cabling to link to the various Telecommunications Systems.

Provide a GPS receiver with built-in sensitive antenna to receive precise data and time from GPS satellite transmission. The GPS receiver must be weatherproof and constructed for indoor or outdoor installation. The GPS receiver must be located to provide unobstructed reception from the GPS satellite. **/1/**

12-5.2 Date and Time Properties.

Date and time synchronization must automatically occur at least once a day. Time synchronization must typically be within +/-0.02 seconds. Date synchronization must include automatic time zone and updating for daylight saving time and leap year.

12-5.3 Electrical Power.

NTS System and equipment must be powered from the essential electrical system emergency power critical branch per Table 12-1. AC-powered equipment must be protected by a UPS unit that must provide at least 15 minutes of full power during an AC power failure. UPS units must comply with UL 1778 and 47 Code of Federal Regulations (CFR) Part 15.

12-6 TELEPHONE SYSTEM CRITERIA.

12-6.1 Type of Service.

The DoR will coordinate with the DoD Project Sponsor and Installation Service provider to determine the appropriate telecommunications solution for the facility. The solution may be a VoIP based telephone system or a hybrid solution of analog and VoIP. The type of service available on the Installation and the project-specific criteria must determine the type of service provided. A mix of the two types of telephone systems may be used in the same facility.

12-6.2 Central Telephone Equipment.

All facilities must receive high reliability service from the Installation Service Provider. All redundancy and reliability requirements of NFPA 99 must be met.

12-6.2.1 Telephone System Features.

The features listed below must be provided with the telephone system. All required hardware and software to provide these features must be included:

a. Call detail recording
b. Automatic diagnostics with local and remote alarms
c. Remote diagnostics
d. Power fail automatic restart
e. Automatic call distribution
f. Voice mail service

12-6.2.2 Emergency Stand Alone Service.

Provide all facilities with the ability to make telephone calls internal to the facility in the event all connections to the Installation are severed. The VoIP service for these facilities must be provided over networks with Assured LAN Services (ASLAN).

12-6.3 Integrated Intercommunication (Intercom) System.

These intercom systems must be completely provided by the telephone system hardware and software with no external equipment and coordinated with the DoD Project Sponsor. These intercom systems must provide communication among department heads, secretaries, and other designated staff members.

Reference paragraph 12-8 for dedicated intercom services.

12-6.4 Patient Bedside Telephones.

Telephones with a dial pad in the handset or the handset integrated into the bedrail must be provided in patient bedrooms. The project DoR must coordinate patient bedroom telephone service with the Installation Service Provider utilizing appropriate telephone instruments compliant with infection control requirements.

12-7 TELECOMMUNICATIONS INFRASTRUCTURE SYSTEM (TIS).

Provide a TIS throughout the facility which must be designed and installed in accordance with UFC 3-580-01, TIA-568, TIA-569, TIA-606, and TIA-607 and tested in accordance with TIA-568 and the DHA Technical Guidance LAN-WLAN Modernization. The TIS must be a universal wiring network to serve all of the voice and data needs of the facility. The TIS must include horizontal and backbone unshielded twisted pair (UTP) copper cables and FO backbone cables. The TIS must support voice, facsimile, data, voice grade wireless network and other special services within the facility. All TIS backbones to TRs supporting the Clinical Information System(s) must have dual cable feeds occupying dual pathways in accordance with all requirements of NFPA 99 for the category of the facility under construction. The TIS cables must be installed in conduit and cable tray. All cables must be terminated on both ends. Cables and outlets must be marked in accordance with the DoD Project Sponsor or local Installation standard. In the absence of the DoD Project Sponsor standard or local installation standard, TIA-606 must be followed. For Installations outside the contiguous United States, shielded twisted pair cables may be required by the project-specific criteria.

12-7.1 UTP Copper Backbone Cable.

Provide a dedicated multi-pair UTP copper cable to support voice applications which must be run from the BDF to each TR. The cable must be sized to accommodate the initial installed capacity plus 50 percent. The cable insulation must be rated for the environment installed in accordance with NFPA 70. In facilities with an installed TSS, the associated main distribution frame (MDF) must replace the BDF cited here. Backbone copper cables must be terminated on patch panels. For new facilities in which VoIP is to be installed, the backbone copper cable to each TR must be reduced to the minimum count needed to accommodate legacy medical systems, alarm and signaling circuits. Minimum count must be 25 pair.

12-7.2 FO Backbone Cable.

Provide a minimum of 12 strands of single mode fiber optic cable between the FMDF to each TR. Final strand count required to support the project will be coordinated with the DoD Project Sponsor. All TIS backbones to TRs supporting the Clinical Information System(s) must have dual cable feeds occupying dual pathways in accordance with all requirements of NFPA 99 for facilities with Category 1 and 2 room designations as defined per Appendix B. The FMDF must be located in the server room or other location identified by the DoD Project Sponsor. Patch panels must be used to terminate all backbone FO cables. Where multiple vertical stacks of TRs are used in Inpatient

MTFs and ambulatory surgery centers, a 24-strand single-mode FO cable must connect each of the TRs on the top of each stack.

12-7.3 Horizontal Copper Cable.

The horizontal cable must consist of four-pair UTP cable rated Category (Cat) 6A or higher. The cable must be installed between patch panels in the TRs and the user outlets. The horizontal UTP cable must support the voice and data needs of the user. When a VoIP system is to be used there will be no difference or distinction between voice and data cable.

12-7.4 Horizontal FO Cable.

Horizontal FO cable will only be installed when required, as coordinated with the Design and Construction Agent, and approved by the DoD Project Sponsor.

12-7.5 Work Area Outlets (WAO).

WAO outlets must be located to support user work stations throughout the facility. A standard outlet must consist of a minimum 4 11/16 in. (120 mm) X 4 11/16 in. (120 mm) X 2 1/8 in. (55 mm) deep back box with a plaster ring that is equal to the wall thickness plus covering, and a one inch conduit to the cable tray **\1\ /1/**. The cover plate must include four available positions for jacks. All UTP jacks must be 8 pin modular rated at Cat 6A or higher. Standard outlets must at a minimum contain three wired jacks in accordance with DHA Technical Requirements-Guidance LAN-WLAN Modernization. Two outlets of (3) jacks each per 100 sf (9.3 sm) administrative office or area are required. The DoR will coordinate outlet requirements with the PRC. The facility must not be wired to support uncertain future changes. Desk outlets must be mounted 18 inches (415 mm) above the finished floor. A minimum of **\1** 12 **/1/** in. (305 mm) of slack on each cable must be coiled into the outlet box.

12-7.5.1 Equipment.

Provide additional outlets, as required, to support both Log Cat A and Log Cat C equipment, paying particular attention to locations such as laboratories, radiology, inpatient bedrooms, nursing team centers, and conference rooms as prescribed the PRC. Additional outlets will be provided above the UFC 4-510-01 and the PRC minimum requirements where required to support equipment and to meet the functional requirements for each room.

12-7.5.2 Wall Telephone Outlets.

Provide single position modular jack telephone outlet designed to support wall-mounted telephone sets that are Architectural Barriers Act (ABA) compliant. Use faceplates for wall height telephone outlets that have one ANSI/TIA/EIA Cat 6A-rated jack and studs for mounting a wall-type telephone set. Where restricted by casework, adjust outlets and appropriately note location on the floor plan and elevation.

12-7.5.3 Modular Furniture Outlets.

Modular Furniture Outlets may be accommodated by wall-mounted or floor-mounted WAO outlets where appropriate, or by the use of consolidation points as allowed by TIA-568 and UFC 3-580-01 open office wiring requirements. The Intermediate Termination Point may be located either above the ceiling or in the distribution zone with connecting conduit to the modular furniture connection point. The use of “power poles” is permitted only if approved by the Design and Construction Agent in coordination with the DoD Project Sponsor.

12-7.5.4 Pharmacy Ceiling Outlets.

Provide ceiling height outlets in Pharmacy locations to accommodate clinical systems. The DoR must coordinate the location and number of outlets with the DoD Project Sponsor.

12-7.5.5 GFGI Systems.

Provide outlets to support Government Furnished Government Installed (GFGI) systems. Coordinate with the DoD Project Sponsor to determine what systems are to be installed and to identify the data wiring and quantity of outlets required to support the systems.

12-7.5.6 Elevator TIS Outlet.

Cabling and a TIS outlet must be provided in elevator machinery rooms for each elevator car for the connection of elevator telephone sets. Telephone instruments must be furnished by the elevator supplier and instruments will provide a direct ring-down or hotline to a 24-hour staffed location.

12-7.5.7 Conference Room Outlets.

Conference rooms must contain outlets to support voice, data, and video teleconferencing. In addition to the voice and data outlets along the walls, outlets must be provided under conference tables to accommodate voice and data instruments and connections for computer inputs to a wall-mounted flat-screen monitor. Combination power and voice/data outlets for conference room tables will be coordinated with the DoD Project Sponsor.

12-7.6 Data Communications Wireless Access Points (WAPs).

Design of new medical facilities must include site preparation for the DHA DAD IO/J6 wireless data network based upon the predictive heat map survey. The government will provide the predictive survey at 65% design. The outlet configuration will be designed in accordance with DHA Technical Requirements-Guidance LAN-WLAN Modernization. This site preparation must consist of providing outlet boxes and cable in trays or conduit for the WAPs. The outlets for the WAPs must be installed above the ceiling and must be a standard size TIS outlet. Two Cat 6A cables must be installed from the nearest TR

and terminated on modular jacks in the outlet. Adjustments to obtain the final WAP configuration must be based on a physical survey using active equipment.

12-7.7 Cable Tray.

Provide cable trays above the suspended ceilings in the corridors for all communications systems cables. Cable trays must be located above the ceiling and be installed to provide 12 in. (305 mm) of clearance above, and 12 in. (305 mm) on at least one side of the cable trays, to ensure ease of accessibility for wiring changes. The Design and Construction Agent, in coordination with the DoD Project Sponsor, may approve a reduction of the clearance above the cable tray to 8 in. (205 mm) when unable to achieve the required clearance, and minor and infrequent incursions into the minimum access spaces if determined that adequate access is provided to allow cables to be removed and/or installed. The cable tray system design and installation must be in full compliance with TIA-569. The DoR must provide a cross sectional model to ensure adequate clearance above ceiling tiles and cable trays. Cable trays for communications systems must not be shared with electrical power systems cables. For facilities with an IBS, cable trays must be installed in the distribution zone instead of the connection zone. J-Hooks must not be used in new construction projects. J-Hooks may only be used in an alteration project where cable trays are not part of the existing structure and space above the ceiling is limited.

12-7.8 Grounding.

All TRs must include a Primary Bonding Busbar (PBB) or Secondary Bonding Busbar (SBB) and be bonded in accordance with TIA-607.

12-8 DEDICATED INTERCOM SYSTEM.

Intercom functions must generally be provided by the telephone system. Dedicated point-to-point intercom systems where the use of the telephone system or direct ring-down telephone circuits is not satisfactory, may be provided. Intercom systems must provide two-way voice communications and may include one- or two-way video communications. Other intercom functions and all dial intercom functions must be by the telephone system.

12-9 NURSE CALL (NC) SYSTEM.

12-9.1 Purpose.

The NC System will communicate patient and caregiver calls for various levels of assistance from appropriate caregiver responders. The communications must include explicit information about the specific call location and level of assistance needed. Consult with the DoD Project Sponsor to determine if the NC System is required to interface with the Medical Facility network. Regardless of network connectivity, the NC System must meet the Assessment and Authorization Process requirements outlined in this chapter. The NC System must meet the requirements of NFPA 99 and be listed to UL 1069 standards for the purpose as installed. A NC System that will be connected to

the Clinical Information System must meet the above requirements and be identified for use in a shared network environment. The Clinical Information System must be managed and controlled as prescribed in NFPA 99.

12-9.2 Capabilities and Typical Locations.

NC System capabilities and typical installation locations must be as defined as noted in the following:

12-9.2.1 Nurse Call Audio Visual System (NCAV).

The Networked NCAV System must provide simultaneous multimedia communication of calls that includes alert tones, visual indicators, selectable voice annunciation, alphanumeric video displays, full duplex voice intercom, and alphanumeric RP.

Provide a Networked NCAV System in inpatient MTFs located in the following areas: patient units (Medical/Surgical, Intensive and Neonatal Intensive Care, Cardiac Care, L&D), the Emergency Department and associated Urgent Care area, the surgical services area, pre-operative holding areas, and post-operative recovery areas. **\1** If required and defined by Appendix A, provide Networked NCAV Systems for inpatient behavioral health units that include tamper resistant equipment and limited patient call capability. **/1/**

12-9.2.2 Nurse Call Tone Visual System (NCTV).

The NCTV System must provide simultaneous multimedia communication of calls that includes alert tones, visual indicators, selectable voice annunciation, and alphanumeric video displays. NCTV communications media do not include full duplex voice intercom.

Provide a NCTV System in Ambulatory Care Centers located in the following areas: medical and dental services, ancillary service areas such phlebotomy and imaging, and blood donor areas. **\1\ /1/**When an MTF includes both inpatient and outpatient services, the NCTV system must be integrated with the Networked NCAV System.

12-9.3 Procurement.

The NC System must be procured as a turn-key system from a single qualified NC System contractor.

12-9.4 UL 1069.

All NC Systems must be listed to UL 1069 standards for the purpose as installed.

12-9.5 Common Criteria.

The application design, configuration, and installation of all NC Systems must comply with these common criteria:

12-9.5.1 Electronic Supervision.

Code Blue and other Code Stations, Annunciator Stations, Master Stations, Patient Stations, and associated wiring to each of these stations must be electronically supervised in accordance with UL 1069, with any failure condition annunciated at the local control or monitoring station, and communicated as further defined herein.

12-9.5.2 Keep-Alive Feature.

All personal computer (PC) based Master Stations and Annunciator Stations must be equipped with a "keep-alive" feature that will automatically re-boot the station if it is turned off for any reason.

12-9.5.3 Call Assurance.

When a call is placed from any call station or device, a call assurance indicator lamp on the station or device must illuminate to indicate that the call has been registered on the system. The call assurance lamp must remain illuminated until the call is cancelled.

12-9.5.4 Alert Signal.

A signal to alert staff to a call must be an audio tone or an alternate voice annunciation. **\1** The audio volume of an alert tone is not permitted to fall below the minimum perceptible decibel level. The adjustment of the alert tone audio volume on any type of station or light must be a maintenance procedure and not an operator function. The alert signal must have an automatic reset feature that turns the alert tone back to announce a new call when the temporary mute feature is activated for the current call. **/1/**

A computer-generated voice annunciation alert of a call, by type and location, must be provided as a user selectable alternative to the alert tone. This alternative must not affect or substitute for any displayed call information.

12-9.5.5 Tone and Visual Call Signals.

12-9.5.5.1 Call Annunciation.

Each call must be annunciated by various combinations of alert tones and visual indicators. **\1\ /1/** In inpatient MTFs that have NCTV and NCAV Systems, the tone and visual signals must be consistent for each System call type and priority.**\1**

12-9.5.5.2 Visual Call Signals. /1/

Visual steady or flashing illumination colors must provide clear and absolute distinction between call types and priorities on the dome and zone lights, and at the duty, annunciator, and master stations. Visual call illumination on zone and dome lights must be identical for each call type. **\1**

12-9.5.5.3 Tone Call Signals. /1/

Tone signals must sound at different intermittent pulse rates to allow adequate distinction between call types and priorities at the duty annunciator, master stations and on dome lights. Audible annunciation is required at all zone lights in accordance with UL 1069.

12-9.5.5.4 Call Routing – Zone Lights.

Within a patient care unit, the routing of call types from any call station, or combination of call stations, must be programmable to allow annunciation of calls on one or more zone lights. Each zone light must be programmed to illuminate in a pattern of zone lights that guides staff from any corridor in the unit directly to the room where the call was initiated.

Zone Light Activation Matrices must be developed. Each zone light must be given an identification (ID) number that must be indicated on the Telecommunications Systems drawings. A Matrix must be developed for each patient care unit served by the NC System. Each Matrix will list all zone lights by their ID number within each patient care zone, and correlate each zone light to the patient care room(s) where a call is initiated to activate zone lights. These Matrices must be included with the submittals beginning at 35% design.

12-9.5.5.5 Call Annunciation Priorities.

All NC systems must simultaneously process and signal all calls regardless of the call priority. When several different priority calls are active on the system at any one time, the signal for the highest priority call must take precedence on call tones and visual indicators that signal several call categories. For example: If dome and zone lights signal an emergency call by a solid red light with intermediate pulse rate tone, and a Code Blue call by a flashing red light with fast rate tone pulse, the dome and zone lights must signal a flashing red light with fast pulse tone when an emergency and code call occur at the same time.

12-9.5.5.6 Call Processing Rates.

a. Except for Code Blue and other Code calls, all calls must be processed from the origination call station to the call destination within 4 seconds.

b. Code Blue and other Code calls must be processed from the call initiation station to the call destinations within eight (8) seconds. The eight seconds must include a four (4) second delay in the initiation of these calls to allow staff to quickly abort accidentally initiated code calls.

c. The call processing rates defined here do not include any RP System transmission time for the alphanumeric RP of calls.

12-9.5.6 Code Blue and other Code Stations.

Each Code Blue and other Code call stations must be physically separate stations and they will not be part of any other station. These stations must be mounted as high as practical to be out of reach of children.

12-9.5.7 Dome and Zone Lights Lamps.

Dome and zone lights must utilize LED lamps. Incandescent lamps are unacceptable.

12-9.5.8 Main Terminal and Equipment Panels.

Locate the main terminal and equipment panel for each NC system in the TR nearest the area serviced and provide for system wire termination, low-voltage power supply that provides power to all stations and lights, and circuitry for system operation, as determined by the system application design. Locate the main terminal equipment in the Server room if it is determined by DHA-FE and the DoD Project Sponsor to be a Server.

12-9.5.9 Standardized System Features and Capability.

All of the systems in each NC System category must have the same standardized performance features and capability. System features and capability not required in a particular patient care unit may not be activated at the time of installation. However, the facility maintenance staff must be able to activate inactive features and capability at any time after installation without impacting the fundamental capabilities of the system, or without assistance from the system contractor.

12-9.5.10 Electrical Power.

The NC System and equipment must be powered per Table 12-1. AC powered equipment must be protected by a UPS unit providing at least 15 minutes full power during an AC power failure. UPS units must comply with UL 1778 and 47 CFR Part 15.

12-9.6 Networked NCAV System.

The NCAV Systems must include operational nodes of a totally integrated network of the major functional components and interfaces that provide a comprehensive facility-wide multimedia capability for the NC fundamental operations and enhanced supplemental operations.

12-9.6.1 Operations.

12-9.6.1.1 Fundamental Operations.

Provide for the communication of these calls from within a patient care unit:

a. Patient and caregiver calls for assistance and information

b. Auxiliary medical device alarm calls

c. Bed exit alarm calls

12-9.6.1.2 Enhanced Supplemental Operations.

Provide enhanced supplemental operations to the fundamental operation for the routing of calls, data, and messages within patient care units and over a system-wide network to facilitate:

a. Central annunciation of designated types of calls, including code calls and equipment failure alarms.

b. Automatic downloading of patient Admissions-Discharge-Transfer (ADT) module data via interface with the Medical Community of Interest (Med-COI). A Nurse Call system that will be connected to the Clinical Information System must meet the above requirements, be authorized for use via the RMF Process and be identified for use in a shared network environment. The Clinical Information System must be managed and controlled as prescribed in NFPA 99.

c. A central database for the logging of all calls and the generation of statistical management reports from a Call Logging Workstation and from designated computers on the hospital network.

d. System operational status monitoring and maintenance from a Central Maintenance Workstation.

e. Processing and transmission of NC data and messages to alphanumeric radio pagers or other wireless communications devices carried by staff, and processing of NC data and messages to GFGI-wide area alphanumeric pagers leased from a local Radio Common Carrier that are carried by staff.

f. Swing routing of calls from any call station to any Master Station in the unit or in adjacent areas.

12-9.6.2 NCAV System Network.

The NC network must be an adjunct network of the facility LAN. Whether the Nurse Call system design provides a Med-COI connected or a Stand-alone Information System (SIS), provide an industry standard network architecture that includes industry standard LAN technology, software, protocols, equipment, and cabling to interconnect all NC major functional components and major interfaces into an integrated NC capability that supports facility-wide communications and all NC functions. When possible, all network management devices (switches, routers, firewall, etc.) must be on the DoDIN Approved Products List (APL).

The Nurse Call System will require an Authority to Operate (ATO) and must comply with DoDI 8510.01 and UFC 4-010-06. As discussed in paragraph 12-9.1, the contractor must consult with the DoD Project Sponsor to determine if the NC System is required to

interface with the Medical Community of Interest (Med-COI) network. **\1** All NC systems that connect to the Med-COI must be in accordance with the DHA Procedural Instruction (PI), "Standard Isolation Architecture for Cybersecurity of Facility Related Control Systems (FRCS)". Nurse Call systems that are connected to the Clinical Information System must meet the above requirements and be identified for use in a shared network environment. The Clinical Information System must be managed and controlled as prescribed in NFPA 99.

12-9.6.2.1 NCAV Servers. /1/

Servers must include the appropriate DHA approved operating system (OS) and application software. Servers must also provide central databases for all of the systems' application programs and data, call logging data, interface with the facility RP or other wireless personal communications device system, and interface with the facility NTS System. Servers must also meet the RMF Requirements for an ATO and be capable of interface with the Med-COI in accordance with the DHA Procedural Instruction (PI), "Standard Isolation Architecture for Cybersecurity of Facility Related Control Systems (FRCS)".

12-9.6.3 NCAV System Major Components.

Provide the following NCAV System major components at the locations indicated. Also refer to paragraph 12-9.5.

12-9.6.3.1 Bed interface outlet stations.

A bed interface outlet station must be located behind each inpatient bed equipped with a communications side rail or bed exit alarm system. The station connector must be compatible with the connector on the bed communications cable.

12-9.6.3.2 Patient Stations.

Single Patient Stations must be provided for each medical/surgical unit patient bed, each critical care unit patient bed, each LDR/LDRP bedroom, each inpatient unit exam, procedure, and treatment room, each emergency exam treatment room and patient care station, each pre-operative patient care station, Phase I post-anesthesia recovery patient care station, and Phase II recovery patient care station.

12-9.6.3.3 Cord Sets and Holders.

Provide the following types of cord sets for each location, except where noted:

a. Pillow Speaker Cord Sets. A pillow speaker cord set must be provided for each patient station in all inpatient bedroom types, excluding inpatient behavioral health bedrooms. In these locations, the patient station cord set receptacle must accommodate the simultaneous use of both a pillow speaker cord set and a push button or pneumatic cord set. The cord set

must be a component in the UL 1069 Listing for the system, or be approved by the Nurse Call Manufacturer for use with their system.

b. Push Button Cord Sets. A push button cord set must be provided for each patient station in each inpatient unit exam, treatment and procedure room, each emergency exam treatment room, each patient station in the pre-operative holding and the post-operative recovery areas. Provide push button cord sets for 25 percent of the patient stations in all other locations. The cord set must be a component in the UL 1069 Listing for the system, or be approved by the Nurse Call Manufacturer for use with their system.

c. Pneumatic Cord Sets. Pneumatic cord sets must be provided for 25 percent of the patient stations in all rooms and cubicles. Cord set must be a component in the UL 1069 Listing for the system or be approved by the Nurse Call Manufacturer for use with their system.

d. Cord Set Holder. A wall bracket must be provided to hold cord sets when not in use.

e. Push Button Stations. Only push button stations will be provided in Behavioral Health areas as required by Appendix A.

12-9.6.3.4 Code Blue Stations.

Code Blue Stations must be provided as a minimum, in the following locations: each medical/surgical unit patient bed, each critical care unit patient bed, each LDR/LDRP bedroom, newborn/well baby nursery, each inpatient unit exam, procedure and treatment room, Cesarean delivery rooms, diagnostic radiography and fluoroscopy rooms, CT scanner rooms, MRI scanner rooms, stereotactic mammography rooms, ultrasound rooms, cystoscopy rooms, bronchoscopy rooms, endoscopy rooms, oral surgery dental operatories, emergency exam treatment rooms and each emergency patient care station, emergency treatment and procedure room, pre-operative patient care station, Phase I post-anesthetic (PACU) patient care station, and Phase II recovery patient care station. Code Blue stations in Behavioral Health units must be in accordance with Appendix A.

12-9.6.3.5 Device Alarm Jack Stations.

Device alarm jack stations must be adjacent to each patient station.

12-9.6.3.6 Duty Stations.

Duty Stations must be provided, as a minimum, in staff lounges, clean core areas, clean and soiled workrooms and storage, nourishment pantry, medication preparation room, changing locker and other areas identified by the DoD Project Sponsor. Each duty station will provide an audible tone without voice, and visual indication that a call has been initiated on the NC system.

12-9.6.3.7 Emergency Pull Cord Stations.

Emergency Pull Cord Stations must be adjacent to each toilet in public, patient and staff restrooms, and in each patient shower and tub, each medical/surgical unit patient, critical care unit and each LDR/LDRP toilet/lavatory location. In showers, locate the station on the shower head wall and above the shower head; these stations must be water resistant. In Behavioral Health settings emergency pull cord stations must be replaced with emergency push button stations.

12-9.6.3.8 Emergency Push Button Stations.

Emergency Push Button Stations must be provided, as a minimum, in each; Intensive, Continuing Care, and Isolation bassinet location; Level 1 Holding Nursery, Admissions.

12-9.6.3.9 Staff Assistance Stations.

Staff assistance stations must be provided, as a minimum, in dayrooms, conference rooms, waiting rooms, interview rooms, emergency procedure and trauma rooms, and Nursery parent teaching and feeding rooms. Each staff station will include the functionality of a duty station plus two-way voice communication.

12-9.6.3.10 Staff Assistance Stations with Emergency Call Button.

Staff assistance stations with an emergency call button must be provided, as a minimum, in each OR, cystoscopy room, cardiac catheterization room, angiography procedure room, Nursery procedure room, isolation and seclusion ante-rooms, day rooms, interventional procedure room, Dialysis Stations, Blood Donor Stations, Immunization rooms, and inpatient pediatric play rooms. Behavioral Health inpatient and outpatient settings must be equipped in accordance with Appendix A.

12-9.6.3.11 Master Stations.

Master stations must be provided, as a minimum, at the following nurse stations: all inpatient care units, Emergency Department, pre-operative unit, Phase I post-anesthetic (PACU) unit, Phase II recovery unit, and at the control desk in the surgical suite.

12-9.6.4 Peripheral Equipment.

Provide the Networked NCAV System peripheral equipment defined here at the locations indicated.

12-9.6.4.1 Main Central Annunciator.

Provide a Main Central Annunciator Station to annunciate all Code calls and failure alarms throughout the entire NC System until the call is cancelled at the initiation point. The main central Annunciator Station location must be approved by the Design and Construction Agent in coordination with the DoD Project Sponsor.

12-9.6.4.2 Call Logging Workstation.

A Call Logging Workstation must be provided for the collection, processing, storage, statistical analysis, report generation, and archiving of call data. The Call Logging Workstation must be capable of printing real-time call data by patient's name, sex, age, room, and bed, the time each call is placed, answered, set on service reminder, or canceled at the Master Station or when logged at the Central Annunciator Station. This workstation must be located in an area approved by the Design and Construction Agent in coordination with the DoD Project Sponsor.

12-9.6.4.3 Maintenance Workstations.

Two Maintenance Workstations must be provided to support remote monitoring, diagnostics, and troubleshooting of failures throughout the system, testing of major NC System components, and for the downloading and installation of software upgrades from the manufacturer. One workstation will support the maintenance of the system stations and lights and must be located in the Facility Management Department. The other workstation must be located in a designated area identified by the DoD Project Sponsor.

12-9.6.5 Duplex Voice Intercom.

Provide a full duplex, non-blocking voice intercom between Master Stations and Voice Calling Stations (patient stations, staff stations, and duty stations) and for voice communications on the NCAV System. A simplex intercom that utilizes voice activation or other switching circuits to permit transmission in only one direction at a time, or that may clip portions of a two-way conversation, are not permitted.

12-9.6.6 Networked NCAV System Interfaces.

Provide the following interfaces at the locations indicated.

12-9.6.6.1 Bed Side Rail Communications and Bed Exit System Interface.

Provide interface at the Bed Interface Outlet Station via the bed communications cable. Side rail controls must allow initiation and routing of a patient call, and provide on/off control of room and reading lights. A bed exit system must initiate a bed exit alarm when the patient exits the bed.

12-9.6.6.2 Interface for Remote Control of Over-Bed Lights.

Provide an interface for on/off remote control of the inpatient bedroom reading and room lights at each bed location via an interconnection to a solid-state, low-voltage light controller. (Reference Chapter 11 Electrical)

12-9.6.6.3 ITV System Interface.

Provide pillow speaker interface in accordance with paragraph 12-12 at each inpatient bed station and the associated patient flat-panel, high-definition television (HDTV) for these functions: HDTV on/off and channel selection control, and remote sound from a pillow speaker cord set. If requested by the DoD Project Sponsor, pillow speaker must also interface with patient interactive access to on-demand and scheduled education and message channels, and interactive access to programs such as patient surveys or food service menu.

12-9.6.6.4 RP Interface.

Provide a networked NCAV System RP server interface to the RP Systems (reference paragraph 12-11) that will automatically route calls to the RP System for transmission to radio pagers assigned to staff.

12-9.6.6.5 Medical Community of Interest (Med-COI) Interface.

When directed by the DoD Project Sponsor, the Networked NCAV System server must interface directly to the Med-COI and the Clinical Information System to automatically download patient ADT module data for use by master stations and whiteboards and to interface with hands free wireless communications devices carried by the staff. A Nurse Call system that is connected to the Clinical Information System must meet the requirements associated with the RMF Process, obtain an ATO and connect in accordance with the DHA PI, “Standard Isolation Architecture for Cybersecurity of Facility Related Control Systems (FRCS)”. A Nurse Call system that is connected to the Clinical information system must meet the above requirements and be identified for use in a shared network environment. The Clinical Information System must be managed and controlled as prescribed in NFPA 99.

12-9.6.6.6 NCTV System Interface.

Provide a networked NCAV System interface to the NCTV System (reference paragraph 12-9.7) to integrate the NCTV System with the enhanced supplemental operations of the Networked NCAV System. This requires the NCTV System to add a network capability that will link the network to the NCAV System LAN.

12-9.6.6.7 NTS System Interface.

Provide an NTS System (reference paragraph 12-5) interface with a NCAV System network server for time and date synchronization.

12-9.6.7 NCAV System Call Types.

The following are NCAV System call types:

a. Patient Routine Call

b. Patient Priority Call

c. Cord Disconnect Call

d. Bed Disconnect Call

e. Emergency Call

f. Staff Assistance Call

g. Code Blue Call

h. Other Code Call

i. Medical Device Service Alarm Call

j. Bed Exit Alarm Call

k. Duplex Voice Intercom Call

l. Service Dispatch and Reminder Call

m. Information Message Call

n. Failure Alarm Call

12-9.6.8 Call Annunciation Modes.

Each call must annunciate throughout the system by various combinations of alert tones, visual and video indications, and the digital display of alphanumeric data and text messages. The specific annunciation for each call type must be as described herein for each type and source of call.

12-9.6.8.1 Master Stations.

On Master Stations, an intermittent call alert tone must sound. A touch-screen color video monitor must graphically and digitally display the call type and call initiation room and bed location. Alphanumeric data and text message information must indicate associated patient data, associated staff assignment data, and associated radio pager assignment data. The facility room name and number must identify the call initiation room. Call data, information, and status must remain displayed on the video monitor until the call is cancelled.

12-9.6.8.2 Central Annunciator Stations.

On Central Annunciator Stations, an intermittent call alert tone must sound. A touch-screen color video monitor must alphanumerically indicate the call type and call initiation patient care unit and room location, or failure alarm call type and equipment location. The video monitor display must indicate at least ten calls simultaneously, and include a scrolling feature that will display additional calls that are not simultaneously displayed. The facility room name and number must identify the call initiation room location. Call data, information, and status must remain displayed on the video monitor until the call is cancelled.

12-9.6.8.3 Duty Stations.

On duty stations, LED lamp(s) with steady or flashing illumination must indicate calls by the call priority level, and sound an alert tone.

12-9.6.8.4 Pagers and Other Devices.

On pagers or other networked wireless personal communications devices carried by the staff, an alert tone or vibration must activate, and an alphanumeric data and text message must indicate the call type, and identify the room and bed location where the call was initiated. For routine calls that are first answered by an attendant, the pager or other networked wireless personal communication device must also indicate that a service dispatch message has been sent by the attendant. The room name and number must identify the call initiation room and bed.

12-9.6.8.5 Annunciation.

The alert tones, and visual and video indication displays for all types and priorities of calls must continue to alert until the call has been answered and cancelled. Except for routine calls, all other calls must be cancelled at the initiating call station. Routine calls may be cancelled at either the initiating station or at the answering Master Station on audio equipped systems. NCTV calls must be cancelled at the initiating station.

12-9.6.9 Call Annunciation Priorities.

The annunciation of all call types must be sequenced in a four level priority rank order, from a high priority, Number 1, to a low priority, Number 4, as listed in Table 12-2. Coordinate Code Call names, meanings, and priority levels with the DoD Project Sponsor.

Table 12-2 Call Annunciation Priorities

Priority Level	Call Type
#1 Code	Code Blue
	Other Code Calls
#2 Emergency	Emergency
	Bed Exit Alarm
	Medical Device Emergency Alarm
	Staff Assistance
	Failure Alarm
#3 Priority	Patient Priority
	Call Cord Disconnect

Priority Level	Call Type
	Bed Cable Disconnect
#4 Routine	Patient Routine
	Medical Device Routine Alarm
	Voice Intercom - Staff and Duty Stations

12-9.6.9.1 Call Types.

All call types must be simultaneously processed regardless of the priority level. However, when several different priority level calls are present on the system at any one time, the highest priority call must take precedence over lower priority calls. For Master Stations and Annunciator Stations that display calls in a list, the displayed list of calls must be in priority order, with the highest priority calls at the top. All call types, regardless of the priority level, must remain indicated until cancelled.

12-9.6.10 Call Routing.

Call routing throughout the networked system must be software programmable to provide the selectable call routing defined here. All patient data and caregiver data associated with any call must automatically accompany the call routing.

a. Calls initiated from a patient toilet or shower room that is entered directly from within the patient bedroom must visually annunciate on the dome light located outside the entry into the patient bedroom.

b. Calls from a dedicated patient toilet room that is entered directly from within another room must visually and audibly annunciate on the dome light located outside the entry door into the toilet room, and visually on the dome light located outside the entry into the other room.

12-9.6.10.1 Call Routing – Master Stations.

Master Station features must allow the attendant to select a call routing, to include the routing of voice intercom between any Master Station and any audio call station, as defined here. If the network or call routing feature should fail, all calls must revert to the original UL 1069 designated Master Station.

a. A default call routing scheme within each patient care zone must be established for calls between each call initiating station and the Master Station(s) in the NCAV System. If there is more than one Master Station in the NCAV System, then the default call routing to each Master Station must be user defined and approved by the User Representative.

b. Any call from a call initiating station can be selectively routed to, and answered from, any Master Station in the NCAV System.

c. Any one Master Station in the NCAV System must be able to handle any combination of calls, or all of the calls, from any call initiating station in the NCAV System.

d. Any combination of Master Stations throughout the NCAV System can be programmed to operate in a parallel mode. When operating in a parallel mode, all calls that would normally be routed to a Master Station must now be routed to all Master Stations at the same time. The parallel mode feature can be either a default setting or an attendant selectable mode at any Master Station.

e. An authorized attendant, using password protection, must be able to perform at any Master Station, a selective call capture function whereby any call initiating station that has been default programmed for call routing to another Master Station must be rerouted to the capturing Master Station. The attendant must be able to selectively capture a single room, groups of rooms, or all of the rooms that have been default assigned to another Master Station. The rerouting of calls from any room must include all associated patient and staff data that has been programmed for the room, including staff assignments.

f. Master Stations that have relinquished reception of calls to another Master Station via the call capture function must retain the manual capability to announce a RP.

g. An authorized attendant, using password protection, must be able to perform a selectable recapture function at any Master Station, of all calls from the NCAV System, or any call station that has been captured by another Master Station by performing a selectable recapture function.

h. All call routing, call capturing, and call recapturing operations must be password protected.

12-9.6.10.2 Call Routing – Main Central Annunciator Station.

The annunciation of a normal local call on a Master Station, the RP of the call, and the call types listed here must be automatically routed to the Main Central Annunciator Station located in an area identified by the DoD Project Sponsor.

a. Code Blue calls

b. Other Code calls

c. Failure alarm calls

12-9.6.10.3 Call Routing – Infant Distress Central Annunciator Station.

In addition to the normal local call annunciation on a Master Station, and the radio page of the call, all infant distress calls must also be automatically routed to the Infant Distress Central Annunciator Station.

12-9.6.10.4 Call Routing – Duty Stations.

All duty stations must be equipped to annunciate all call types.

12-9.6.10.5 Call Routing – Call Logging Server and Call Logging Workstation.

All call data from the NCAV System must be routed to the call logging database in the call logging server. The call logging database will be accessed from the NCAV System Call Logging Workstation and any additional location identified by the DoD Project Sponsor in coordination with the facility Information Technology Representative. Call logging application programs used to access the call logging database and to generate call data reports must be installed on designated computers on the hospital network. Failure of the Call Routing or Call Logging feature, to include, but not limited to, out of logging space conditions or a network failure, must not cause degradation of the basic services as defined in UL 1069.

12-9.6.10.6 Call Routing – Maintenance Workstations.

All failure alarm calls from all major functional components of the network and all systems must be routed to the Maintenance Workstation(s). Failure of the Call Routing or Call Logging feature, to include, but not limited to, out of logging space conditions or a network failure, must not cause degradation of the basic services as defined in UL 1069.

12-9.6.10.7 Call Routing – RP System Pagers.

All calls and failure alarms on the Networked NCAV System must be routed by NC selectable duty assignment programming via the NCAV RP Server interface (reference paragraph 12-11), for transmission to RP System Pagers assigned to designated staff. Failure of the Call Routing Radio Page feature must not cause degradation of basic services as defined in UL 1069.

12-9.7 NCTV System.

12-9.7.1 Overall Configuration and Capability.

There are two typical configurations for the application of the NCTV System: one configuration is for installation in ACCs to include blood donor centers and the second configuration is for installation in inpatient MTFs. Both configurations must provide the same fundamental operations for patient and staff calls, and communications operations. However, the configuration for inpatient MTFs must provide enhanced supplemental operations for signaling and data handling from the NCTV System when it is integrated with the enhanced supplemental operations of the NCAV System in the facility. The common fundamental operations of both configurations, and the enhanced supplemental operations for inpatient MTFs must be as defined here.

An inpatient MTF that is equipped with a Networked NCAV System (reference paragraph 12-9.6) that provides enhanced supplemental operations, must be linked as

nodes on a network provided as part of the NCTV System., with the NCTV network linked to the Networked NCAV Systems network. The NCTV System must have the same enhanced supplemental communications capabilities as the NCAV System, to include alphanumeric RP or other wired networked personal communications devices, central annunciation of code and failure calls, and the central logging of all call transactions.

12-9.7.2 NCTV System Major Components and Locations.

Provide the following NCTV System major components at the locations indicated.

12-9.7.2.1 Emergency Call Stations.

Emergency Call Stations must be located as directed herein.

a. Patient toilets (beside and toward the front of each toilet)
b. Staff toilets that may be used by patients (beside and toward the front of each toilet)
c. Public toilets (beside and toward the front of each toilet)
d. Patient showers (waterproof unit on shower head wall above shower head)
e. Phase II recovery patient care stations (adjacent to the patient's head)
f. Phase I post-anesthesia recovery (PACU) patient care stations
g. Pre-operative patient care stations
h. Emergency Laboratory Phlebotomy area or rooms
i. Blood Donor stations
j. Physical Therapy treatment stations and the exercise gym
k. Special Procedure rooms: coronary, neurological or peripheral angiography, electrophysiology procedures, cystoscopy, bronchoscopy, colonoscopy, and endoscopy
l. Operating rooms
m. Pulmonary function laboratory and testing rooms
n. Immunization and Allergy injection rooms
o. Dialysis patient care stations
p. Cardiac Rehab Exercise gym
q. Electroencephalogram (EEG) Testing rooms
r. Stress Electrocardiogram (ECG) and Echocardiogram rooms
s. Medical Radioisotope Laboratories
t. Patient dressing rooms and locker area

u. Dental oral surgery rooms

v. CT Scanner rooms

w. MRI Scanner rooms

12-9.7.2.2 Code Blue Station Locations.

The minimum required locations must be located as directed herein.

a. Procedure rooms that utilize high-level disinfection or sterile instruments, and some environmental controls that are not required to support an operating room or Dental oral surgery rooms

b. ECG Echocardiogram rooms

c. Physical Therapy Exercise gym

d. Laboratory Phlebotomy areas or room

e. Blood Donor rooms

f. Renal dialysis rooms

g. Immunization and Allergy Injection rooms

h. Chemotherapy infusion rooms

i. CT Scanner rooms

j. MRI Scanner rooms

12-9.7.2.3 Dome Lights and Whiteboard Locations.

Locate a dome light above or beside the entry to each room and each patient care station that will be equipped with an Emergency Call Station or Code Blue Station. Dome lights without a tone device must be located above or beside the entry to each room and each patient care station that will be outfitted with any of these NC System components: patient station, emergency pull cord station, emergency push button station, or Code Blue station. Dome lights with a tone device must be located outside the door to a dedicated toilet room that is accessed from within another room.

Zone lights must be located at each corridor intersection within multi-corridor units. White Board (WB) Stations must be located at the Nurse Station or Team Center in each patient care unit.

12-9.7.2.4 Zone Lights with Tone Locations.

Locate a ceiling mounted zone light with tone at each corridor intersection within multi-corridor areas.

12-9.7.2.5 System Annunciator Station Location.

The system annunciator station will be located in an area that is continuously monitored by staff.

12-9.7.3 Call Types and Alarms Signaled.

Call types and alarms signaled will include:

a. Call from a patient or staff for emergency assistance from an emergency pull cord station or an emergency push button station

b. Call from staff for Code Blue assistance from a Code Blue station

c. Call from staff for Other Code assistance from Other Code stations

d. Failure alarms from electronically supervised wiring, Code Blue Stations, Other Code Stations, and Annunciator Stations

12-9.7.4 Call Priorities.

The processing of calls must be sequenced in a two-level priority rank order, from a high priority, Number 1, to a low priority, Number 2, as listed here:

Priority Number	Call Categories
1	Code Blue and Other Codes
2	Emergency and Failure Alarm

12-9.7.5 Annunciator Station Function and Call Routing.

When a call is activated on the NCTV System, an intermittent call alert tone will sound on the system Annunciator Station. The Annunciator Station touch-screen color video monitor screen must alphanumerically identify the call type and call initiation room. The Annunciator Station must simultaneously process and display multiple calls. All calls must continue to be indicated until cancelled at the call initiation station.

A call signal cannot be cancelled at any Annunciator Station; it must be cancelled at the initiating call station. A tone mute icon may be used to temporarily silence a current call tone signal. The tone signal circuit must have an automatic reset feature that allows the tone signal to sound when the next call is placed.

12-9.8 Enhanced Supplemental Operations.

An MTF that is equipped with a Networked NCAV System (reference paragraph 12-9.6) that provides enhanced supplemental operations, to include an onsite RP System, the NCTV System must be configured with an integrated network that will be interconnected with the Networked NCAV System to fully utilize these NCAV enhanced supplemental operations for the routing of calls and data to facilitate:

a. The processing and transmission of call data and messages to alphanumeric pagers or other wireless networked personal communications devices carried by the staff

b. Central annunciation of code calls and failure alarms

c. The logging of all calls, and the generation of statistical management reports by a central database

d. Central system operational status monitoring and maintenance from a Maintenance Workstation

This enhancement will require the NCTV System to have the fundamental capability to be upgraded with all necessary networking hardware and software, and will include the provision of identical Radio Pagers for the NCTV System. The NCTV System Annunciator Stations must be upgraded with the hardware and software, to include a keyboard and a mouse, to allow manual alphanumeric RP from the Annunciator Stations.

12-10 INTERNAL CELLULAR ANTENNA SYSTEMS (IRES).

Provide a RF Distribution System to support communications from fire, emergency, and other first responder systems in accordance with NFPA Section 11.10 and NFPA 1225 for all facilities greater than 50,000 GSF (4645 GSM). Permitted operations include the RP System and the local fire service radio system. The signal sources may be either external or internal to the facility and the service will be capable of bi-directional services internally or externally. Systems that service fire radios must meet cabling and battery backup requirements per the local Installation Fire Marshall. Other frequencies and system requirements will be identified by the DoD Project Sponsor. Site requirements, field strength surveys, engineering & design documents, and test results will be provided as part of the system.

12-11 RADIO PAGING SYSTEM.

12-11.1 Radio Paging (RP).

Provide **\1** a paging system with paging receivers to support 100 percent coverage within the MTF. **/1/** The RP system design must provide 100 percent coverage within the MTF.

12-11.2 Page System Interfaces.

The RP System must interface with these following systems as noted in their respective sections of this chapter: Telephone System (numeric paging only) (reference paragraph 12-6), NC System (reference paragraph 12-9), Electronic Security System (reference Chapter 5, and IRES (reference paragraph 12-10).

12-11.3 System Function.

The RP system must utilize tone and vibration alert paging receivers that display an alphanumeric message. Each pager must be accessible by dialing a discrete set of digits via the telephone system. Access to the RP system must also be available at the central control console within the health facility when provided and at each NCAV System control station. The DoR must provide space for control and coaxial cables as well as the AC power, and the conduit for the system. Location of head end equipment and system components must be coordinated with the DoD Project Sponsor.

12-11.4 Emergency Response Team Pagers.

Pagers assigned to members of the code and other emergency response teams must have at least two separate and distinct alert tones: one for routine and priority calls and one for emergency calls. These pagers must also have two separate access codes: one for calls to individual pagers, and one for group alerts. The group alert code must signal all pagers in a group simultaneously.

12-11.5 Antennae Type and Mounting.

The antenna type selection, and the mounting height determination must provide complete facility coverage. Provide an antenna and mast that conforms to TIA-222 and TIA-329. A wireway, conduit, or cable tray must be provided from the transmitter location to the antenna. In the presence of an IRES, an appropriate low-level signal from the RP System transmitter must be directly injected into the IRES to supply coverage. With this type of design, an external antenna is not required.

12-11.6 Power Requirements.

All RP equipment must be connected to the life safety branch of the EPS and rated for continuous duty.

12-11.7 Transmitter and Encoder.

The transmitter must comply with FCC Emission Designator 11K0F2D for 12.5 KHz Narrow Band Transmission and appear as a listed device with the JITC. Provide two transmitters and encoders in a hot-swap configuration. Provide a Maintenance and Programming station.

12-12 INTERACTIVE TELEVISION (ITV) SYSTEM.

The ITV system is a proponent funded television receiver system used for patient entertainment and education and funded separately from MILCON.

Provide the following to support this system:

12-12.1 Electrical Power.

Provide electrical power to support the requested ITV systems in accordance with the electrical code and Table 12-1, and the device location provided by the System Contractor.

12-12.2 Empty Conduit and Boxes and Cable Trays.

Provide junction boxes and empty conduits with pull strings for the installation of cables. Calculate cable requirements into cable tray capacity calculations and provide adequate cable tray capacity to support these systems. Where system wiring will be designed to be connected utilizing the facility TIS, the specific location must be identified. Provide outlets, wiring and patch panel capacity in TRs to support these systems. Provide conduits from head end equipment location to the antennas mounted on the roof and, if required, conduits for coaxial and control cables for all system components associated with the Ambulance Dispatch.

12-12.3 Structural Support.

Provide structural support and sufficient mounting space for the antennas.

12-12.4 Equipment Space Support.

Provide floor space and racks as required in Communications Radio Equipment Room (COM04). Include this equipment in the TR Floor Space Calculations where equipment is located in TRs.

12-13 TV BROADBAND DISTRIBUTION NETWORK.

12-13.1 Purpose.

Provide a TV broadband distribution network to receive and distribute TV program channels from a commercial TV service to flat-panel HDTVs throughout a stand-alone facility.

12-13.2 Procurement.

Procure the entire TV network as a turn-key system from a single qualified TV network contractor.

12-13.3 Commercial TV Service.

The DoD Project Sponsor must select and separately contract for the provision of TV program channels from a locally available commercial TV service.

The system application designer must request and obtain from the DoD Project Sponsor the ID of the TV service that must be used, and obtain a detailed description of the facility space and infrastructure requirements that must be provided to accommodate

the TV service signal reception or entry and any headend equipment to be installed in the facility.

12-13.3.1 Facilities and Infrastructure for the TV Service.

Provide the facilities, space, and infrastructure to accommodate the installation requirements of the commercial TV service. **\1**

12-13.3.1.1 CATV Facilities and Infrastructure. /1/

For CATV service, provide the facilities and infrastructure to accommodate the routing of the CATV service trunk-line entry from the nearest source on the Installation to the network headend in a facility TR, including the CATV trunk-line and trunk amplifier (as may be required). The trunk-line routing into the facility may be via an underground duct or an underground cable link from an overhead pole adjacent to the facility site. **\1**

12-13.3.1.2 SATV Facilities and Infrastructure. /1/

For SATV service, provide the facilities and infrastructure to accommodate the installation of an SATV service roof-top antenna, cable entry into a facility TR, and any required headend equipment provided by the SATV service.

12-13.4 Broadband Distribution Network.

The broadband distribution network must consist of cable and equipment to receive, process, and distribute all TV program channels received from the TV service. The TV distribution network can be configured either as a broadband coaxial network or a gigabit Ethernet network for the communication of all TV channels to all TV outlets throughout the facility. The distribution network must conform to the radiation standards specified in 47 CFR Part 76. **\1**

12-13.4.1.1 RF Broadband Coaxial Cable Distribution Network. /1/

An RF broadband coaxial cable distribution network must include quad shield coaxial cables, power supplies, amplifiers, splitters, directional couplers and taps, attenuators, terminators, TV outlets, and any other required equipment. **\1**

12-13.4.1.2 Ethernet Network. /1/

A gigabit Ethernet network must be configured as a dedicated network including network switches, patch panels, FO and UTP cable, modular TV outlets, and equipment racks for the mounting of all equipment. The network must conform to TIA/EIA criteria standards. The fiber and copper cabling and network outlets required for this system are in addition to those required for the Telecommunications Infrastructure System (TIS) in this chapter.

12-13.5 TV Outlets and Signal Level.

TV outlets must be provided in these locations:

a. Waiting Rooms
b. Conference Rooms
c. Classrooms
d. Patient Education rooms
e. Lounges
f. Inpatient Behavioral Health Activity rooms
g. Behavioral Health Group Therapy rooms
h. Patient bedrooms
i. Emergency exam treatment rooms

For Coaxial/RF based systems, the TV signal level at each TV outlet must be between +3 dBmV and +9 dBmV.

12-13.6 Flat-Panel HDTVs and Connecting and Mounting Items Configuration.

Provide devices to interface the flat-panel HDTVs with the TV distribution network. **\1\ /1/** Provide jumper cables for connection of the flat-panel HDTVs to the TV outlet jack and any network interface devices. The cable between the network interface device and the HDTV must be an HDMI cable.

Provide wall brackets and furniture mounts for the mounting of all flat-panel HDTVs. Coordinate the requirements for in-wall support plates for wall mounting brackets with the architectural and structural design, and the requirements for casework or furniture mounts with the architectural design and the PRC List.

12-13.7 Electrical Power.

Provide a quad AC power receptacle at all TV outlet locations. The AC power receptacle must be mounted in a separate back box from the TV outlet back box and be located adjacent to the TV outlet.

12-14 ELECTRONIC SECURITY SYSTEM (ESS).

Electronic security system requirements are included in Chapter 5 Antiterrorism (AT) and Physical Security and in Appendix A.

12-15 RADIO AND PUBLIC ADDRESS (PA) SYSTEM.

12-15.1 System Purpose.

Provide a zoned loudspeaker paging and zoned music program system that must evenly distribute recorded or live voice messages or recorded music throughout designated areas of the facility. The distributed sound must be free of noise and distortion. It must be balanced and highly intelligible per the Modified Rhyme Test (MRT) of ANSI/ASA S3.2. The system must be capable of individually and simultaneously paging all separate independent zones provided by the system configuration.

12-15.2 System Components.

Provide the following system components:

12-15.2.1 Headend Equipment.

12-15.2.1.1 Equipment Racks.

Provide floor-mounted equipment racks and double sided cable management to house all headend equipment.

12-15.2.1.2 Auxiliary Inputs.

Provide rack space and preamplifier input ports to support the specified number of auxiliary inputs identified by the DoD Project Sponsor in coordination with the facility Information Technology Representative. The rack space and input ports must support a minimum of two auxiliary inputs.

12-15.2.1.3 Distribution Equipment.

Provide mixer-preamplifiers, power amplifiers, mixer amplifiers, input modules, partial octave graphic equalizers, and input selection switches for connecting program inputs to the distribution system.

12-15.2.1.4 Monitor Panel.

Provide a system monitor panel with selector switch and speaker to check each zone output, voice input, and zone selection.

12-15.2.1.5 Telephone Interface Couplers.

Provide telephone interface couplers for loudspeaker paging. The telephone interface must be coordinated with Installation Telecommunications service provider. The number and type of telephone lines provided must be based on the system configuration. There must be one unique telephone number provided for each local loudspeaker paging zone and the all-call loudspeaker paging to all zones in the system.

Telephone system interface equipment must be provided as part of the PA system. Loudspeaker paging control functions such as call answer, tone announcement before the page, and automatic preset time out must be accomplished by the telephone interface couplers.

a. Coordinate and define the telephone system interface and programming requirements for loudspeaker paging access with the DoD Project Sponsor.

b. Local zone loudspeaker paging access from the telephone system must be programmed for access only from telephones within the local zone.

c. Wide area and all-call loudspeaker paging access from the telephone system must be restricted to selected telephones as defined by the DoD Project Sponsor.

12-15.2.2 Loudspeaker System.

Provide low power loudspeakers for uniform sound distribution at low volume levels. For maximum coverage, corridor speakers must be spaced apart at a maximum distance that is twice the ceiling height. Provide speakers with separate volume controls in individual rooms. Volume control and bypass relay features must be provided for paging speakers in designated areas as defined by the DoD Project Sponsor. The bypass relay must allow for all-call paging to bypass the local volume control and be audible at normal system volume. Speakers will not be provided in normally occupied spaces such as patient bedrooms, offices, exam rooms, procedure rooms, Emergency exam treatment rooms, and procedure rooms. Provide speakers that are designed to provide even sound dispersion over the 20 Hz–20 KHz frequency range within the entire speaker coverage area.

12-15.2.2.1 Indoor Loudspeaker Assemblies.

Provide cone speakers with enclosures and baffles in all indoor locations.

12-15.2.2.2 Outdoor Loudspeaker Assemblies.

Provide weather resistant cone speakers with enclosures and baffles in outdoor ceiling locations. Provide horn speakers in outdoor wall mount locations.

12-15.2.3 Microphones.

Provide the type and quantity of microphones with control switches and mounts identified by the DoD Project Sponsor in coordination with the facility Information Technology Representative.

12-15.3 System Configuration.

Provide a system configured in accordance with these specifications:

12-15.3.1 All Call Capability.

Provide an ‘all zone’ paging capability, which will have priority over all other paging functions in the facility except the Mass Notification System, as described in Chapter 14 Fire Protection and Life Safety. The All Call capability may be accessed via a microphone, telephone, or both. The microphone access must have priority over the telephone access for all zone types.

12-15.3.2 Local Zones.

Provide local loudspeaker paging zones for all areas and services of the facility where patients are seen for diagnosis or treatment. Local zones must be accessed using the telephone system, microphones, or both, as defined by the DoD Project Sponsor in coordination with the facility Information Technology Representative. All Call paging must override local and zone paging. The ability to control loudspeaker volume must be provided from a controlled access area inside the local zone floor space.

12-15.3.3 Medical/Dental Zoning.

Provide two separate wide area zones, one for medical and one for dental, where these services are combined in a facility. An All Call for the entire facility must be provided.

12-15.3.4 Auditorium Zone.

In a facility that has an auditorium equipped with an AV system (reference paragraph 12-17), loudspeaker paging in the auditorium must be limited to only the All Call loudspeaker paging.

12-15.3.5 Microphone Applications.

Telephone system input is the preferred method and must be provided for all systems and zones. The DoD Project Sponsor in coordination with the facility Information Technology Representative provides guidance on the number and location of microphone stations, which must be limited.

12-15.4 System Performance.

The loudspeaker system must provide even sound distribution throughout the designated area, +/-3 decibel (dB) for the 1/1 octave band centered at 4,000 Hz. The system must provide uniform frequency response throughout the designated area, +/-3 dB as measured with 1/3-octave bands of pink noise at locations across the designated area selected by the Contracting Officer. The system must be capable of delivering 75 dB average program level with additional 10 dB peaking margin sound pressure level (SPL) in the area without causing the associated amplifier to exceed normal operating specifications for power or distortion. Unless otherwise specified, the reference SPL is 20 micro pascal. The minimum audio SPL to ambient noise ratio must be at least +15 dB in all areas. The system must not have any audible hum, noise, buzz, or rattle at a

loudspeaker. The electrical/acoustic signal-to-noise ratio for the entire system must be a minimum of 66 dB.

12-15.5 Electrical Power.

PA system equipment in inpatient MTFs must be powered from the essential electrical system emergency power life safety branch per Table 12-1. AC powered equipment must be protected by a UPS unit that must provide a minimum of 15 minutes of full power during an AC power failure. All UPS units must comply with UL 1778 and 47 CFR Part 15.

12-16 SOUND REINFORCEMENT SYSTEM.

12-16.1 Purpose.

Provide distortion and noise-free, highly intelligible (per the MRT of ANSI/ASA S3.2), balanced, and evenly dispersed sound reproduction and reinforcement from multiple sources to an audience in auditoriums and large conference rooms as required by the DoD Project Sponsor.

12-16.2 Inputs.

The sound reinforcement system must accept input from multiple sources such as wired and wireless microphones, digital audio, video programming and playback devices, and PC-based programming. **\1\ /1/** The system must address the specific functions of the space where it will be located in relation to the number and types of inputs.

The major components of the system must consist of, but not be limited to:

a. Preamplifiers and power amplifiers
b. Partial octave graphic equalizers
c. Sound mixer/amplifier
d. Wired microphones with goose neck stands
e. Wired handheld microphones
f. Wireless microphones and wireless receivers
g. Compact disc (CD)/digital video disc (Blu-Ray) recorders/players
h. Auditorium wireless hearing assistance systems
i. Auditorium sound combiner and switching
j. Volume controls
k. Auxiliary input ports to support a minimum of two sources with preamplifiers and rack space for auxiliary source equipment
l. Speakers to include enclosures and baffles

12-16.3 Headroom.

Provide a system with a minimum of 3 dB of headroom.

12-17 INTEGRATED AUDIO VIDEO SYSTEMS (AV).

Provide an integrated AV system for an auditorium or a large conference center. The auditorium or conference center will have the ability to simultaneously perform all required functions in all sections of the auditorium, or in the conference center that may be divided into multiple spaces by moveable partitions.

a. Audio functions must be provided to allow for the functions described in paragraph 12-16. In addition to those functions, provide monitor speakers for the stage area. Provide for sound feedback monitoring and stabilization. Provide wireless hearing assistance systems in auditoriums with receivers for a total of 5 percent of the auditorium capacity. Provide surround sound capability.

b. Provide the ability to display video from various sources and ensure that the display will be visible from all areas of the auditorium or conference center. Provide a video feedback screen that will allow the presenter to see what is being displayed. Provide a motorized screen and data projectors or appropriate large flat-panel displays as specified by the DoD Project Sponsor and per the PRC. Provide a control room to house equipment and a control console station. Provide the capability to record and reproduce presentations.

c. Provide a control console that includes video switching capability, audio switching and mixing, pan tilt zoom (PTZ) camera controls, motorized screen control, and lighting control for the auditorium or conference center.

d. Provide the capability to control motorized screens, audio volume, recording capability, and microphones from a podium or control station.

e. Provide the capability to interface with the ITV System for the live broadcast of programs when indicated by the DoD Project Sponsor.

12-18 PHYSIOLGICAL PATIENT MONITORING SYSTEM.

An empty conduit system with pull cords must be provided for the installation of the physiological patient monitoring system equipment and cabling. All equipment including monitors, computers, and printers must be connected to the critical branch of the EPS. A GFGI UPS must be provided by the DoD Project Sponsor and comply with the DHA Performance Standard Section 27 52.13.

12-18.1 System Requirements.

Data entry points must be monitored by a central computer. A minimum of one **\1** 4 11/16 in. (120 mm) by 4 11/16 in. (120 mm) by 2 1/8 in. (55 mm) deep back box and one 1 in. (25 mm) conduit with pull cord **/1/** must be provided from each data entry point to the communication system cable tray. Conduits with pull cords must be provided from the central physiological monitor computer location to the communication system cable tray.

12-18.1.1 Locations.

At a minimum, data entry and monitor points must be provided as specified here. Provide conduit to the printer and monitor at each Nurse Station if the system is not networked.

a. Emergency trauma rooms, exam treatment rooms and patient care stations, nurse stations

b. Patient bedrooms to include critical care, medical/surgical, L&D, and post-partum

c. Surgical Services Operating rooms with outlet located in the ceiling service console, Phase I and II post-anesthesia recovery patient care stations and nurse stations, and the anesthesia work room

d. Special Procedure rooms to include coronary, neurological or peripheral angiography, electrophysiology procedures, cystoscopy, bronchoscopy, colonoscopy, and endoscopy

e. C-Section Delivery rooms and associated recovery patient care stations

12-18.2 Fetal Monitoring.

A conduit with pull wire must be provided from each L&D patient labor and delivery room (LDR/LDRP, C-section OR), antepartum bedroom, L&D stress testing room and triage exam room, to a pull box above the ceiling at the associated Nurse Station. A minimum of one conduit with pull wire must be provided from the pull box to the Nurse Station for the monitors.

12-18.3 Neonatal Monitoring.

A conduit with pull wire must be provided from each NICU, isolation and newborn nursery bassinet location, LDR/ LDRP, and postpartum bedroom to a pull box above the ceiling at the associated Nurse Station.

12-18.4 Anesthesia and Respiratory Gas Analysis System.

Conduit with pull wire must be provided to the anesthesia workroom, where the analyzer and central processing unit are to be located, from:

a. Each OR ceiling column

b. 25 percent of the patient service consoles serving each Phase I and II post anesthesia recovery patient care station, to include isolation rooms

c. Each special procedure room at the head of the table

d. Each C-section delivery recovery patient care station service console

Conduit must be provided to the anesthesia administrative suite and to the blood gas lab for printer or cathode ray tube units. All conduit must be installed from the outlet to the cable tray system.

12-19 EMERGENCY MEDICAL SERVICE (EMS) COMMUNICATIONS.

The EMS system consists primarily of GFGI radio equipment, which is used for voice and telemetry communications with military and civilian ground and air ambulances.

12-19.1 Electrical Power.

Provide power for all radios and remote control units from the life safety branch of the emergency system.

12-19.2 Empty Conduit and Boxes.

Provide junction boxes and empty conduits with pull strings for the installation of cables. Identify system(s) and their location(s) as indicated by the DoD Project Sponsor, that must be connected utilizing the facility TIS. Provide conduits from the EMS communications equipment to the antennas mounted on the roof and conduits for coaxial and control cables from the Ambulance Dispatch to the associated head end equipment.

12-19.3 Structural Support.

Provide structural support and sufficient mounting space for the antennas.

12-20 EMS RECORDER SYSTEM.

Provide a multichannel recorder system as required by the DoD Project Sponsor for inpatient Facilities. The system must include these functions and features:

12-20.1 EMS Recorder Function and Features.

The EMS recorder must typically be installed in the Ambulance Dispatch area. The system must be used to record voice communications on selected telephone lines and all EMS radios. The telephone lines recorded must include, but are not limited to, all active lines of the Emergency Department Nurse Station and the Ambulance Dispatch telephones. The actual lines to be recorded must be defined by the DoD Project Sponsor. Two-way audio communications from each of the EMS radios must be recorded. The recorder must, at a minimum, have these features:

a. Recording media must have a minimum of 24 hours of recording capacity.

b. A minimum of ten channels plus one channel that records time in hours, minutes, and seconds for record retrieval. Channels must be calculated as one channel per each monitored telephone line, and one additional channel for each radio service monitored.

c. A microprocessor-based control system that provides system control and diagnostics.

d. A rapid search system that enables fast retrieval of time-dated information.

e. Search and playback capability from digital memory while the system continues to record the prescribed channels.

12-20.2 System Inputs and Mounting.

The system must accommodate multiple input impedances to allow recording from the varied media components. The system must be rack-mounted in a free-standing cabinet.

12-21 OTHER PROVIDED SYSTEMS.

Reference MILSTD 1691, Section 6 for a full list of RPIE and PP systems provided on individual projects under separate funding from MILCON.

For RPIE and PP systems, provide electrical power to support the identified additional systems in accordance with the electrical code and Table 12-1.

12-21.1 Empty Conduit and Boxes and Cable Trays.

Provide junction boxes and empty conduits with pull strings for the installation of cables. Calculate cable requirements into cable tray capacity calculations and provide adequate cable tray capacity to support any of additional systems. Identify the additional system(s) and the location(s) that is to be connected utilizing the facility TIS. Provide outlets, wiring and patch panel capacity in TRs to support these systems.

12-21.2 Structural Support.

Provide structural support and sufficient mounting space for the antennas.

12-21.3 Equipment Space Support.

Provide floor space, port capacity, rack space, etc. as required to support these systems. Include this equipment in the Server Room (CMP01), head end equipment room (COM04) and Telecommunications Room Floor Space Calculations as required.

CHAPTER 13 ACCESSIBILITY PROVISIONS FOR THE DISABLED

13-1 GENERAL.

This chapter provides design guidance on the application of accessibility provisions within DoDM MILCON. All applicable facilities must be designed and constructed to be accessible to persons with physical disabilities in accordance with the ABA Accessibility Standard for DoD Facilities (DoD Standards) and implemented by DoD Policy Memorandum (Subject: Access for People with Disabilities) dated 31 October 2008.

13-2 GENERAL EXCEPTIONS.

Sites, buildings, and facilities are exempt to the extent specified by the ABA Accessibility Standard for DoD Facilities (DoD Standards).

13-3 DOD EXCEPTIONS/EXCLUSIONS.

Facility exceptions and exclusions to the DoD Standards are outlined in the DoD Policy Memorandum.

13-4 SPECIFIC MILITARY MEDICAL FACILITY REQUIREMENTS.

13-4.1 Parking.

Provide accessible parking and passenger loading zone facilities as required by paragraphs F208.2.1, Hospital Outpatient Facilities; F208.2.2, Rehabilitation Facilities and Outpatient Physical Therapy Facilities; F209.3, Medical Care and Long-Term Care Facilities; and complying with Section 502, Parking Spaces, and Section 503, Passenger Loading Zones, of the DoD Standards.

13-4.2 Patient Sleeping Rooms.

All patient bedrooms (sleeping rooms) and bedroom toilet rooms are to be accessible. Turning space, clear floor or ground space, and toilet and bathing rooms within patient sleeping rooms are to comply with Section 805, Medical Care and Long-Term Care Facilities, of the DoD Standards.

13-4.3 Patient Dressing Rooms.

All patient dressing rooms are to be accessible and located on an accessible route. In renovation projects, where structurally impracticable to make all dressing rooms accessible, one patient dressing room for each sex (or a unisex) on each accessible floor or level are to be made accessible.

13-4.4 Telephones.

If pay telephones are provided, comply with Section F217, Telephones, of the DoD Standards.

13-5 WAIVERS.

Any other deviation from the ABA Accessibility Standard for DoD Facilities must be made through the waiver process in accordance with the DoD Policy Memorandum.

CHAPTER 14 FIRE PROTECTION AND LIFE SAFETY

14-1 GENERAL.

This chapter provides policy and design guidance related to fire protection engineering and life safety for applicable facilities.

14-2 FACILITY FIRE PLAN.

Prepare the facility fire plan (as defined in NFPA 99) in accordance with the minimum requirements for “emergency action plan” in NFPA 101, which includes direct participation by designated stakeholders from the Installation, in order for a complete design to be executed and delivered.

14-3 LIFE SAFETY COMPLIANCE FOR BUILDING REHABILITATION.

Building rehabilitation will comply with the minimum requirements established in the chapter for “Existing Facilities” of UFC 3-600-01 as well as the contents of this section. For all projects involving rehabilitation work in facilities with either health care or ambulatory health care occupancies, where the classification of the work category includes extensive modification; reconstruction; changes of use; changes of occupancy classification; or addition in accordance with NFPA 101, the DoD Project Sponsor may evaluate existing facilities in accordance with the conditions established in this section to determine and document the original level of fire protection and life safety afforded the occupants in a report as part of the project initiation process.

14-3.1 Life Safety Assessment.

The preparation of a Life Safety Assessment (or LSA) is required for all projects in accordance with paragraph 14-3. Provide the LSA, including life safety plans, to the DoD Project Sponsor as well as to the facility for upload to the TJC electronic Statement of Conditions (eSOC) account as required to assist in the accreditation process at beneficial occupancy. For the purposes of meeting the requirement to prepare the LSA, the DoD Project Sponsor may require that the preparer of the LSA meet not only the minimum qualifications for the “Qualified Fire Protection Engineer” in UFC 3-600-01 but also has a minimum of seven years of experience in the design and review of medical facilities.

14-3.2 Health Care and Ambulatory Health Care Occupancies.

For health care and ambulatory health care occupancies as established by NFPA 101, it is acceptable to use a copy of the most recent TJC eSOC or Life Safety Assessment, provided either one has been updated within 12 months or less prior to project initiation for this specific facility.

14-3.3 Interim Life Safety Measures.

Develop and implement a specific set of safety measures, also referred to as Interim Life Safety Measures (or ILSMs) by TJC. Such safety measures consist of a series of administrative actions intended to temporarily compensate for significant hazards posed either by existing fire protection or life safety deficiencies to NFPA 101 or by such hazards resulting from construction activities. The ILSMs will be incorporated into the accompanying report to assist the project delivery team with scope of work development, design development, and construction execution.

14-4 AUTOMATIC SPRINKLER PROTECTION.

Provide automatic sprinkler protection as required by UFC 3-600-01, except as modified below in this section.

14-4.1 Components and Hardware.

Provide components and hardware for automatic sprinkler protection in accordance with UFC 3-600-01 unless otherwise modified herein.

14-4.1.1 MRI Shielded Enclosures.

Provide non-ferrous piping for all areas of MRI shielded enclosures.

14-4.1.2 Behavioral Health.

Provide quick-response “institutional sprinklers” throughout the fire compartment(s) or floor(s) in behavioral health areas that require hard ceilings (for example gypsum wallboard or plaster) and, these sprinklers must have the following performance characteristics.

a. Tamper-resistant features designed to make them more suitable than other types of sprinklers for installation in environments where vandalism is a concern, in order to reduce the likelihood of false activation and the possibility of the escutcheon (or any components of the sprinkler itself) from being removed and used as a weapon.

b. Ligature-resistant features designed to reduce the likelihood of attaching heavy loads to the sprinkler assembly and being able to use any component as an anchor point prior to failure of the sprinkler assembly.

c. However, in such areas with suspended ceilings (for example lay-in acoustical tile), develop and implement additional safeguards with approval from the Design and Construction Agent.

14-4.2 Audiometric Booths.

Extend automatic sprinkler protection into audiometric booths 16 sf (1.5 sm) or greater in area.

14-4.3 Defend in Place.

Where buildings are required to be separated into smoke compartments (as established by NFPA 101), subdivide and electronically supervise the automatic sprinkler protection accordingly (per smoke compartment). Provide all piping for automatic sprinklers in a given smoke compartment as one system and electronically supervise each compartment (or zone) using a dedicated control valve assembly (with associated check valve, waterflow indicator, and tamper supervision).

14-5 FIRE ALARM, FIRE DETECTION, AND MASS NOTIFICATION.

Provide fire alarm and fire detection, as required by UFC 3-600-01, and mass notification, as required by UFC 4-010-01, except as modified below in this section.

14-5.1 Autonomous Control Unit and Local Operating Console.

Provide autonomous control units (or ACUs). However, due to the nature of operations in medical facilities, provide accompanying local operating consoles (or LOCs) as directed by the Design and Construction Agent. Also, do not provide LOCs in normally unoccupied building service equipment support areas (or NUBSESAs) as established by NFPA 101.

14-5.2 Occupant Notification.

Provide occupant notification in accordance with NFPA 72 and NFPA 99 unless otherwise modified herein.

14-5.2.1 Direct Viewing.

Provide visual notification appliances in direct view of all exits, all nurses' stations, and at all locations, such as in mechanical equipment rooms, where the operating noise level exceeds the level of the audible alarm as permitted by NFPA 72.

14-5.2.2 Audiometric Booths.

Provide visual notification inside of an audiometric booth except where visual notification already being installed outside of the booth can be seen from an occupant within the booth.

14-5.2.3 Private Operating Mode.

Provide occupant notification, where the defend-in-place strategy is employed, in accordance with this subsection.

a. Permit the use of private operating mode, as defined and established in NFPA 72, in all facilities, excluding those facilities not rendering medical treatment to patients, for example, medical warehouses, central utility plants, and telecommunication buildings.

b. Carefully review and incorporate occupant notification, where the private operating mode is used, during the design, with a special emphasis on the additional duties, responsibilities, and associated training expected for the staff at the facility to learn and maintain.

c. Provide audible notification for all facilities in accordance with NFPA 72, except within Category 1 spaces (as defined in NFPA 99), such as surgical operating rooms, critical care rooms, or similar areas, where alarm activation is likely to cause injury or death to a patient.

d. Upon operation of a fire alarm initiating device, notify staff and occupants only in the zone of alarm origin via audible signaling using three-pulse temporal pattern, visible signaling, and textual signaling (where mass notification is either required or is being provided).

e. Simultaneously transmit a voice message to the rest of the building (and other buildings) as necessary in an effort to notify enough staff to respond to the zone of alarm origin. Do not activate visible appliances outside of the zone of alarm origin.

f. Subsequent activations of initiating devices in the same zone of alarm origin will not initiate any new alarm outputs but will appear at the fire alarm control unit and printer. Subsequent to the original alarm, activation of initiating devices in a different zone will initiate the audible three-pulse temporal signal and other related visual and textual notification appliances in the new zone and will initiate a new voice message to the locations, as determined above, to identify the new location of alarm.

g. Program both audible and visual signals to continue to operate for five minutes or until the system is acknowledged and silenced by an operator. Only activate the visual notification appliances in the zone of alarm origin and not in the zones where the voice message is used.

h. The voice message is to be preceded by a tone alert and must be announced with no less than three rounds of it to bring staff to the zone of alarm origin.

i. Manual operation of the voice system will override all automatic voice messages in the system.

14-5.3 Smoke Detection Used in Conjunction with Smoke Compartmentation.

Where smoke detectors are provided to hold doors open between smoke compartments, provide them on both sides of the opening between smoke compartments. Program such smoke detectors for their respective zone to initiate the proper alarm as well as to close the door(s) served.

14-5.4 Behavioral Health.

Provide institutional-style manual pull stations in behavioral health areas, where keys are used to operate or lock covers.

14-6 MANAGEMENT OF SMOKE.

Provide smoke management and control systems in accordance with NFPA 92 and the appropriate sections of NFPA 101.

14-6.1 New Smoke Control Systems.

Zoned smoke control systems, as defined in NFPA 92, are not required for new projects.

14-6.2 Existing Smoke Control Systems.

Existing smoke control systems must comply with NFPA 92 or at the time of contractual acquisition of the system(s). Decommission zoned smoke control systems not in compliance with NFPA 92.

14-7 WATER SUPPLY.

Where the seismic chapter in this UFC requires on-site storage to be provided, design the secondary water supply to meet the largest expected demand for fire suppression purposes.

14-8 INTERSTITIAL BUILDING SYSTEM (IBS).

Comply with the related appendix in this UFC for projects incorporating IBS design concepts.

14-9 SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY.

This section provides specific criteria for medically unique occupancies and hazards. However, when this section does not otherwise address a particular occupancy or hazard, comply with NFPA 101.

14-9.1 Dental Treatment.

The following rooms are used to perform treatment or provide anesthesia, or both, which render the patient incapable of taking action for self-preservation under emergency conditions without assistance of others in facilities providing dental treatment:

a. Dental Treatment Room, Comprehensive [DNTC1]

b. Dental Treatment Room, Periodontics [DNTP2]

c. Dental Treatment Room, Oral Surgery [DNTS1]

d. Dental Treatment Room, Recovery [DNTR1] when provided in support of one of the above rooms.

When more than three of any combination of patient chairs, either in dental treatment rooms or associated recovery rooms, are located in a single facility; an occupancy classification of ambulatory health care is considered present and must be applied to either the entire facility or the portion(s) thereof containing these rooms.

14-9.2 Research Facilities.

Comply with the minimum requirements in NFPA 45 for laboratories where chemicals are used or handled. Comply with the minimum requirements of NFPA 2 in laboratories where hydrogen is used or handled.

14-9.2.1 Flame Spread and Smoke Developed Indices.

Provide and document flame spread and smoke developed indices for the interior finish installation for all walls, ceilings and floors in laboratories categorized as either Biosafety Level 3 (BSL-3) or Biosafety Level 4 (BSL-4), as established in Biosafety in Microbiological and Biomedical Laboratories, to ensure compliance with NFPA 101.

14-9.2.2 Spot-Type Photoelectric Detection.

Provide spot-type photoelectric smoke detection throughout laboratory spaces in facilities where laboratory function protocol requires occupants to be suited, for example, wearing positive-pressure, supplied-air protective suits.

14-9.3 Veterinary Care and Animal Research Facilities.

Throughout animal housing facilities classified as Animal Health Care (Category 1) or Research (Category 3), comply with the minimum requirements in NFPA 150 except as modified in this section. Since UFC 3-600-01 establishes that NFPA 5000 must not be used in projects for DoD, all references to NFPA 5000 in NFPA 150 are instead to be considered references to UFC 3-600-01, which identifies NFPA 101.

a. With regard to the provision of occupant notification, assume that evacuation of animals is not practical in animal research facilities (subclassified as Category 3 by NFPA 150).

b. Where fire alarm notification would adversely affect the needs of the animals and occupants subject to approval from the Design and Construction Agent and where private mode is already being employed, provide alternative notification devices (for example private-mode flashing lights or beacons) in animal areas.

14-9.4 Pharmacy Storage.

Storage spaces of pharmacies, including receiving areas and main shelving spaces, within health care and ambulatory health care occupancies are considered hazardous areas as defined by NFPA 101. Separate such storage spaces within pharmacies using one-hour fire-rated construction. Where pharmacy storage spaces are open to dispensing or other pharmacy work areas, provide the one-hour fire-rated separation at the pharmacy perimeter walls.

14-9.5 Areas with Heat-Producing Appliances.

Apply the minimum requirements from NFPA 101 for “special hazard protection” to any area(s) being served by Bunsen burners, which includes providing smoke partitions having passive fire protection features, such as automatic or self-closing door assemblies and protection of penetrations to limit the transfer of smoke.

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CHAPTER 15 FURNITURE, FIXTURES AND EQUIPMENT

15-1 GENERAL.

This chapter provides guidance on furniture, fixtures and equipment (FF&E) for facilities. FF&E procurement and installation responsibility for project planning and execution must be in accordance with MIL-STD-1691 and this chapter. These sources provide a uniform basis to identify items of construction and material, and to identify logistical and financial responsibility.

15-1.1 IDENTIFICATION of FF&E.

The DoD Project Sponsor develops a PRC report of FF&E using the SEPS program report module. The determination of FF&E requirements must be made not later than the end of the 20% design period or final Request for Proposal (RFP) submission timeline, depending on project delivery method, and must be complete by the time the floor plan is locked. Consideration to reuse FF&E are dependent on the age, condition, remaining service life, and other maintenance considerations to the extent practical for the project. Final decisions on FF&E acquisition or reuse in support of all Initial Outfitting (I/O) activities must be completed as late as possible in project development but scheduled to align with facility operational milestones and project delivery method.

15-1.2 APPROVAL of SUBSTITUTIONS.

When design and space planning changes necessitate substitution of FF&E, the Design and Construction Agent must coordinate change details with the DoD Project Sponsor. When the substitution results in a change in the Logistical Category (LOGCAT) or equipment funding source as defined in the MIL-STD-1691, the change is coordinated with the DoD Project Sponsor.

15-2 PROCUREMENT.

Provide FF&E in accordance with MIL-STD-1691 and applicable project specific guidance. Procurement includes applicable manufacturer’s literature for installation, user operation and service/maintenance (including schematics). The DoD Project Sponsor determines which items of existing FF&E transfer to the new, altered, or temporary facility whenever feasible and economical.

15-3 FUNDING SOURCE

The Funding Source identifies the appropriation fund used to program, purchase and install building systems, FF&E, and control systems in Defense Health Program (DHP) project delivery. There are two property designations: “RPIE” (Real Property Installed Equipment), which are resources using “Project Funds”, and “PP” (Personal Property, sometimes referred to as operational equipment), generally referenced as “Initial Outfitting and Transition” or IO&T funds. Use of appropriations for outfitting of facilities is prescribed in Federal Management Regulation (FMR) Volume 03, Chapter 17.

15-4 LOGISTICAL RESPONSIBILITY.

Equipment is procured and installed in accordance with the LOGCAT as defined in the MIL STD 1691 Policy, and this document. The policy document can be found on the World Class Facility Toolkit.

The LOGCAT codes shown in Table 15-1 are used to identify procurement and installation responsibility. The responsibility column contains the acronym used to identify responsibilities of Government and Contractor relative to procurement and installation. The description column provides a definition of the LOGCAT code.

Table 15-1 Logistical Responsibility (LOGCAT)

LOGCAT	Responsibility	Description
A	CFCI	Contractor Furnished Contractor Installed. Equipment purchased and installed by the construction contractor.
B	GFCI	Government Furnished Contractor Installed. Equipment purchased or provided by the Government (or entity conducting business on behalf of the Government) and installed by the construction contractor.
C	GFGI	Government Furnished Government Installed. Equipment is provided by the Government and installed by the Government (equipment vendor, Initial Outfitting contractor).
D	Leased (VFVI)	Vendor Furnished Vendor Installed. Leased or rented equipment, arranged by the Government, or any similar type arrangement requiring special funding and/or condition.
R	GFCI or GFGI	Reuse. Transferred and reused equipment assets. May be Government Furnished Contractor Installed or Government Furnished Government Installed

15-5 DESIGN.

15-5.1 Casework.

All built-in casework must be fabricated and designated by materials, construction methods, and fabrication that align with the highest grade quality and infection control standards for casework for use in high-performing healthcare building applications. Typical industry standards for medical/laboratory grade materiel applied in the absence of project specific requirements/guidance. Corrosion resistant steel (CRS) or other nonporous, seamless joint casework are mandatory in these areas: operating and C-section rooms; their sub-sterile and clean-up areas; laboratory (as required by the DoD Project Sponsor); central sterile supply, decontamination and clean-up areas (including Dental); Autopsy and its associated clean-up areas.

Movable, modular (“systems”) casework systems may be used in projects deemed appropriate by the DoD Project Sponsor.

15-5.2 Technically Complex Equipment and Medical System.

Planning for and inclusion of complex medical technologies, to include but not limited to linear accelerators, positron emission tomography (PET), lithotripsy units, MRI systems, hyper and hypo baric chambers, robotic surgical systems, and automated product delivery systems, in a MILCON project is the responsibility of the DoD Project Sponsor. Design must be in accordance with the appropriate Code of Federal Regulations (CFR), National Council on Radiation Protection and Measurements (NCRP) guidelines, associated non-governmental standards for unique technologies, the recommendations and guidance of the respective manufacturer, Facility Guidelines Institute (FGI) and other federal entities as applicable. Close coordination by the DoD Project Sponsor, design team, and manufacturer’s technical representatives is critical to ensure staff and patient safety measures are in place, and all clinical functionality and capability is met.

15-5.2.1 Shielding Requirements.

When equipment or systems require shielding to minimize exposure to primary and secondary radiation, the DoR is responsible to include on the design team a qualified expert (medical or health physicist) who is regularly engaged in the design of radiation shielding, and certified by American Board of Radiology, American Board of Medical Physics, American Board of Health Physics, or Canadian College of Physicists in Medicine. The using MilDep’s Health Physicist or their qualified representative must be consulted during the early planning and/or design stages to ensure all aspects of the design, both clinical and technical, are met, and shielding reports are retained by the DoD Project Sponsor for audit purposes.

The Construction Contractor is responsible for the shielding system installation and integrity certification by a qualified expert. It is highly recommended that the Construction Contractor consult with the using MilDep’s Health Physicist or their qualified representative during design and construction to ensure continuity from planning and design through final building acceptance.

15-5.3 Equipment Connectivity.

The project delivery team (PDT) must work closely with Health Information Technology and Logistics staff early in planning and throughout the design and construction phases to make every effort to comply with cybersecurity requirements for Facility-Related Control Systems and Medical Devices and Equipment. The design for equipment and utilities that support active and passive medical devices must comply with the Standard Isolation Architecture for Cybersecurity of Medical Devices and Equipment (MDE) as well as cybersecurity principles based on medical cybersecurity industry best practices.

15-5.4 Automatic External Defibrillator (AED).

The location and number of recessed or semi-recessed Automatic External Defibrillator (AED) cabinets is determined during project design. The DoR is responsible to ensure quantity, placement, and all appropriate markings (signage) are shown in the final design solution. The DoR coordinates with the Design and Construction Agent and DoD Project Sponsor clinical representative to ensure adequate placement and facility coverage.

15-5.5 Hyperbaric Medicine.

Hyperbaric oxygen therapy is used as an adjunct to the clinical and surgical treatment of wounds and certain diseases. It consists of administering oxygen to the patient at pressures greater than 1 atmosphere (atm) in a compressed air multi-person chamber or oxygen mono-chamber. The DoD agency responsible for design requirements and certification is the Naval Facilities Engineering Command. This agency is available to assist the Design and Construction Agent, DoD Project Sponsor, and DoR as needed. Reference UFC 4-159-01N.

CHAPTER 16 TRANSPORTATION AND LOGISTICS

16-1 GENERAL.

This chapter provides guidance for the study, selection, and design of transportation and logistics systems including but not limited to; elevators, escalators, dumbwaiters, material delivery equipment (automatic guided vehicles [AGVs] and Autonomous Mobile Robots [AMRs]), pedestrian traffic, service cart systems, pneumatic tube station (PTS), gravity and pneumatic chute return systems for linen and trash, and Central Material Management Systems in CAT 500 facilities. The elevator UFC 3-490-06, in conjunction with criteria in this chapter, establish minimum design requirements. In the event of conflict this UFC is the ruling criteria.

16-1.1 Scope.

This chapter applies to horizontal and vertical circulation within facilities, and the transportation devices, equipment, and methodologies required for efficient, cost-effective, and timely movement of people, equipment, materials, and related materials-management logistical functions. Addition/alteration projects are to meet these guidelines to the extent practical and provide a holistic design approach in addressing correction of existing facility shortcomings.

This chapter does not prescribe when systems are required or where they should be employed. Table 16-1 prescribes when different technical analyses are required based on a facility's size; depending on the results of the analysis different transportation systems may be required. It is the responsibility of the DoR to develop a holistic and efficient design incorporating the DoD Project Sponsor's operational and functional needs.

16-1.2 Transportation Systems Evaluation.

For all projects requiring a Transportation Logistics Analysis (TLA) as described in paragraph 16-2.1, the Design and Construction Agent must ensure the services of a qualified Medical Transportation and Logistics Consultant (MTLC) are included in the request for planning and architectural services. The MTLC must be an integral part of the design team, and be involved in every aspect of the design as it relates to transportation and logistics. This includes, but is not limited to, departmental adjacencies, vertical and horizontal circulation, facility logistics, and waste management. Refer to Table 16-1 for project analysis requirements.

The Design and Construction Agent must ensure all transportation and material handlings systems selected are procured, installed, and commissioned in accordance with design documents and applicable codes and standards.

16-1.3 Medical Transportation and Logistics Consultant.

A qualified MTLC to the DoR is an individual who has received comprehensive training and experience in the areas of materials management, food and nutrition, solid waste

management, horizontal and vertical transportation, central sterile processing, and materials handling for a period of not less than five years. These services should be specific to transportation and logistics and must be documented. The MTLC must demonstrate prior experience on projects that relate to the scope and nature of the project to include OCONUS locations, if applicable. The MTLC must not be involved in the sale, installation, distribution, manufacture, or representation of conveyance or material management equipment.

Table 16-1 Analysis Requirements

Analysis	Facility Characteristic
TLA	Any facility >200,000 BGSF (18,580 BGSM) All major renovations and new construction of ambulatory care clinics, hospitals, and medical centers
ETSA	All facilities >1 story
MMA	All facilities >100,000 BGSF (9290 BGSM)
WMA	All facilities >100,000 BGSF (9290 BGDM)
Notes: Facilities include medical and dental clinics, research and laboratory buildings, ambulatory care clinics, ambulatory surgery centers, hospitals, and medical centers.	
ETSA	Elevator Traffic Study and Analysis
MMA	Material Management Analysis
TLA	Transportation Logistics Analysis
WMA	Waste Management Analysis

16-2 TRANSPORTATION AND LOGISTIC ANALYSIS REQUIREMENTS.

Different transportation and logistics analyses are required for facility designs as indicated in Table 16-1. These analyses must address the transportation, logistics, and waste management requirements of the project as required by this document. When required by Table 16-1, the different analyses must be submitted with the Design Analysis narratives beginning with the initial design submission and through the final design submission.

16-2.1 Transportation Logistic Analysis.

The MTLC must prepare a TLA in accordance with Table 16-1. The analysis must take into account total staff and patient travel times and travel distance with the objective of minimizing both travel times and distances to achieve higher staff efficiencies and lower patient environmental exposure.

16-2.1.1 TLA Requirements.

The TLA must address all aspects of a facility's transportation, logistics, and waste management methodology to include but not limited to; traffic demand, vertical and horizontal travel distances, mix of traffic type in the areas to be served, mode of containerization, and items specifically addressed in the other studies. The TLA must document the following:

a. Elevator Traffic Study and Analysis (ETSA). Reference paragraph 16-2.2.

b. Material Management Analysis (MMA) to include a comparison of automatic vs. manual material handling systems. Automatic systems include: AGVs, AMRs, PTS, and pneumatic chutes in addition to other or newer technologies. Reference paragraph 16-2.3.

c. Waste Management Analysis (WMA). Reference paragraph 16-2.4.

d. Life cycle cost analysis (LCCA) to be used to evaluate the alternatives and to determine the appropriate system.

e. The MTLC to sign the TLA certifying the information contained therein is accurate, vendor neutral, and based on empirical data.

f. The TLA to take into account the existing transportation systems and processes for addition/alteration projects.

g. The TLA to describe in detail the MTLC recommendations to maximize the transportation and logistics efficiencies and how the recommendations are implemented into the design.

h. The TLA to focus on defining process methodologies that optimize spatial adjacencies and minimize overall patient, staff, and material movements in design.

i. When required by the Design and Construction Agent, the TLA to include the use of simulation to more accurately analyze and optimize departmental adjacencies and horizontal and vertical transportation solutions.

16-2.1.2 TLA supporting documents.

Base the TLA on:

a. Empirical data provided by the DoD Project Sponsor.

b. Site visits to an existing facility identified by the DoD Project Sponsor.

c. Data including site constraints, Design CONOPS (including CONOPS for the logistical departments like food service, linen and waste management, materials management, housekeeping, pharmacy, central sterile supply) and projected workload for the new facility.

d. Elevator loading density and the load/unload time based on site visits to account for unique conditions at a facility and the cultural aspects of the area, for example, amount of “personal space” required by individuals, number of visitors per patient, number of escorts or companions accompanying outpatients.

16-2.2 Elevator Traffic Study and Analysis.

Prepare the ETSA to determine the appropriate types, locations, sizes, speeds, and groupings of elevators that result in a cost-effective and efficient operation.

16-2.2.1 ETSA Requirements.

The ETSA must document the following:

a. ETSA to be prepared by an independent elevator consultant on all ambulatory care clinics, hospitals, and medical centers.

b. Conformance to Chapter 16, specifically paragraphs 16-3 and 16-4.

c. A description of the elevator systems proposed (each elevator type should be broken down separately based on types per Table 16-4), function, travel, stops, building population, handling capacity, interval, etc.,) including an analysis with drawings of the walking distances, elevator types, and locations as described in paragraph 16-4.3. Prohibit the use of general terminology of “electric traction”. MRL elevators are to be separate and specifically identified. Otherwise, the default for language associated with electric traction would be geared or gearless traction with machine room.

d. The population (number of working and visiting population within the facility).

e. The number and average size of material movements within the facility.

f. The peak hours of vertical transportation, including but not limited to: Morning Shift Change Peak (primarily a peak period in upward travel), Lunch Peak (heavy two-way traffic), Afternoon Shift Change Peak (primarily a peak period in downward travel, with moderate opposing traffic).

g. The elevator loading densities used for each proposed elevator for working and visiting population, for example, pedestrians, person on crutches/walker, wheelchairs, gurneys, beds, and carts. Include extra “spare capacity” when determining the aggregate elevator cab size.

h. In determining the proposed elevator speeds provide:

i. The handling capacity calculations

j. The assumed population load/unload times

k. The proposed elevator wait and response times

Table 16-2 Elevator Performance Guide

Table presents minimum acceptable elevator performance based on elevator type and building type.

PASSENGER ELEVATORS		
Building Type	**Average Interval Required**	**Handling Capacity**
Hospital, medical center, or ambulatory surgery center	30 to 35 Seconds	13 - 15% of the calculated building elevator population for the area served (plus 20% migration for multiple elevator groups)
Medical clinic, dental clinic, or ambulatory care clinic	35 to 40 Seconds	11 - 13% of the calculated building elevator population for the area served (plus 20% migration for multiple elevator groups)
Research or laboratory building	40 to 45 Seconds	11 - 13% of the calculated building elevator population for the area served (plus 10% migration for multiple elevator groups)
Admin building	40 to 45 Seconds	10 - 12% of the calculated building population
Parking garage	45 to 50 Seconds	110% of the calculated elevator population for the area serviced
Notes:		
1	Passenger elevators are intended for use by the public. (See paragraph 16-4.2 and Appendix H for definitions)	
2	Passenger elevators to be Class “A” loading as a minimum	

PATIENT SERVICE ELEVATORS		
Building Type	**Average Interval Required**	**Handling Capacity**
Hospital, medical center, or ambulatory surgery center	35 to 40 Seconds	115% of the calculated traffic
Medical clinic, dental clinic, or ambulatory care clinic	40 to 45 Seconds	110% of the calculated traffic
Notes:		
1	Patient Service elevators are intended for use by staff movement and for the transport of bed-bound inpatients. (See paragraph 16-4.2 and Appendix H for definitions)	
2	Service/Staff elevators to be Class “C3” as a minimum	

MATERIALS HANDLING SERVICE ELEVATORS		
Building Type	**Average Interval Required**	**Handling Capacity**
Hospital, medical center, or ambulatory surgery center	35 to 40 Seconds	13 -15% of the calculated elevator population for the area served (plus migration)
Medical clinic, dental clinic, or ambulatory care clinic	40 to 45 Seconds	11 - 13% of the calculated elevator population for the area served (plus migration)
Research or laboratory building	45 to 50 Seconds	11 - 13% of the calculated elevator population for the area served (plus migration)
Notes:		
1	Logistics elevators are intended for use by staff for material and equipment movement. (See paragraph 16-4.2 and Appendix H for definitions)	
2	Logistics elevators to be Class “C1” as a minimum	

<table>
<tr><th colspan="5">MATERIALS HANDLING SERVICE ELEVATORS</th></tr>
<tr><th colspan="2">Building Type</th><th colspan="2">Average Interval Required</th><th>Handling Capacity</th></tr>
<tr><td>3</td><td colspan="4">Average Loading Density. An average person will require about 3 sf (0.28 sm) of floor area to feel comfortable (18 in. (460 mm) body depth x 24 in. (610 mm) shoulder breadth). Reference paragraph 16-2.2.1(g).</td></tr>
<tr><td>4</td><td colspan="4">Normal Loading Density. Normal loading to be based on 2.3 sf (0.21 sm) per person which is generally accepted as the norm for crowded elevators. Reference paragraph 16-2.2.1(g).</td></tr>
<tr><td>5</td><td colspan="4">Extreme Loading Density. Extreme loading to be based on 1.5 sf (0.14 sm) per person. Reference paragraph 16-2.2.1(g).</td></tr>
<tr><td>6</td><td colspan="4">Door Opening Speed. Passenger and Service elevator door operator to be capable of opening doors at the rate of 2.5 fps (0.76 m/s), with actual speed being adjusted to meet requirements of the specific installation.</td></tr>
<tr><td>7</td><td colspan="4">Door Closing Speed. Closing speed to be 1 fps. All power operated doors to be equipped with an automatic reopening device for passenger protection.</td></tr>
<tr><td>8</td><td colspan="2">Average Interval Performance Standards</td><td>PASSENGER ELEVATOR
(General Hospital)
Excellent – 30 to 35
Good – 35 to 40
Fair – 40 to 50
Poor – Over 50</td><td>SERVICE/PATIENT ELEVATOR
(General Hospital)
Excellent – 40 to 45
Good – 45 to 55
Fair – 55 to 60
Poor – Over 60</td></tr>
<tr><td>9</td><td colspan="3">Average Handling Capacity Performance Standards</td><td>Excellent – Over 14%
Good – 12 to 14%
Fair – 10 to 12%
Poor – Under 10%</td></tr>
</table>

16-2.3 Material Management Analysis (MMA).

Material to be manually moved throughout a facility unless the designer can show an automated system is physically, safely, and economically justified. The specific systems included in a project must be determined by detailed physical, functional, and economic factors including LCCA. Prepare the MMA to determine the appropriate types, locations, sizes, speeds, and design of MMA that result in a cost-effective and efficient operation.

16-2.3.1 MMA Requirements.

The MMA must document when the DoD Project Sponsor does not require an automated system and continue no further. When required, the MMA must document the following:

a. Conformance to Chapter 16, specifically paragraphs 16-3 and 16-5.

b. Proposed automated systems including but not limited to AGV, PTS, and mobile robots.

c. The users of the proposed systems.

d. The number of Full-Time Equivalent (FTE) on staff for the movement of materials.

e. Location, size, speeds of proposed systems.

f. Specific requirements for each type of system, for example, dry vs. wet PTS.

g. An LCCA comparing manual movement vs. proposed alternatives.

16-2.4 Waste Management Analysis (WMA).

The preliminary design of a waste management system requires consideration of the operational and mission characteristics of the facility, the existing waste disposal practices of the facility or base/post, the governmental regulations affecting the design, and the costs and application of system handling and disposal technologies.

16-2.4.1 WMA Requirements.

When required, the WMA must document the following:

a. Conformance to Chapter 16, specifically paragraphs 16-3 and 16-6.

b. Determination of the waste stream components and soiled linen types.

c. Estimation of waste and soiled linen volumes.

d. Concepts for segregation, holding at the generating departments, and central bulk holding.

e. Space, utility, and life safety requirements for departmental holding rooms.

f. Concepts for collecting and transporting waste and soiled materials within the facility.

g. Soiled dock arrangement, layout, and equipment.

h. Waste Management Center (WMC) space, layout, equipment, and support utility requirements.

i. Concepts for the disposal of each waste category.

j. Proposed Waste Management Systems including, but not limited to, gravity chutes and pneumatic trash/linen systems.

k. Life-cycle costing studies including Regulated Medical Waste (RMW) processing equipment.

l. Aspects of RMW processing; O&M, safety, infection control.

m. Accommodations for empty wood pallet(s) storage and pick up area

16-3 FACILITY DESIGN.

Transportation and logistics requirements must be integrated into the overall facility design. Design the overall floor plan and circulation to provide the most direct routing practical. Separate different types of traffic as required in paragraph 16-3.1.

16-3.1 Traffic Separation.

Establish traffic patterns to separate the various traffic types in an efficient, logical, safe, and secure manner, while maintaining levels of aseptic control consistent with the requirements of the facility. Consider all of these factors for separation for horizontal and vertical circulation: patient privacy; accessible access; aseptic control; routing efficiency; utilization of appropriate hardware systems, safety, and security. Where circulation conflicts occur, prioritize traffic as listed here:

a. Patient

b. Staff

c. Equipment

d. Visitors

e. Materials/logistics (may be combined use – supply elevators with staff)

16-3.2 Transportation Systems.

The DoR must consider traffic demand, vertical travel distance, mix of traffic type in the areas to be served, and mode of containerization. Traffic demand and vertical travel distance must determine equipment type and speed required. Traffic mix and mode of containerization must determine load capacity, platform size, configuration, and door type.

16-3.3 Vertical Automation.

Systems designed exclusively for vertical only transportation of materials on carts must use elevators, guide path, and other devices, as applicable. Designs must consider future upgrade to allow horizontal travel.

16-3.4 Equipment/Materials Separation.

Separate the equipment/materials traffic from patient and visitor traffic as noted on the Elevator Traffic Separation Guide, Table 16-3, which presents recommended arrangement of elevators by facility configuration and mission. Where separate elevators are not required, separate the materials traffic by schedule and policy. Maximize separation between visitor/patient and staff/materials/logistics. Primary horizontal materials circulation should occur on a single level, with vertical penetrations that are convenient to heavy use areas. Do not move AGVs, carts, pallet trucks, and similar material carriers long distances on floors and corridors routinely traveled by patients or visitors. Use two (or more) single elevators in distributed areas if traffic needs dictate more than one service/AGV elevator.

16-3.5 Clean and Soiled Material Separation.

Materials management programs must provide for clean and soiled separation consistent with all applicable codes and standards, including those of TJC.

16-3.5.1 Soiled Material.

Soiled materials are normally transported in separate covered or closed carts designed to provide containment of the material and to maintain infection control. Soiled material transport may occur in the same corridor and elevator systems that handle other traffic. However, soiled materials are not transported on the same elevator at the same time with patients, visitors, or clean or sterile materials. Transport circulation design must allow soiled carts to be properly washed prior to reuse as a soiled container and washed and sanitized prior to use for transporting clean materials.

16-3.5.2 Sterile Material.

Transport all sterile material for use in Surgery, Catheterization, and Labor/Delivery or other areas requiring sound aseptic controls from the sterile processing/storage area to its destination via a clean route that must not compromise the integrity of the material. Where case carts are used, they must be transported from sterile storage to the clean surgical core by means that protect the cart and its contents from contact with less clean environments.

16-3.6 Escalators.

Escalators may be considered if justified by traffic studies. Design escalators in accordance with all applicable codes, including UFC 3-490-06, IBC and ASME A17.1, A17.3, and A17.5.

Table 16-3 Elevator Traffic Separation Guide

	Facility Types				
Facility Characteristics	**Hospital, medical center, or ambulatory surgery center**	**Medical clinic, dental clinic, or ambulatory care clinic**	**Research or laboratory building**	**Admin building**	**Warehouse or parking garage**
Facilities <50,000 BGSF (4645 BGSM)	Separate Passenger. Separate Inpatient. Separate Materials Traffic	Combine regardless of traffic types	Combine regardless of traffic types	Combine regardless of traffic types	Combine regardless of traffic types
Facilities >50,000 but <100,000 BGSF (>4645 BGSM but < 9290 BGSM)	Separate Passenger. Separate Inpatient. Separate Materials Traffic	Combine elevators or Separate Passenger and Materials Traffic	Combine elevators or Separate Passenger and Materials Traffic	Combine elevators or Separate Passenger and Materials Traffic	Combine elevators or Separate Passenger and Materials Traffic
Facilities >100,000 but <200,000 BGSF (>9290 BGSM but < 18580 BGSM)	Separate Passenger Traffic. Separate Inpatient Traffic. Separate Materials Traffic	Combine elevators or Separate Passenger and Materials Traffic	Separate Passenger. Combine Materials and Special Use Traffic	Combine elevators or Separate Passenger and Materials Traffic	Not Applicable
Facilities >200,000 BGSF (> 18580 BGSM)	Separate Passenger. Separate Inpatient. Separate Materials Traffic	Combine elevators or Separate Passenger and Materials Traffic	Separate Passenger Traffic. Combine Logistic Traffic	Not Applicable	Not Applicable

Notes:
1. The decision to separate or combine any elevator function must be supported in the ETSA.
2. Combined passenger and service elevators may be installed where combined use is possible without interfering with normal activities in the healthcare facility. Avoid mixing patient transport with any other traffic.

16-4 ELEVATOR DESIGN.

All multistory facilities must have at least two elevators. The ETSA must include a risk assessment to determine if at least one is to be sized to accommodate a gurney (see appendix H for definition). All multistory inpatient and surgical facilities must have not less than two elevators sized to accommodate a gurney.

16-4.1 Codes.

Elevators to be designed in accordance with UFC 3-490-06 where applicable, all applicable Federal, state, and local codes, including ASME A17.1, A17.3, 17.5, and elevator design requirements for earthquake/seismic loads in accordance with ASCE 7. This includes designing to the appropriate rating/load classification for the intended application. Elevators must be designed to meet all DoD and ABA provisions applicable to the project.

16-4.2 Elevator Selection.

Elevators in medical facilities provide for three major functions: passenger movement, inpatient movement, and material handling. Passenger elevators are intended for use by the public, staff, and other ambulatory patients. Patient Service elevators are intended for use by staff movement and for the transport of patients (wheelchair and/or bed-bound inpatients). Dedicated elevators are patient assist/trauma elevators intended for patient transport from Critical Care Areas, for example ER trauma rooms, to the ORs. Materials Handling Service elevators are intended for use by staff for material, supplies and equipment movement. Special Use elevators are intended for loading docks, mortuary, or the transport of animals. Where allowed by Table 16-3, a single set of elevators can serve multiple functions. All elevators must meet the following:

16-4.2.1 Elevator Types and Speed.

Elevator types and speed guidelines are shown in Table 16-4. Higher speeds may be used if needed to satisfy traffic demands. Elevator selections must not exceed the elevator rise criteria given in Table 16-4.

16-4.2.2 Elevators for Inpatient Facilities.

Inpatient facility Patient Service elevators to have interior car dimensions that accommodates a patient bed/ gurney with attendants. Cars to be a minimum 5 ft 8 in. (1727 mm) wide by 8 ft 5 in. (2565 mm) deep. Car doors are to provide a minimum clear opening of 4 ft 6 in. (1372 mm) wide and 7 ft (2134 mm) high. All other elevator dimensions to meet the requirements of Tables 16-5 and 16-6.

16-4.2.3 Elevators for Existing Facility.

Do not resize existing elevators that can accommodate patient beds. Other existing elevators may require renovation depending on the results of the ETSA.

16-4.2.4 Elevators for Hospital and Ambulatory Surgery Centers (Front and Rear Opening).

Front and rear opening hospital and ambulatory surgery center elevators may be used as combined use for passenger and service/staff traffic when space or budget restrictions limit use of separate passenger elevators.

16-4.2.5 Passenger Elevators.

Passenger elevators are required to be wide car configuration, have center opening doors, be a minimum 4000 lb (1815 kg) capacity, and have a minimum 4 ft 0 in. (1220 mm) wide door opening. See additional elevator minimum dimensions and requirements in Tables 16-5 and 16-6.

16-4.2.6 Patient Service Elevators.

Patient Service elevators are required to be deep car configuration, have side opening or center opening doors, be a minimum 5000 lb (2270 kg) capacity, and have a minimum 4 ft 6 in. (1372 mm) wide door opening. See additional minimum elevator dimensions and requirements in Tables 16-5 and 16-6.

16-4.2.7 Materials Handling Service Elevators.

Material Handling Service elevators are required to be deep car configuration, have side opening or center opening doors, be a minimum 5000 lb (2270 kg) capacity and have a minimum 4 ft 6 in. (1372 mm) wide door opening. See additional minimum elevator dimension and requirements in Table 16-5 and 16-6.

16-4.2.8 Trauma Elevators.

Trauma elevators are required to be deep car configuration, have center opening doors, be a minimum of 6000 lb (2720 Kg) capacity and have a minimum 5 ft 0 in. (1525 mm) wide door opening. Larger capacity and car sizes to be used for facilities that require three or more attendants and possibly equipment to accompany patient transport.

16-4.2.9 Traction Elevators.

Specify overhead machine room geared hoisting machine elevators for up to four stops with a minimum rise of 32 ft (9.7 m) and minimum rated speed of 200 fpm (61.0 m/min). Specify overhead machine room geared hoisting machine elevators for up to ten stops with a minimum rise of 64 ft (19.5 m) and minimum rated speed of 350 fpm (106.9 m/min) in coordination with Table 16-4.

16-4.2.10 Hydraulic Elevators.

Specify oil hydraulic direct plunger elevators for up to four stops with a minimum rise of 16 ft (4.88 m) and minimum rated speed of 150 fpm (45.7 m/min) in coordination with Table 16-4. Holeless plunger will be considered for difficult site conditions. Provide

necessary machine room ventilation and equipment cooling, overload protection with a preferred 120 starts per hour.

16-4.2.11 Machine Room-Less (MRL) Elevators.

MRL elevators are only allowed where deemed appropriate by the Design and Construction Agent in coordination with the DoD Project Sponsor. Provide written justification and Life Cycle Cost Analysis (LCAA). If allowed, they are be used for passenger elevators ONLY with minimum capacity limitation of 4000 lb (1815 Kg) with 3 stops or more in coordination with Table 16-4 and Table 16-5 or Table 16-6.

16-4.3 Elevator Location and Travel Distances.

Elevators must be designed, arranged, and placed within the building to; minimize patient/staff travel distance and time, provide convenient access to healthcare delivery services, and provide cost-effective elevator performance (direct capital cost of elevators, indirect cost of the space dedicated to their function, and O&M are major cost components of any building). The walking distance from the elevator doors to the center point of the farthest occupied room should not exceed 200 ft (61 m) unless there is adverse impact to operational functionality or elevator locations. The A/E must provide a description of the elevator system(s) proposed, including an analysis of the walking distances, elevator types, and locations for evaluation. The DoD Project Sponsor, in coordination with the Design and Construction Agent, must evaluate the proposed elevator system(s) to determine if proposed travel distances from elevators to healthcare delivery services and administrative areas are acceptable based upon the mission, population served, and operational concepts.

Additional elevators may be required based upon an assessment by the DoD Project Sponsor in coordination with the Design and Construction Agent. These elevators must be in addition to the main elevators provided for efficient and effective travel throughout the building, in compliance with Section 16-4. These additional elevators are intended for staff use only, thus should be located away from main thoroughfares and should not be located where the public can interfere with clinical activities. These elevators must provide average intervals of under 45 seconds and provide a handling capacity equal to 10 percent of the population within the area of service provided. Elevators added for this purpose must be of service type and be access controlled by staff.

16-4.4 Elevator Location, Lobbies, and Groupings.

Placement of elevators must meet the travel distance requirements of paragraph 16-4.3, Material and traffic separation of paragraphs 16-3.1 through 16-3.5 while considering the requirements of paragraphs 16-4.4.1 through 16-4.4.3.

16-4.4.1 Elevator Location.

Place elevators on the direct horizontal path between the areas they serve, wherever possible. Locate elevators so that visitors do not normally pass service, material, or convenience cars en route to passenger cars, unless those cars are substantially hidden.

Table 16-4 Elevator Selection Guide

Table presents minimum elevator types and performance parameters by elevator travel distance.

Elevator Rise		Speed in Feet / Minute (Meter / Minute)				Capacities in Pounds (Kilogram)	
		Elevator Types					
Stops	Travel Distance in feet (meter)	Hydraulic	MRL[6]	Geared Traction (w/MR)	Gearless Traction (w/MR)	Passenger	Service
2	<16 (4.9)	125[4] (38.1)	NA	NA	NA	4000[2] (1815)	5000[3] [5] (2270)
3–4	32-48 (9.8 - 14.6)	150[4] (45.7)	350 (106.7)	200[4] (61.0)	NA	4000[2] (1815)	5000[3] [5] (2270)
5–10	64-144 (19.5 - 44.0)	NA	350 (106.7)	350[4] (106.7)	NA	4000[2] (1815)	5000[3] [5] (2270)
11–17	160-256 (48.8 - 78.0)	NA	350-500 (106.7 - 152.4)	350[4] (106.7)	500[4] (152.4)	4000[2] (1815)	5000[3] [5] (2270)
18+	272 (82.9)	NA	NA	NA	500–700[4] (152.4 - 213.4)	4000[2] (1815)	5000[3] [5] (2270)

Notes:

1. This table identifies the type of equipment and the associated speed based solely on the Rule of Thumb of the height of the building.
2. Wide Car configuration required with passenger elevators.
3. Deep Car configuration required with service and combination elevators.
4. Application to be utilized by elevator consultant in preparation of ETSA.
5. 6000 lb (2720 kg) capacity minimum required if facility has motorized beds or as determined by the ETSA.
6. Only where deemed appropriate by the Design and Construction Agent in coordination with the DoD Project Sponsor. Provide written justification and Life Cycle Cost Analysis (LCAA).

NA – Not allowed

Table 16-5 Elevator Dimension – Front Openings Guide

Table presents minimum elevator dimensional parameters for front opening elevator types.

Capacity	Hostway Width[7]	Hostway Depth[7]	Clear Interior Width[4]	Clear Interior Depth[4]	Clear Door Width[4]	Clear Door Height[4]	Door Type
6000 lb (2720 kg) Deep Car	9’-1” (2768 mm)	11’-5” (3480 mm)	6’-0” (1829 mm)	9’-8” (2946 mm)	5’-0” (1525 mm)	7’-0”[3] (2134 mm)	Side Opening or Center Opening[5]
5000 lb (2270 kg) Deep Car	8’-2” (2489 mm)	10’-1” (3073 mm)	5’-8” (1728 mm)	8’-5” (2565 mm)	4’-6” (1372 mm)	7’-0”[3] (2134 mm)	Side Opening
4500 lb (2040 kg) Deep Car	8’-2” (2489 mm)	9’-6” (2896 mm)	5’-8” (1728 mm)	7’-9” (2362 mm)	4’-0” (1220 mm)	7’-0”[3] (2134 mm)	Side Opening
4000 lb (1815 kg) Deep Car	8’-2” (2489 mm)	9’-0” (2743 mm)	5’-8” (1728 mm)	7’-3” (2210 mm)	4’-0” (1220 mm)	7’-0”[3] (2134 mm)	Side Opening
4000 lb (1815 kg) Wide Car	9’-4” (2845 mm)	7’-8” (2337 mm)	7’-8” (2337 mm)	5’-5” (1651 mm)	4’-0” (1220 mm)	7’-0”[3] (2134 mm)	Center Opening

Notes:

1. All dimensions are for non-seismic zone.
2. All dimensions do not include counterweight safeties.
3. 8 ft 0 in. (2438 mm) also available.
4. All elevator car/cab minimum dimensions listed are pre-determined to accommodate ABA standards, ambulance stretcher and/or other requirements.
5. Elevators dedicated only to AGV system operation (not shared with people) to have a minimum 4 ft 0 in. (1220 mm) clear door width, minimum 5 ft 0 in. (1525 mm) clear interior width, minimum 8 ft 5 in. (2565 mm) clear interior depth, and allow for a maximum single AGV wheel load of 1,050 pounds (476 kg), except for fork style AGV, which requires minimum 10 ft 7 in. (3227 mm) clear interior depth and has maximum single AGV wheel load of 1,150 lb (522 kg). Minimum capacity for AGV system-dedicated elevators to be 5000 lb (2270 kg).
6. Center opening doors are preferred, unless annotated otherwise in the table above. Center-opening doors take less time to operate than single-slide doors of the same width. Center-opening doors are also more efficient as they provide two-way traffic.
7. Hoistway dimensions may vary based on manufacturer. A/E or DoR to coordinate.

Table 16-6 Elevator Dimension – Front and Rear Openings Guide

Table presents minimum elevator dimensional parameters for front and rear opening elevator types.

Capacity	Hostway Width(7)	Hostway Depth(7)	Clear Interior Width(4)	Clear Interior Depth(4)	Clear Door Width(4)	Clear Door Height(4)	Door Type
6000 lb (2720 kg) Deep Car	9’-1” (2768 mm)	12’-4” (3759 mm)	6’-0” (1829 mm)	9’-8” (2946 mm)	5’-0” (1525 mm)	7’-0”(3) (2134 mm)	Side Opening or Center Opening(5)
5000 lb (2270 kg) Deep Car	8’-2” (2489 mm)	10’-11” (3327 mm)	5’-8” (1728 mm)	8’-6” (2590 mm)	4’6” (1372 mm)	7’-0”(3) (2134 mm)	Side Opening
4500 lb (2040 kg) Deep Car	8’-2” (2489 mm)	10’-4” (3150 mm)	5’-8” (1728 mm)	7’-10” (2387 mm)	4’-0” (1220 mm)	7’-0”(3) (2134 mm)	Side Opening
4000 lb (1815 kg) Deep Car	8’-2” (2489 mm)	9’-10” (2997 mm)	5’-8” (1728 mm)	7’-4” (2235 mm)	4’-0” (1220 mm)	7’-0”(3) (2134 mm)	Side Opening
4000 lb (1815 kg) Wide Car	9’-4” (2845 mm)	7’-4” (2235 mm)	7’-8” (2337 mm)	5’-5” (1651 mm)	4’-0” (1220 mm)	7’-0”(3) (2134 mm)	Center Opening

Notes:

1. All dimensions are for non-seismic zone.
2. All dimensions do not include counterweight safeties.
3. 8 ft 0 in. (2438 mm) also available.
4. All elevator car/cab minimum dimensions listed are pre-determined to accommodate ABA standards, ambulance stretcher and/or other requirements.
5. Elevators dedicated only to AGV system operation (not shared with people) to have a minimum 4 ft 0 in. (1220 mm) clear door width, minimum 5 ft 0 in. (1525 mm) clear interior width, minimum 8 ft 5 in. (2565 mm) clear interior depth, and allow for a maximum single AGV wheel load of 1,050 pounds (476 kg), except for fork style AGV, which requires minimum 10 ft 7 in. (3227 mm) clear interior depth and has maximum single AGV wheel load of 1150 lb (522 kg). Minimum capacity for AGV system-dedicated elevators to be 5000 lb (2270 kg).
6. Center opening doors are preferred, unless annotated otherwise in the table above. Center-opening doors take less time to operate than single-slide doors of the same width. Center-opening doors are also more efficient as they provide two-way traffic.
7. Hoistway dimensions may vary based on manufacturer. AE/DoR to coordinate.

from view. Consider operational impacts such as noise, vibration, temperature, and other environmental factors when adjacent to critical treatment areas or those having sensitive equipment. Place adjacent car entrances either in straight lines or in opposite banks to each other.

Where AGV systems are used that require more than one elevator, single elevators must be distributed to minimize horizontal travel on patient floors. On the service levels, consideration should be given to open both sides to allow drive-through capability to achieve higher throughput. On the patient floors, there must be two openings (front and rear) into secure access AGV lobbies/vestibules used for the primary purpose of temporary staging, picking up, and delivering carts. Adequate space inside these lobbies should be coordinated with AGV system vendors prior to finalizing the design.

16-4.4.2 Elevator Lobbies.

Elevator ingress/egress should be from a distinct elevator lobby and not directly from a corridor. Minimum/maximum lobby depth for service cars are 12–14 ft (3.7–4.3 m) when the opening opposes a wall and 14–16 ft (4.3–4.9 m) when the opening opposes another elevator. Minimum/maximum lobby depth for passenger cars are 10–12 ft (3.1–3.7 m) when the opening opposes a wall and 12–14 ft (3.7–4.3 m) when the opening opposes another elevator.

16-4.4.2.1 Elevator Access.

Where elevators are accessed from corridors, they must be located on one side of the corridor only with a maximum of three cars. Elevators must be set back 8–12 ft (2.5–3.7 m) for service and combined use cars and 4–8 ft (1.2–2.4 m) for passenger cars.

16-4.4.2.2 Elevator Separation.

Where two or more elevator group lobbies are adjacent, provide walls or other building features to prevent a free flow of traffic between those lobbies (to minimize one user from placing calls to both groups). Where Table 16-3 requires separation of elevators, passenger elevators must not share the same lobby with service and materials handling elevators. Acoustically isolate all elevator lobbies from Critical Care Areas.

16-4.4.3 Elevator Groupings.

For service and combined use cars, two in a row are preferred and not more than three in a row should be used; for passenger cars three in a row are preferred and not more than four in a row should be used.

If more than six service cars or eight passenger cars are required in one area, provide two smaller, strategic groups.

16-4.5 Passenger and Service Elevator Features.

Passenger and service elevators must meet the requirements of the subparagraph below.

16-4.5.1 Operation.

Elevators are to be arranged to operate with or without attendants and be provided with key operated switches for hospital priority service. Each elevator bank to be equipped for emergency operation by means of a key operated switch at each landing. This switch must cause the closest available car to bypass all other calls in response to an emergency call. Duplex collective operation to be provided for two-car banks. Three- or four-car banks must be a group operation. An on-demand microprocessor system must be provided for all elevator controls.

16-4.5.2 Code Blue Controls.

Provide medical emergency elevator control, sometimes called Code Blue Control, as a means of overriding normal operation of elevators capable of medical emergency transportation of a patient in bed, accompanied by attendants. This control feature must be provided in conjunction with, or in addition to, controls provided for fire department emergency use. Firefighters' operation, as defined in ASME A17.1, must override Code Blue Control.

16-4.5.3 Doors.

Passenger elevators to have center opening doors unless allowed by the Design and Construction Agent. Two-speed side opening doors may be provided in facilities with separate material handling systems (reference Table 16-3). Door closing time must comply with ASME code requirements. Minimum door opening speed to be 2.5 fps (0.8 m/s) except for high speed elevators (500 fpm (152.4 m/min) and over) where the door opening speed to be 2.5-3.0 fps (0.8 – 0.9 m/s). Equip service elevators with buttons to extend door open time, adjustable between 0 to 30 seconds. All elevator car doors must be provided with infrared screen detectors.

16-4.5.4 Signals.

Install hall position indicators at the main floor(s) containing the command and outpatient entrances. Provide hall push-button stations with call register lights. Install hall lanterns with an audible signal on all elevators. Install car position indicators in each car with floor designations, a floor directory signal, and direction arrows. Car operating panels must use car register-type floor buttons. Provide a lobby control panel on elevator banks with two or more cars.

16-4.5.5 Emergency Power.

When otherwise required, connect elevators to operate on alternate source emergency power in conformance with electric power and lighting criteria. Emergency power

selection switches are required for each bank of elevators. The elevator control system must have an ATS which returns each elevator to the main egress level, one car at a time. The last car to arrive at the main floor must automatically be selected to operate at normal design speed.

During an emergency power condition, ASME A17.1 requires all groups of elevators, which are supplied with an alternate power source, to automatically sequence one at a time to the main egress level. Once all cars have reached the designated level, the elevator system must automatically select one car within the group to operate. A manual override switch must also be provided, so emergency personnel may select a particular car if desired.

16-4.5.6 Machine Rooms, Control Rooms, and Machinery Spaces.

Locate electric traction elevator machine rooms above elevator hoist ways. Machine rooms must be sized to accommodate the maximum space requirements anticipated from competitively bid projects, including provisions of space to service and maintain equipment, as well as any additional DoD required equipment and functions including, but not limited to emergency descent to fire fighters' designated level for elevators that are not served by an emergency generator. In the event of a flood zone location, the Machine Room can be located on the first floor above the flood zone. Provide air conditioning in machine rooms to maintain ambient temperature below 85 ^{o}F (29.4 ^{o}C) and above 60 ^{o}F (15.6 ^{o}C). Provide filters to remove dust. Size hydraulic elevator rooms accordingly for the equipment, place them adjacent to the elevator, and on the lowest served floor. Electrically and acoustically isolate all elevator equipment rooms to prevent interference with building electronic equipment and objectionable noises.

The MRL control room closet must be located adjacent to the elevator hoistway and accessible from the corridor. Follow UFC 3-490-06 requirements for elevator control rooms and elevator machinery spaces except for the following:

a. The MRL elevator control equipment must be located in a dedicated control room/ closet. The use of door jamb control equipment is prohibited. Control rooms must be sized to accommodate the elevator panels, disconnects, controller and other related equipment. It must be possible to remove major equipment components of each elevator for repair or replacement without dismantling components of an adjacent elevator.

b. Proprietary elevator systems, components, parts, motors, and software is strictly prohibited.

16-4.5.7 Elevator Car Enclosure.

Car lighting to be either indirect or of the luminous ceiling type. Provide mechanical exhaust for elevator cars. Provide protective cab interior blanket hooks and one set of full-height blankets per cab.

16-4.5.8 AGV System Elevator Features.

When determining elevator usage requirements for AGV systems, consideration must be given to whether the elevator is to be dedicated for exclusive use of the AGV system. The elevator must be dedicated to sole use by the AGV system if the AGV system requires greater than 50–60 percent of any single elevator. If the AGV system usage is less than 50–60 percent of the elevator, then the AGV/elevator interface must allow for a manual mode of operation to accommodate other material conveyances.

16-4.5.8.1 Shared Use Elevators.

For shared (automatic and manual) use elevators, the AGV system must release the elevator for manual movements when all automatic transports have been completed. The AGV system must request automatic mode when needed and the elevator controls must disable hall call buttons and flash “Elevator in Automatic Mode” warning signs in the halls. After all cabin calls are answered and the doors close, the elevator must change from manual mode to automatic mode. The specific signals and sequencing of them for AGV/elevator interface must be specified by the AGV system vendor after selection and the elevator manufacturer must conform to it as well as maximum leveling and gap tolerances. Fire service level and alternate fire service levels must be identified in the TLA.

16-4.5.8.2 Shared Mode Elevators.

Shared Mode Elevators must include flashing lights with the words “Elevator in Automatic Mode” on all landings to indicate when the AGV system has requested use of the elevator. A flashing sign with audible warning must activate inside the cabin after the elevator doors have closed, there are no more cabin calls, and the elevator control changes from manual mode to automatic mode.

16-4.5.8.3 AGV System Interface.

The elevator controls must include an AGV system interface terminal strip to which discrete, potential free contacts rated for 24 volts are wired in the machine room. Supporting elevator software/logic must control the contacts inputs and outputs (I/O) in accordance with a specification to be provided by the selected AGV system vendor. A manual key switch for entering automatic mode must be located in the elevator cabin.

Each AGV system elevator controller must have discrete I/O terminals to receive and transmit.

AGV elevator doors must have switches on each door to signal when the doors are completely closed as well as completely open so as not to restrict the clear opening. Leveling circuitry must be incorporated to prevent signaling the arrival of the cabin to a floor when the cabin is not within the leveling tolerance.

16-5 MATERIAL MANAGEMENT DESIGN.

16-5.1 AGV Systems.

Design the AGV systems to incorporate the latest state-of-the-art in proven technology; systems not proven in at least five previous similar applications must be avoided. System must be an integrated turnkey automated cart transportation system.

AGV systems may utilize a variety of transportation vehicles (transporters) including “cart carrying” type and forklift type; towing type transporters are not desired because they do not transport carts with the casters off the floor.

16-5.1.1 Design.

The design must establish horizontal rights-of-way to:

a. Aid in directing traffic to the appropriate vertical core, while avoiding inappropriate elevators and other building areas;

b. Provide high levels of patient privacy and protection from high noise levels; and

c. Eliminate potential contamination of clean and sterile areas.

16-5.1.2 AGV Elevators.

The elevators that provide vertical transport for AGVs must open into enclosed pickup and delivery (P&D) lobbies with motorized door access to the main circulation corridors on the patient floors. Consider two vestibules - one accessible from each elevator door - for separate soiled and clean cart staging areas. Where higher cart transport volumes exist, a path must be included for AGV vehicle travel from the clean side to the soiled side without having to use the elevator cabin. Recommendations for positive/negative air pressure or motorized doors between these areas must be included.

16-5.2 Pneumatic Tubes.

Provision of PTSs must be consistent with requirements for a particular facility regardless of the size of the facility. No specific correlation can be made between the number of beds in a MTF and the need for a PTS. Facility parameters and FTE usage are the primary drivers for the use of pneumatic tubes.

a. Design systems to reach individual project peak traffic requirements, plus a minimum spare capacity of 20 percent. Designs must provide for soft handling of all systems where laboratory specimens and other delicate items are transmitted.

b. Select tube systems that provide automatic control of carrier movement. A selector device that permits correspondence with any station served by the system must set the destination of the carrier.

16-5.3 Mobile Robots.

Mobile robots must be considered only when they have been proven in other similar applications in at least five similar hospitals and can be considered for travel through any corridor to nursing units and to patient rooms.

Mobile robots that interface with elevators must use a similar interface method to the AGV system interface described elsewhere. Mobile robot travel must be segregated from AGV system traffic routes and AGV elevators unless they use the same control system.

16-5.4 Dumbwaiters and Cart Lifts.

Dumbwaiters must meet the requirements of the following subparagraphs.

16-5.4.1 Codes.

Dumbwaiters to comply with applicable Federal, State, Local and Elevator codes including ASME A17.1, A17.2, A17.5, NFPA 70, ASME/UL – 10B and 508.

16-5.4.2 Dumbwaiters, Counter Loading.

Automatic loading and unloading are to be considered. Dumbwaiters without automated devices to have powered or manual doors. Provide bi-parting type powered doors with door safety reversing edges. Locate machine at the bottom of the hoistway.

16-5.4.3 Dumbwaiters, Floor Loading.

Floor loading dumbwaiters to have powered vertical panel slide-up door with safety reversing edge. Bi-parting doors can be utilized in conjunction with a larger pit depth along with drawbridges to provide a smooth entrance for wheeled carts. Locate machine at top of hoistway.

16-5.4.4 Dumbwaiter Platform Size.

Dumbwaiter systems are to be limited to a maximum platform size of 1550 in^2 (1 m^2) x 48 in. (1219 mm) high and maximum capacity of 500 lb (227 kg). A platform size of 30 by 48 in. (762 by 1219 mm) is acceptable. Automatic loading and ejection devices of larger capacity and size, used in conjunction with automatic cart lifts, and conform to the ASME standards for elevators. Determine the dimensions of the car lift platform by the largest cart selected for dietary, linen, or other materials distribution.

16-5.4.5 Dumbwaiter and Cart Lift Control.

Distribution and return programs must be provided for dumbwaiter and cart lift operation. The control station must contain a switch for program selection and a series of dispatch buttons that correspond to the floors served. Design the system to permit

dispatching carts to any landing from the central dispatching area and to provide for return of carts only to the central dispatching area.

16-5.4.6 Dumbwaiter and Cart Lift Signals.

Stations at each floor or landing must contain lights to indicate which program is in effect.

Table 16-7 Dumbwaiter and Cart Lift Parameters

Dumbwaiter Rise		Type				Speed	
Stops	**Travel Distance in feet (meter)**	**Motor**	**Light**	**Medium**	**Heavy**	**fpm (m/min)**	**Notes**
2	<16 (4.88)	Winding Drum	X	X	NA	50 (15.2)	(2)
3-4	32-48 (9.75 - 14.63)	Traction		X	NA	200 (61.0)	(2)
5-10	64-144 (19.51 - 43.89)	Traction		X	NA	300 (91.4)	(2)
11+	135+ (41.15)+	Traction		X	NA	300 (91.4)	(2)
Notes:							
Light-Duty Dumbwaiter 100 - 200 lb (45 – 91 kg) (up to 24” wide x 24” deep x 36” high) (610 mm wide x 610 mm deep x 915 mm high)							
Medium-Duty Dumbwaiter 200 - 750 lb (91 – 340 kg) (up to 38” wide x 38” deep x 48” high) (965 mm wide x 965 mm deep x 1219 mm high)							
Heavy-Duty Material Lift 750 - 2500 lb (340 – 1134 kg) (up to 60” wide x 96” deep x 96” high) (1524 mm wide x 2438 mm deep x 2438 mm high)							
NA – Not Applicable							
1.	This table identifies the type of equipment and the associated speed based solely on the Rule of Thumb of the height of the building.						
2.	Application to be determined by elevator consultant in preparation of ETSA.						

16-5.4.7 Cart Lifts with Automated Transfer Devices.

Doors must be power operated with upper and lower safety edges. Maximum cart lift capacity to be 1000 lb (453 kg).

16-6 WASTE MANAGEMENT DESIGN.

The waste management system must be designed to help maintain aseptic environments in the hospital, and to minimize or eliminate physical and infection hazards to patients, hospital staff, and the general public, at the lowest LCC to the Government. The design objectives should include hazardous waste optimization/process improvements, recycling, waste minimization, and hazardous material substitution to more environmentally friendly products/processes.

16-6.1 Waste Categories.

The categories of medical facility waste are: Regulated Medical Waste (RMW), Hazardous Waste (HW), Recyclable Materials (RM), and general waste. Each of the categories of waste requires individual design consideration of handling, storage, and disposal by the facility. In addition, regulatory requirements differ for each category dependent upon the geographic location (state or country), relative personnel and public hazards and environmental impact.

16-6.2 Waste Collection and Transport.

The waste management system must be fully coordinated with the transportation design to determine the most appropriate means and routing of transport of wastes inside and outside of the facility. Consideration should include: regional waste collection service provider to account for dumpster sizes (usually provided by the Installation / DPW); dumpster loading/unloading offsets; and minimum turning radius of waste removal trucks. Automatic or manual systems should be considered. The design must avoid creating conditions that require or involve the double-handling of waste, especially RMW and HW.

a. Where facilities receive palletized supplies, designate an exterior area for the storage of empty/idle pallets waiting for disposal.

b. Provide easy access to dumpsters from back-of-house materials management/waste management areas. If dumpsters are located at a distance from the facility due to ATFP or other reasons, ensure ramps or other means are provided to allow the transport of wheeled trash carts from the facility to the dumpster.

c. Supply and loading dock areas should be provided with overhead weather protection by either a canopy or overhang.

d. If Nuclear Medicine, Decay Storage (NMDS1) and Nuclear Medicine, Decay Calibration (NMDC1) rooms are included in the Program for Design (PFD), coordinate the location with the DoD Project Sponsor and identify

the path of travel to meet 10 CFR 35.92, 10 CFR 20.1201, and 10 CFR 20.1301.

16-6.3 Regulations, Codes, and Standards.

The preliminary design of the waste management system must comply with all applicable Federal, state, and local codes and regulations, including: Nuclear Regulatory Commission (NRC) guidelines; NFPA 82; 40 CFR 261–265 and 40 CFR Part 22; 49 CFR 171–180; 29 CFR 1910.1200, 29 CFR 1910.1030, and 29 CFR 1910.134. Guidelines and advisory standards available from the NFPA, the CDC, National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services (HHS), and TJC must be utilized as applicable and considered minimum criteria for facility design. The WMA must be based on regulations and standards enforced by the local authority.

16-6.4 Gravity Chutes.

Gravity chutes to comply with NFPA 82 unless otherwise modified herein.

a. Consider gravity chutes either alone or in combination with horizontal pneumatic chutes, for internal general and soiled linen transportation (down only) in multistory facilities. Also, consider hospital service elevators, AGVs, and cart lifts for internal transportation of solid wastes in multistory buildings. Consider that the AGV system has to move empty linen carts down from patient areas and these movements can be used for transport of soiled linen at very little, if any, incremental cost.

b. Collection areas for soiled linen to be located near the loading dock.

c. Provide chute access on user levels through a separate room with dimensions adequate for holding the collection cart, with room doors closed, while the attendant is charging the chute.

d. Size terminal rooms to accumulate the amount of materials dictated by the WMA. Minimum dimension must allow accumulation of 24 hours of collected materials. Design must ensure that collected material does not block the entrance door or hinder the pickup operation.

e. Masonry waste chutes are prohibited. Refractory lined chutes are prohibited. Automatic sprinklers are required in all chutes regardless of construction.

16-6.5 Pneumatic Trash/Linen.

Pneumatic trash/linen systems to comply with NFPA 82 unless otherwise modified herein.

a. Pneumatic trash/linen systems are either fully pneumatic or gravity pneumatic. In general, no station to be designed that is “up send” in nature. All materials should travel in the down direction after first being

loaded into the system. Verify system traffic capabilities by detailed traffic studies.

b. Fully pneumatic systems are continuous sealed transport systems (run) from source (material loading) to disposition (collection room or compactors) consisting of full vacuum stations equipped with interlocked doors, an air source, and the same size diameter transport piping throughout.

c. Vertically aligned charging doors of the same chute system must be interlocked so that only one station can be charged at one time, thereby reducing the possibility of charges jamming within the chute. Provide gravity chutes with negative pressure, relative to the charging area, to eliminate aerosol discharged into the charging areas when charging doors are opened.

d. Fully pneumatic systems are allowed where deemed appropriate by the Design and Construction Agent in coordination with the DoD Project Sponsor. Provide written justification and LCCA.

e. Gravity-pneumatic systems, a combination of gravity chutes for vertical transportation, and pneumatic chutes for horizontal transportation are subject to the same fire protection requirements as gravity systems.

f. Gravity chutes must be equipped with a storage section at the bottom of the chute. Gravity chute charging stations equipped with electric control systems may be loaded with as many bags of waste or linen as necessary. Bags are accumulated in the storage section and are removed as a single load on demand.

g. Both gravity-pneumatic and fully-pneumatic chutes must be manually charged, enclose charging doors and frames in fire-rated rooms. Sprinklers in the charging stations must protect pneumatic chutes. Charging stations must have a receiving compartment with an outer and inner door. When the door is opened to put in a load, the inner door must be automatically locked so that the load cannot freely enter the chute. When the outer door is closed, the inner door must open in its sequential turn and the load to be automatically transported by negative pressure to its point of discharge. Only one load to move through each leg of a pneumatic chute system at one time.

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CHAPTER 17 CONSTRUCTION

17-1 CONTRACT AWARD.

The DoD Project Sponsor will provide authority to the Design and Construction Agent to award a construction contract in accordance with Chapter 3 Design.

17-2 COMMISSIONING DURING CONSTRUCTION.

Reference Chapter 19 Commissioning.

17-3 CONSTRUCTION CONTRACT CHANGES.

17-3.1 Process for Reporting Changes.

The Design and Construction Agent specifies reporting procedures as follows:

b. For projects assigned to USACE, proposed project changes impacting unique medical technical criteria covered under this document must be coordinated with the CEHNC-EDX for their comment and recommendation.

b. For projects assigned to NAVFAC HQ MFPO, they have responsibility for changes as they require and deem appropriate.

c. For projects in the United Kingdom, the AFCEC has responsibility for changes as they require and deem appropriate.

17-3.2 Process for Approving Funds.

Changes must be submitted for approval to the designated Design and Construction Agent (USACE, NAVFAC HQ MFPO, or AFCEC/CFM) in accordance with their established business practices. All discretionary changes must be submitted in accordance with DoD Project Sponsor policy.

17-4 CONSTRUCTION FUNDS.

17-4.1 Funds Management.

The DoD Project Sponsor will sub-allocate all of the appropriated design and construction funds to the Design and Construction Agent who must manage the funds at the project level.

17-4.2 Funds Availability.

If funds are required for changes that exceed the amount available and the authorized contingency is inadequate, the Design and Construction Agent must notify and request additional funds from the DoD Project Sponsor in writing, along with justification for additional contingency funds, and cite source of funds. The Design and Construction

Agent must notify the DoD Project Sponsor if actual requirements exceed the appropriated amount.

17-5 NOTIFICATION OF CONTRACTOR CLAIMS.

The Design and Construction Agent must notify the DoD Project Sponsor of submitted contractor claims that have been approved by the Contracting Officer or the Board of Contract Appeals within 30 working days of date of the determination to reimburse the contractor for claims that require additional funding. Such claims must be accompanied with a narrative explanation, recommended resolution, and estimated final cost.

17-6 LIFE SAFETY ASSESSMENT.

Refer to Chapter 14 for LSA requirements.

17-7 DEMOLITION OF VACATED FACILITIES.

The demolition of vacated facilities must be reported on the project DD Form 1354 in accordance with UFC 1-300-08.

CHAPTER 18 BUILDING INFORMATION MODELING (BIM)

18-1 GENERAL.

BIM is an enabling tool and process for facilities projects within the MHS to more effectively achieve current requirements described throughout this document and assist the MHS in achieving fundamental Facility Life Cycle Management (FLCM) requirements in supporting the delivery of applicable facilities.

18-1.1 MHS BIM Objectives.

The MHS BIM objectives support and provide improvements for:

a. Clearly and concisely defining the requirements for models, facility data, processes, and respective deliverables.

b. Interoperability and analysis across the FLCM.

   i. Automated SEPS to BIM PFD analysis for validation to actual design/construction.

   ii. Automated SEPS to BIM PRC analysis for validation.

   iii. Defense Medical Logistics Standard Support - Facilities Management (DMLSS-FM) and future LogiCole integration.

   iv. Defense Medical Logistics Standard Support - Equipment and Technology Management (DMLSS-E&TM) and future LogiCole Medical Equipment integration.

c. Planning and programming analysis.

d. Design coordination/process and design criteria validation.

e. Construction and commissioning execution and QA/QC.

f. Risk management from Interference Management through virtual design and construction processes.

g. Simulation and visualization of healthcare operations.

h. IO&T efforts.

i. Quality and efficiency enhancements distributed across all current and future projects for continual process and product improvements.

j. Data-enhanced deliverables for facility owners, users, and operations and maintenance available prior to handover.

18-1.2 Corresponding Project Model Uses.

The United States National BIM Standard (NBIMS–US™) defines standard “BIM Uses” (also referred to as “Model Uses”). Each of the MHS BIM Objective have corresponding Model Uses as identified below as the minimum mandatory model uses required for

every project. Contractor selected elective model uses are encouraged to provide enhanced project outcomes and additional consideration for contractor selection.

18-1.2.1 Design Phase Model Uses.

The Design Phase model Uses include:

a. Design Authoring

b. Progress Reviews

c. Interference Management or Clash Detection (3D Coordination)

d. Program Validation

e. Construction and Operations Building information exchange (COBie) for the MHS (COBie-MHS)

18-1.2.2 Construction phase Model Uses.

The Construction Phase Model Uses include:

a. Interference Management or Clash Detection (3D Coordination)

b. Program Verification

c. Record Modeling

d. COBie-MHS

18-1.3 Applicability.

To ensure these objectives are uniformly achieved, all projects are required to implement the MHS BIM Minimum Requirements established for projects funded, or to be operated and maintained, under DHP funds. This applies to all projects CONUS or OCONUS, except Unspecified Minor Construction (UMC). The MHS BIM Minimum Requirements are located at http://facilities.health.mil/repository/getfile/1463.

CHAPTER 19 COMMISSIOINING

19-1 GENERAL.

This chapter addresses the Total Building Commissioning (TBCx) requirements and the process to be implemented as required by Federal regulations and the Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding.

Upon receipt of DA for A/E Award (for the A/E that develops full design for DBB projects or the DoR that develops the RFP for DB projects), the Design and Construction Agent and DoD Project Sponsor must jointly determine the commissioning leadership structure, the extent, and the level of commissioning services required during all project phases as appropriate for the specific project; this must be communicated in the project requirements documents.

19-2 SUPPLEMENTAL CRITERIA.

Guidance for the Commissioning process is contained in ASHRAE Standard 202, ASHRAE Guideline 0, ASHRAE Guideline 1.1, ASTM E2813, **\1** ASTM E2947, **/1/** and NFPA 4. Other references are available that describe similar processes that may be used at the DoD Project Sponsor and Design and Construction Agent's discretion.

19-3 PRELIMINARY COMMISSIONING REQUIREMENTS.

In order to verify design and performance, and ensure that the Government requirements are met, employ commissioning practices appropriate to the size and complexity of the building and its system components and document specific roles and responsibilities for key commissioning participants.

19-3.1 Level of Commissioning.

Provide Commissioning for projects that are greater than 10,000 GSF (92.9 GSM) with a Construction cost of greater than $3 million dollars as described in paragraph 19-4. For small, non-complex, projects provide commissioning as described in paragraph 19-5.

Exception: When deemed appropriate by the DoD Project Sponsor and recommended by the Design and Construction Agent based on the project size and complexity, the commissioning requirements to be used (paragraph 19-4 or 19-5) shall be as directed by the DoD Project Sponsor.

19-3.2 Roles and Responsibilities.

Based on the commissioning leadership structure determined for the project, clearly define the roles and responsibilities of key commissioning participants to ensure that all required tasks are provided and that responsibility is appropriately assigned.

19-4 TOTAL BUILDING COMMISSIONING.

19-4.1 Process Overview.

TBCx must be executed during all project phases, including the design, construction, post-construction, and warranty phases. TBCx must at a minimum include the commissioning requirements of this chapter. TBCx must verify that building systems perform interactively according to the intent of the design, and that the systems meet the DoD Project Sponsor's operational needs. The Commissioning process must execute and document the commissioning activities required to comply with the Third Party Certification (TPC) requirements for the Project. Provide all commissioning documentation required to meet the TPC requirements.

The minimum systems listed here must be commissioned as appropriate for the specific project:

a. HVAC systems, including electronic digital control systems and building energy management systems.

b. Plumbing systems and associated controls.

c. Medical and dental gas, compressed air, and vacuum systems.

d. Steam (high, medium, and low pressure), clean steam, and other major energy plant equipment.

e. EPSs and their interfaces to other critical building system operations.

f. Lighting systems: automatic daylighting controls, manual daylighting controls, occupancy sensing devices, and automatic shut-off controls.

g. Fire suppression, smoke control, smoke or fire dampers, fire detection and alarm systems, and mass notification systems, and their interfaces to other building system components.

h. Communication systems including telecommunication infrastructure, NC, ITV, intrusion detection, infant abduction, other ESSs, and other communication systems.

i. Building systems that are incrementally constructed and commissioned, such as in phased construction projects.

j. Energy conservation equipment and systems, including solar hot water system and any renewable energy systems.

k. Water and energy measurement devices.

l. Building envelope, including exterior walls, fenestration, roofs, and openings.

19-4.2 Commissioning Leadership Structure.

The Commissioning leadership structure, including roles and responsibilities, must be fully defined in the project requirements documents, as the structure may vary depending on the acquisition strategy, size, complexity of the project, and expertise of the participants. Regardless of leadership structure, the process requires full and open communication for all parties to maximize the benefits of the process. The principal Commissioning Lead definitions and roles are noted here:

19-4.2.1 Commissioning Specialist for the Government (CxG).

The CxG is an entity having expertise in the commissioning of medical facilities of a scope and complexity comparable to the individual project, and employed regularly in building commissioning. Refer to paragraph 19-4.2.5 for additional qualifications.

a. The CxG may be person(s) employed by the Design and Construction Agent, or an entity directly contracted by the Design and Construction Agent, but not affiliated with the construction contractor. The CxG must provide management and oversight of the Commissioning process through the design, construction, and warranty phases to ensure it is effectively and thoroughly implemented.

b. The CxG must have documented commissioning authority experience in at least two building projects and be independent of the work of design and construction.

c. The CxG must meet the requirements and perform the roles specified for the commissioning authority required by the project's TPC. For small DB projects, the commissioning authority role may be provided by an independent third-party commissioning agent hired as a first tier subcontractor to the DB contractor as defined in paragraph 19-4.2.3 and they must meet the requirements and perform the additional roles defined for the CxG in this paragraph. Specific roles include the development and maintenance of the Owner's Project Requirements (OPR), development of the draft Commissioning Plan, and assisting in the development of Systems Manuals for the commissioned systems. At the discretion of the Design and Construction Agent and DoD Project Sponsor, the CxG must conduct a Lessons-Observed meeting at the end of the Commissioning process to discuss the process used, discuss what worked well and what could be improved, develop recommended improvements for future similar projects, and document the meeting in a closeout report.

19-4.2.2 Commissioning Specialist for the Design Phase (CxD).

The CxD must be an entity on the Design A/E staff, or directly contracted by the A/E, having expertise in the commissioning of medical facilities of a scope and complexity

comparable to the individual project, and employed regularly in building commissioning. Refer to paragraph 19-4.2.5 for additional qualifications.

For DBB projects, the CxD must be responsible for development of all design phase commissioning documentation, including hands-on development of the Commissioning Plan, and commissioning specifications to include Pre-Functional Checklists (PFCs) and Functional Performance Tests (FPTs). For DB projects, the CxD must be responsible for developing commissioning scope requirements for inclusion in the RFP.

19-4.2.3 Commissioning Specialist for the Construction Phase (CxC).

The CxC must be an entity employed as a first tier subcontractor by the construction contractor, independent from the installing contractors, having expertise in the commissioning of medical facilities of a scope and complexity comparable to the individual project, and employed regularly in building commissioning. Refer to paragraph 19-4.2.5 for additional qualifications.

The CxC must be responsible for scheduling and coordinating all construction phase commissioning activities, refinement of PFCs and FPTs to match the specific purchased equipment, and direct oversight and reporting of the execution of the Commissioning process.

19-4.2.3.1 Design After Award CxC Responsibilities.

For projects which include design-after-award activities (for example Design-Build), the CxC must additionally be responsible for development of all commissioning documents required during design, including the Commissioning Plan and commissioning specifications to include PFCs and FPTs.

19-4.2.4 Commissioning Lead Role Application.

The CxG is required for all project procurement methods. The CxD is typically required for DBB projects and may be utilized during DB RFP preparation for DB projects. The CxC is typically required for DBB and DB projects.

19-4.2.5 Commissioning Lead Qualifications.

The Commissioning Specialist entities must be members of, or certified by, a nationally recognized commissioning organization. Each entity must employ a commissioning professional who must be the Commissioning Lead for their area of responsibility. In addition, each entity must employ additional staff to ensure adequate attention to all systems requiring commissioning as identified in paragraph 19-4.1.

Table 19-1 provides the minimum qualification requirements for Commissioning Lead personnel:

Table 19-1 Commissioning Lead Personnel Qualifications

Qualification	CxG	CxD	CxC
Registered Professional Engineer (P.E.)	YES	YES	
Proven hands-on experience in the commissioning of projects of equivalent scope	YES	YES	YES
Certified as a commissioning professional by a nationally recognized commissioning organization	YES	YES	YES

19-4.3 Commissioning During Design.

The Commissioning process must be fully defined in the design phase for each project. The CxG should be involved early in project development to facilitate the development of the DoD Project Sponsor's OPR document, which records the expectations and requirements for the commissioned systems, and the Commissioning Plan, which outlines the process, commissioned systems, participants, roles and responsibilities, communication procedures, and deliverables. The scope and rigor of Commissioning activities to be completed during construction need to be defined in the contract documents so that they are clearly understood and can be adequately bid. The CxG should review the design documents at various stages of development to verify that the designed systems are commissionable, and suggest alternative designs that would save energy, allow for system optimization, and decrease overall LCC. The CxG must oversee the development of the Commissioning Specifications by the CxD and/or CxC for design after award work features, which define the specific SOW and the roles, responsibilities, and requirements of the construction contractor's commissioning team members. The specifications must also include draft PFC and FPT procedures for each system to be commissioned to adequately define the scope and rigor required.

19-4.4 Commissioning During Construction.

During the construction project, it is necessary for the CxG to oversee the contractor's commissioning execution as managed by the CxC to verify that the contractor's proposed testing procedures, personnel, and instrumentation fully meet the design document requirements, that the tests are properly conducted, and results documented. As part of the commissioning process, verify that adequate training has been provided on all commissioned systems.

19-5 SMALL PROJECT COMMISSIONING.

19-5.1 Process overview.

Perform Functional Performance Testing/Acceptance Testing (FPT/AT) in accordance with this section using generally accepted engineering standards. Incorporate FPT/AT into the design and construction of the project to verify systems specified in this section perform in accordance with construction documents.

The minimum systems listed in paragraph 19-4.1 must be covered by FPT/AT as appropriate for the specific project.

19-5.2 Oversight of the testing.

The Government will designate an Acceptance Representative to lead, review, and oversee completion of FPT/AT activities. The Acceptance Representative will review construction documents to verify relevant sensor locations, devices, and control sequences are properly documented.

The construction documents must indicate who is to perform acceptance tests and the details of the tests to be performed.

19-5.3 Requirements during construction.

Verify proper installation and start-up of the systems. Provide a minimum 7 day trend log of the system operation prior to the FPT/AT. Perform FPT/AT, complete test forms and include a signature and license number, as appropriate, for the party who has performed the test.

Verify a system manual has been prepared that includes O&M documentation, full warranty information, and provides operating staff the information needed to understand and optimally operate building systems.

19-6 SPECIFIC SYSTEM REQUIREMENTS.

19-6.1 Interoperability.

Various systems, such as HVAC systems, fire alarm and fire detection systems, EPSs, communication systems, and others, have complex, interwoven operational requirements in medical facilities. For each project where applicable, designers must develop new and modify existing specifications as needed to provide for integrated systems testing to validate interoperability of these systems and to verify correct function, acceptable speed of response, operation in normal and failure modes, and restoration to normal operation. Integrated systems testing of fire systems and life safety systems must be provided in accordance with NFPA 4. In all cases, detailed testing protocols or system diagrams must be developed to clearly convey the required scope of the commissioning effort.

19-6.2 Addition and Alteration Considerations.

For addition and alteration projects, commissioning specifications must be developed to describe the step by step procedures required for interim, as well as final, commissioning for systems constructed (or altered) and placed in operation on a temporary, or sequential, basis.

APPENDIX A BEHAVIORAL HEALTH DESIGN

A-1 GENERAL.

This appendix provides mandatory criteria for the design and development of the built environment for Behavioral Health (BH) functions in new and existing MTFs.

A-2 SCOPE OF BEHAVIORAL HEALTH SERVICES.

A-2.1 Inpatient Functions.

DoD Space Planning Criteria Chapter 460 outlines BH services and programs provided in MTFs in the Military Health System (MHS).

Services specifically covered in Chapter 460 are for 24-hour healthcare operations that are provided on inpatient units for Behavioral Health and Substance Abuse / Alcohol Rehabilitation programs. Additionally, Partial Hospitalization Program, which is a day treatment program for patients who need intensive treatment but not 24 hour care, is often collocated with an inpatient BH Unit. The Partial Hospitalization Program will follow the requirements specified for inpatient BH Units in this appendix if the Program is located in an inpatient MTF.

A-2.2 Outpatient Functions.

DoD Space Planning Criteria Chapter 318 outlines services and programs provided in an outpatient BH setting. Where outpatient is used in this appendix, it includes freestanding BH facilities that include the services noted below, as well as BH clinics located within a hospital or medical center. Services specifically covered in this chapter are Behavioral Health, Child and Adolescent BH Services, the Family Advocacy Program, and the Substance Use Disorder Clinic.

DoD Space Planning Criteria Chapter 350 includes spaces that support the care of BH patients who seek treatment at the Emergency Department (ED).

A-3 BEHAVIORAL HEALTH PROGRAM.

A-3.1 Concept.

In accordance with specific BH project requirements, the DoD Project Sponsor will develop the Functional Program to describe how the inpatient BH Unit, or outpatient clinic, will function within the physical environment. The MilDep's Surgeon General's BH Consultant and facility end users will also assist with developing the Functional Program to identify how the design criteria, as outlined in this appendix, will be implemented and identified when developing the scope of work for the project.

A-3.2 Behavioral Health Design Guide.

Design the inpatient BH Unit, and where appropriate the outpatient BH clinic to meet all of the requirements of the Behavioral Health Design Guide (BHDG), which is available from Behavioral Health Facility Consulting, LLC.

Exception: Due to the changing nature of behavioral health design, consider using the most current BHDG for product selections and finishes. The DoD Project Sponsor may require specific safety features from the current BHDG.

A-3.3 Functional Program and Safety Risk Assessment.

Develop the Functional Program in conjunction with the BH Safety Risk Assessment (SRA), also available at the link, to identify project specific design requirements. Safety levels identified by the BH SRA for the inpatient unit may not be the same in all areas nor be the same for each unit/population; and are fundamentally correlated to an understanding by the facility staff of a patient's intent for self-harm. For example, during the day the activity room may be Level 2, however at night on the weekends, it may be a Level 3. The Functional Program and SRA should take into account the number and location of staff in regard to specific areas or spaces. Review and update the Functional Program and the SRA during development of the RFP, and throughout the design and construction phases of the project. The A/E of Record is responsible for maintaining and updating the SRA during design and construction. Refer to Chapter 3 for specific SRA requirements and Appendix C for design submittal requirements.

A-4 CONSULTING SERVICES.

For BH projects, the A/E of Record must provide the services of a qualified behavioral health consultant at project initiation. The consultant must provide design, FF&E, and Low Voltage Systems input to inform the 35 percent design effort. The consultant must also provide input on the project SRA throughout the design process to identify potential safety concerns, review for compliance with the Functional Program, in relation to adjacencies, flow, and with the BHDG for product selection related to interior finishes, toilet accessories, hardware, electrical fixtures, etc. The consultant will present possible solutions, and explain the positive and negative elements of each, in collaboration with the DoD Project Sponsor. A qualified BH consultant is one who has been in business or employed as a BH professional or provider, for a period of not less than five years, and has had experience with the planning and design of inpatient and outpatient BH medical facilities. The consultant must not be involved in the sale, installation, distribution, manufacture, or representation of BH equipment. Furthermore, the consultant must demonstrate prior experience with DoD MTFs that relates to the scope and nature of the project to include locations OCONUS, if applicable.

A-5 DESIGN CRITERIA.

A-5.1 Environment.

Design a safe, functional, therapeutic, and aesthetically pleasing, non-institutional BH environment that “normalizes life” for patients, staff, and visitors. There are four “areas of concern” that must be considered when designing a BH environment: 1) Patient Safety – reducing risks for suicide/self-harm or harm to other patients; 2) Staff Safety – reducing risks or opportunities for patients to harm attending staff; 3) Structural Resistance – reducing damage to facilities and preventing an increase in maintenance costs; and 4) Life Safety - egress for inpatient behavioral health may include delayed egress locking devices, for patients, staff and visitors. The Functional Program will include the following: applicable codes and regulations, to include operational risk mitigation strategies (for example staff rounding, monitoring by staff, and doors-open policy during daytime hours), the findings of the BH SRA, and include the implementation of the design criteria set forth in this appendix to provide direction on several means of improving safety of staff and patients in BH settings. The Functional Program will state unequivocally that, whereas safety of staff and patients is paramount, the design intent is to limit the “institutional” look of the BH environment. Generally speaking, the using MilDep Surgeon General’s BH Consultants have not supported such measures as bullet-proof glass surrounding reception desks, or security staff and metal detectors at entrances to Outpatient BH Clinics. The implementation of such extraordinary measures will be identified early and incorporated into the SRA and project documents following full discussion with the Design and Construction Agent and the DoD Project Sponsor.

A-5.1.1 Exterior Spaces.

Consider the inclusion of an outdoor area during project design to support respite and group activities as a component of the inpatient BH therapeutic environment. This outdoor area, which may have attached or unattached canopies or overhangs, will comply with Chapter 3 for scope and cost estimating. Plan the location and design of this outdoor space to reduce the risk of elopement, climbing, jumping, impalement and concealment in relation to wall surfaces, furniture selection and placement, sufficient lighting for nighttime, staff sight lines and video surveillance use, and landscaping features are essential. Include the outdoor area in the SRA. Apply design considerations and safety features noted in the sections below.

A-5.1.2 Interior Spaces.

Drivers that influence the selection of materials include safety, durability and maintenance, infection control, integrated wayfinding, and sustainability. Every effort must be made to eliminate ligature points, sharp edges, and the potential to make weapons out of objects or materials. The term ligature resistant as used in this appendix is defined as “without points where a cord, rope, bed sheet, or other fabric/material can be looped or tied to create a sustainable point of attachment that

may result in self-harm or loss of life." This is consistent with The Joint Commission's definition.

The DoD Project Sponsor are responsible for the validation of the SEPS generated PRC to ensure JSNs reflect the BHDG requirements and support the SRA.

A-5.1.3 Architecture.

Incorporate the following guidance when developing the design and layout of spaces for BH care for inpatient and outpatient settings:

a. Avoid dead-end corridors, alcoves or other architectural features that provide concealment or blind spots.

b. Provide column-free spaces in patient bedrooms, group therapy or counseling rooms, activity rooms and other rooms where patients and staff interact.

c. Provide staff areas that promote team collaboration and HIPAA compliance while maintaining visibility and connection between the care team and patients. Design staff areas to provide an area of refuge (but not as used in the context of NFPA 101) for staff safety.

d. Maximize windows to exterior and interior spaces to create a sense of transparency, openness, and safety.

e. Segregate noisy activities (art therapy) and quiet activities (patient bedrooms or counseling spaces) to improve processes and consolidate disciplines.

f. Outfit the "transition zone" between the inpatient bathroom and the bedroom with ligature resistant fixtures and features and select a bathroom door that aligns with the SRA requirements specific to a particular patient or groups of patients who may not be permitted access to the inpatient bathroom.

g. Locate staff support spaces such as janitor closets and soiled utility rooms, in an area that promotes access without having to enter secure patient areas. To enhance safety, provide self-closing and self-locking mechanisms on the doors of staff rooms that are directly accessible from the secure patient care area. Mount the closer on the staff side of the door. Provide tamper-resistant locksets and a vision panel in the door of electrical and communications rooms that are located in the secure patient area of an inpatient unit.

h. Orient and layout furniture and equipment in BH provider/counselor offices, group therapy rooms and other locations where staff and patients interact to provide a clear path of egress or an "escape corridor."

i. Locate two means of egress for each group therapy room (OPMH1), either on opposite ends or sides of the room.

j. Do not reduce the size of BH counseling rooms (OFDC1, OFDC2) from 120 NSF, as noted in DoD Space Planning Criteria Chapters 460 and 318.

A-5.1.4 Furniture, Fixtures and Artwork.

For the inpatient BH Unit, provide furniture and fixtures that have rounded edges and curves and meets or exceeds the requirements noted in the BHDG to maximize safety for patients, staff, and visitors. Minimize the amount of furniture in BH patient bedrooms and outfit with furniture that is heavily weighted or fixed to the floor, is non-breakable and contains no compartments for hiding. Utilize ligature resistant clothes hooks. Coordinate the placement of inpatient BH Unit furniture with the ceiling plan to avoid patients gaining access to ceiling fixtures or ligature points. Select artwork for all BH settings that is soothing and provides a connection to nature. Avoid abstract artwork or finishes that produce animated or other illusions. The DoD Project Sponsor will define specific inpatient BH Unit requirements for location of artwork as well as provide instructions for mounting and hanging of artwork to avoid ligature risks or detachment from the wall. Provide wall mural artwork in BH patient bedrooms, and elsewhere in the BH setting to minimize safety risks. Shower curtains are prohibited in inpatient bathrooms. Provide cabinet and drawer locks for all areas where patients may be unsupervised for even short durations as identified in the Functional Program and the SRA.

A-5.1.5 Finishes.

Incorporate colors, textures and surfaces that are soothing, do not produce a harsh glare, shiny surface, or distorted reflections, and provide a connection to nature. Construct wall and other room finish materials to resist intentional damage or removal. For the Inpatient BH setting incorporate wall and ceiling finishes that are abrasion and indention resistant; wood veneer products that have a natural finish and meet or exceed the latest ANSI/HPVA HP-1 tolerance standards. For other specific finishes, provide products that meet or exceed the minimum requirements as noted in the BHDG.

A-5.1.6 Walls.

For inpatient BH settings, construct wall assemblies with impact and abrasion resistant gypsum board. Utilize heavier construction materials, as recommended by the safety guidelines in the BHDG, for the inpatient BH Unit seclusion room(s) and Emergency Department secure holding room(s). Wall cove base used for inpatient BH Units should be cut into short lengths not to exceed 14 in (360 mm). Secure the base along the edge with pick resistant caulk to prevent tampering or hiding contraband. Do not use metal trim wall cove base. Do not use wall cove base in seclusion or secure hold rooms; extend wall gypsum to the floor and finish with pick resistant caulk.

Construct outdoor areas dedicated to the inpatient BH unit with smooth wall surfaces that have no grooves or crevices to prevent climbing, and are ligature-resistant. Wall height must be a minimum of 14 ft (4.27 m) above the outdoor finished floor area.

A-5.1.7 Ceilings.

Apply the Appendix B requirements specified for ceiling type and height to all room codes noted in the project specific Program for Design (PFD). Where hard ceilings are specified for the inpatient BH setting per the Functional Program and SRA, provide impact resistant gypsum board with key lockable access panels that comply with the BHDG. Where lay-in ceilings are permitted, provide security clips to restrict access to ligature points in the space above the drop ceiling. The installation of motion sensors above lay-in ceilings to alert staff to patient tampering is not a mandatory safety measure and should only be used where required by the project SRA. Coordinate the location of ceiling fixtures such as overhead lights, sprinklers, and registers on an inpatient BH Unit with room furniture plans and the safety guidelines in the current BHDG. Ensure furniture cannot be moved, stacked, or climbed upon to access any ceiling fixtures or materials. Wherever devices and accessories (for example lights, air grilles, access panels, toilet accessories, etc.) are mounted on the ceiling or wall and they do not fit securely, finish the edges or flanges with pick resistant caulk to fill the gaps.

A-5.1.8 Floors.

Apply the Appendix B requirements specified for flooring material to all BH room codes in both inpatient and outpatient settings. Minimize joints and seams to the furthest extent possible in all BH rooms outfitted with tile or sheeting to enhance safety.

A-5.1.9 Doors.

Apply requirements for door locking, latching, and access control arrangements (for example fail-safe electronic locks and fail-secure electronic locks) in accordance with Chapter 5 and UFC 3-600-01. Wherever a BH inpatient crosses the threshold of a door, utilize ligature resistant hardware. Design a sally port at the primary entry to the inpatient BH Unit that locks and unlocks in sequence to optimize access control. Apply the requirements for sequential locking to a sally port at any secondary entries. Where patient bedroom doors require locking, provide ligature resistant “classroom” type door locks. All inpatient BH Unit doors and hardware, including, but not limited to, hinges and handles, must comply with the requirements in the current BHDG. Identify which doors on the inpatient BH Unit require risk-mitigation devices installed to decrease the risk that the top of a corridor door will be used as a ligature point; and which doors require barricade risk mitigation strategies such as outward swinging doors; double-acting doors; a door in a door; an unequal pair of double egress doors, or an additional door with outward swing. Provide additional risk mitigation strategies, such as appropriate rounding and monitoring by staff, or requiring that doors be left open during certain hours. All solid doors installed in a BH setting will be outward swinging or utilize rescue hardware that provides double acting, continuous pivot hinges.

Reevaluate inpatient BH Unit door types and hardware requirements as needed, and document in the Functional Program and SRA prior to finalizing the contract documents.

A-5.1.10 Windows and Glazing.

Glazing thickness will be calculated by the manufacturer. Laminated glazing is the preferred alternative to glass-clad polycarbonate glazing.

A-5.1.10.1 Interior windows.

Install impact-resistant glass products in all patient accessible areas inclusive of interior window surfaces in all inpatient BH Units. Impact-resistant glass products are recommended for outpatient facilities in areas where patients may be left unattended. Test interior windows in accordance with American Architectural Manufacturers Association AAMA 501.8-13: Standard Test Method for Determination of Resistance to Human Impact of Window Systems Intended for Use in Psychiatric Applications.

A-5.1.10.2 Exterior Windows.

Install impact-resistant glass products on the interior face of exterior windows where the window sill is 6 ft 6 in. (1961 mm) or less. Design exterior windows to resist impact loads of 2000 ft-lb (2712 N·m) applied from the inside. Where operable windows are used, also test hinges and locking devices. Install integral blinds and ligature resistant blind hardware for the exterior windows in BH patient bedrooms. For other inpatient BH areas or outpatient settings, install window roller shade treatments specifically manufactured for use in the BH setting that meet or exceed the current safety requirements of the BHDG.

A-5.1.11 Mechanical HVAC.

HVAC Air Diffusion Devices (for example grilles, registers, etc.): Install tamper and ligature resistant air diffusion devices in accordance with the current BHDG. Where perforated diffusion devices are required, perforations must be a maximum of 3/16 in. (5 mm).

A-5.1.11.1 Thermostats.

Install thermostats in accordance with the current BHDG.

A-5.1.11.2 CO2 sensors.

CO2 sensors may not currently be available in a ligature resistant style and should only be installed where permitted by the project SRA. CO2 sensors may be installed within ducts.

A-5.1.12 Plumbing.

Install ligature resistant plumbing fixtures in inpatient BH settings; include floor mounted toilets with back water supply constructed of high impact resistant materials that promote a residential versus institutional setting. Shut-off valves and cleanouts for fixtures in BH patient bedrooms must be directly accessible from the corridor. Install

tamper / vandal resistant drains in all inpatient bathrooms, toilet/showers, kitchenettes, and laundry rooms. Install a floor drain for each shower and a second floor drain for the bathroom area. Select drain types (standard round or trench drains) that are tamper and ligature resistant and that minimize opportunities for intentional blockage. At locations where inpatients will be unsupervised during showering, install a “timing” system that has a re-set capability to limit the length of time that shower water may continuously flow.

A-5.1.13 Electrical.

Install electrical power outlets in all areas of the inpatient BH setting that are tamper / vandal resistant and GFCI. Install in inpatient BH settings electrical switches and outlets made of polycarbonate material that are affixed with tamper / vandal resistant screws to reduce the risk of exposing the wiring. The Functional Program and SRA should indicate if outlets will be installed in the BH Unit patient bedrooms and toilet/showers. Wherever outlets are installed in these inpatient rooms, they must have a dedicated circuit. Do not install outlets in the BH Unit seclusion room(s) or the ED secure holding room(s). In the outpatient setting, install tamper resistant outlets.

A-5.1.14 Lighting.

Identify the use of, and placement of table lamps for the outpatient setting in the Functional Program and SRA. Do not outfit the secure area of inpatient BH Unit with table lamps. Install tamper / vandal resistant and ligature resistant light fixtures with impact resistant lenses in the inpatient BH setting. Install light fixtures in all inpatient BH areas, including corridors, counseling, interview, activity, patient bedrooms, and all areas not under direct observation by staff, including blind spots and areas not under video surveillance. In the BH patient bedroom, install a tamper/vandal resistant, ligature resistant night light that is situated close to floor level to light the path of travel from the patient bed into the patient bathroom. Activation of the night light will be by room lighting level and by a switch exterior to the patient bedroom. Install interior lights in painted hollow metal frames with laminated glazing in inpatient BH settings. Calculate the glazing thickness and the size of the glazing stop based on the size of the light. Secure the glazing stops with tamper /vandal resistant screws to secure the glazing stops. The Functional Program to identify all BH rooms that require dimming beyond those that are already required to have dimming capability per Appendix B. Install impact and tamper / vandal resistant device plates (switches, receptacles, covers) secured with tamper resistant fasteners all areas where BH light fixtures are required per the Functional Program and SRA. Securely mount and fasten emergency exit signs to walls with tamper-resistant screws. Do not mount emergency exit signs to ceilings.

A-5.1.15 Communication.

A-5.1.15.1 Audio/Visual.

At the primary entry to a BH Unit, install an audio/visual communications system that will connect this entrance to the staff /nurse station, or another location as directed in the Functional Program, to provide call-to-enter capability.

A-5.1.15.2 Nurse Call.

Install Nurse Call push buttons in BH patient bedrooms and the associated bedroom toilet area and the shower, and in patient toilets in all BH settings. Pull cords are prohibited. On the inpatient BH Unit, install ceiling mounted speakers and microphones to facilitate the staff call-back function. Do not install a dome light over the inpatient toilet/shower door. Install a Nurse Call override switch outside each BH Unit bedroom and seclusion room, and each ED secure holding room.

A-5.1.15.3 Behavioral Health Staff Assist Alarm System.

Install a standalone BHSA Alarm system in all BH settings that complies with the DHA Performance Standard 28-26-36. The BHSA Alarm system is a component of the Electronic Security system and is categorized as Personal Property according to Section 6 of MIL-STD-1691. The BHSA Alarm system is independent of the Nurse Call system, the Intrusion Detection system, and the Duress Alarm system. Additionally, DO NOT connect the BHSA Alarm system to the facility local area network (LAN) or the wireless local area network (WLAN). Incorporate wireless BHSA alarm pendants to be worn by the staff, and wall mounted wireless or wired devices. The Functional Program and the SRA to indicate the locations of the wall mounted devices, to include specific rooms, corridors, and areas throughout the BH setting. Install ligature resistant wall mounted devices adjacent to the door inside an enclosed room. Transmit all BHSA Alarm device signals to the same annunciator station located at the reception point, nurse station, or other location identified in the Functional Program. When a signal is activated, an alarm tone will sound, and a graphical display at the BHSA alarm annunciator station will indicate the signal origination point, and the location of the staff member sending the alarm. The wireless pendant must comply with the DHA Performance Standard 28-26-36. The location feature will be deactivated when the staff member is outside of the BHSA alarm zone. The components of the BHSA Alarm system provide an opportunity for BH staff to be “first” responders and intervene in situations that do not require assistance from the facility security office or the Installation Provost Marshall. If a situation escalates and an emergency arises, the Duress Alarm system will be activated.

A-5.1.15.4 Wi-Fi Transmitters.

Install recessed, ligature resistant ceiling mounted Wi-Fi transmitters with a break-away feature to support the wireless IT system and the BHSA Alarm system.

A-5.1.15.5 Duress Alarm System.

Install a Duress Alarm system that allows staff to immediately activate a Duress Alarm button or equivalent in the event that a situation requires an elevated level of response from either the Facility Security office or Installation security. Integrate communication capabilities between the Duress Alarm system and other entities on the Installation as determined by the Functional Program and the SRA. Install wiring, conduit, power supply, buttons, and other appurtenances to support the Duress Alarm system at each Duress Alarm annunciator station. Install Duress Alarm buttons in areas where staff are present at all times; for inpatient BH Units, this is the staff / nurse station, and for outpatient BH settings it is the reception desk.

A-5.1.16 Video Surveillance System.

For inpatient BH units, install Video Surveillance System (VSS) cameras at locations determined by the DoD Project Sponsor, and identified in the Functional Program. Install VSS cameras that capture video monitoring only; no audio recording function is permitted for BH settings. Install monitoring stations on the inpatient BH Unit and at a central security location in the inpatient MTF, as directed in the Functional Program. As a minimum, install cameras in locations to assist with supervision of the admissions / triage area, group activity areas, corridors, entrances, fire exits, staff / nurse station(s), exercise areas (interior and exterior), and patient laundry. DO NOT install VSS cameras in BH patient bedrooms; however, they may be installed in the seclusion room(s) on the BH Unit or in the secure holding room(s) in the ED. Cameras must be tamper /vandal resistant and they may be unique for the BH Unit or ED BH spaces rather than integrated with the MTF security system. Install ligature resistant, wall or ceiling mounted VSS cameras mounted with tamper resistant fasteners. Install camera cases and lenses that are impact resistant or shatter proof.

A-5.1.17 Televisions.

Do not install Televisions (TVs) in BH patient bedrooms. Locate TVs in other spaces for inpatient and outpatient settings as reflected in the project's PRC. Install wall mounted TVs that meet or exceed the current safety requirements noted in the BHDG.

A-5.1.18 Security.

In accordance with the Functional Program and SRA, install a small safe in a secured location close to, but outside, the primary entrance of the inpatient BH Unit to allow security personnel to stow side arms prior to entering the Unit. Remote release of BH Unit entry doors is prohibited. For inpatient BH settings, provide the following minimum security requirements: control of corridor lighting including motion detectors, securing of patient bedroom doors, notification of patient bedroom door switch position to staff / nurse station, incorporation of a sally port at the secondary BH Unit entrance(s), VSS monitoring activated by motion detectors, and Electronic Security System access control at entrances/exits (interior and exterior), staff-only spaces, stairwells, etc. For outpatient settings, install as part of the Electronic Security System, electronic access

control from reception/waiting to treatment areas and from the treatment areas to any back-of-house corridors. For outpatient BH settings, provide VSS cameras associated with the duress alarm button located at reception.

A-5.1.19 Fire Protection and Life Safety.

See Chapter 14 for additional requirements. Design specific fire protection and life safety features to support the BH environment (for example eliminating strobes or fire alarms from Child Observation, Group Therapy, and other rooms where these devices may lead to panic, or trigger undue stress in BH patients).

A-6 EQUIPMENT SPECIFICATIONS.

Specify equipment requirements that meet or exceed the standards as noted in the current BHDG. Vendors will often use the terms “tamper-proof”, “tamper-resistant”, “vandal proof”, and “institutional,” and apply them arbitrarily. Closely examine the specifications and equipment submittals provided by both the construction contractor and for initial outfitting purchases to ensure they meet the requirements of the BHDG, the Functional Program, and the SRA.

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APPENDIX B ARCHITECTURAL AND ENGINEERING DESIGN REQUIREMENTS

B-1 GENERAL.

Appendix B is a compilation of mandatory architectural and engineering design criteria organized by standard Room Codes. The Design and Construction Agent, in conjunction with the DoD Project Sponsor, may provide additional criteria to meet special needs, for example, bariatric design, demountable partitions, contingency facilities. The Room Codes used to organize this appendix are the same as the codes used to organize the PFD and the Equipment List so that the initial design requirements should be well established for the A/E. For Room Codes that are used but are not included in Table B-1, the room criteria must be obtained from the DoD Project Sponsor. A period (".") indicates that there is no specific requirement for this parameter or the parameter matches the ambient conditions.

B-2 LEGEND & NOTES.

B-2.1 Room Code.

Room identifier from DoD Space Planning Criteria. This five digit Code is the reference key that ties the criteria to the project PFD.

- * An asterisk (*) prior to the Room Code indicates that it is a new Room Code added since the previous UFC version.
- The letter "X" in the fifth digit indicates that the criteria applies to multiple spaces/room codes in accordance with PFD.

B-2.2 Room Function.

Room function from DoD Space Planning Criteria.

B-2.2.1 Code.

Category of Patient Care Space in accordance with NFPA 99. The listed code defines the category for the expected Patient Care Space function. The DoD Project Sponsor must define room function and reassess codes to be used for the specific project. The A/E must validate the room function and propose appropriate changes to a room category for Patient Care Spaces. The A/E will ensure the architectural and engineering criteria are appropriate for the code used. A waiver will be required for changes to room categories.

The categories of Patient Care Spaces are independent from and should not be confused with Building System Categories. Building System Categories must be as defined in NFPA 99.

1 Category 1 – Critical Care Space

2 Category 2 – General Care Space

3 Category 3 – Basic Care Space

4 Category 4 – Support Space

C Category to be determined by the DoD Project Sponsor

N Not applicable. This room is not intended for patient examination or treatment.

B-2.3 Space Parameter Notes.

For room codes that do not have Architectural and Engineering design parameters listed, utilize the following notes:

a. For this room code, utilize the Architectural and Engineering parameters of the room where this area is located unless otherwise directed by the DoD Project Sponsor.

b. This new room code is under development. Architectural and Engineering parameters must be provided by the Design and Construction Agent and DoD Project Sponsor.

c. Provide emergency power for selected electrical receptacles.

d. Provide essential power only as required by the DoD Project Sponsor for selected equipment connections.

e. Provide dedicated exhaust for this area.

f. Provide minimum of 700 lux for this area.

B-3 ARCHITECTURAL.

B-3.1 Materials and Finishes.

FL Floor and base finishes. See Architectural Note 1.

<u>Poured flooring finishes</u>

AR Acrylic resin system with integral coved base. See Architectural Note 9.

ER Poured epoxy resin system with integral coved base. Includes epoxy terrazzo flooring systems. See Architectural Note 9.

PR Poured resin flooring– either AR or ER, consistent in rooms with the same room code.

PS Poured specialty flooring with integral base.

<u>Tile flooring finishes</u>

CP Carpet Tile with rubber base. See Architectural Note 2 and 12.

CT Ceramic or Porcelain tile with ceramic/porcelain tile base.

LV Luxury vinyl tile with rubber base. See Architectural Note 2.

RT Rubber tile with rubber base.

SD Static Dissipative Tile with rubber base.

UT User specific tile: For projects where Navy provides the facility maintenance, use LV. Otherwise, use LV or RT with Design and Construction Agent approval after coordination with the DoD Project Sponsor.

Sheet flooring finishes

SM Sheet material: either SR or SV, consistent in rooms with the same room code. For projects where Navy provides the facility maintenance, use SV.

SR Sheet rubber with integral rubber base. **\1** See architectural note 6. **/1/**

SV Sheet vinyl with integral vinyl base. See Architectural Note 3.

US User specific sheet: For projects where Navy provides the facility maintenance, use SV. Otherwise, use SR.

Other flooring finishes

CS Concrete sealer. Resilient base on gypsum wallboard and plaster walls. No base on concrete or block walls.

MA Match finishes of the adjacent area where this space is located.

PF Prefabricated.

SF Safety Flooring with rubber base or integral base for wet areas.

SP Special. Determined by the Design and Construction Agent in coordination with the DoD Project Sponsor. Describe specific finish requirements in the final RFP for DB projects or by the 35% design submittal for DBB projects.

WL Wall Material & Finish. First character is wall material. Second and third characters are finish. See Architectural Note 1.

Wall Material (first character)

C Concrete.

B Concrete block or clay tile.

G Gypsum wallboard. See Architectural Note 4.

L Lead lined gypsum wallboard. See Architectural Note 11.

S Special. Determined by the Design and Construction Agent in coordination with the DoD Project Sponsor.

Wall finish material (second and third characters)

AT Acoustical wall treatment, such as fabric, panels, or alternate material on painted finish.

CS Concrete sealer.

CT Ceramic or Porcelain tile.

LG Liquid Glaze Coat. See Architectural Note 5.

PF Prefabricated.

PT Paint.

EL Epoxy coating, seamless, lead lined.

EP Epoxy coating, seamless.

SP Special. Determined by the Design and Construction Agent in coordination with the DoD Project Sponsor.

SS Solid surface material wall cladding. See Architectural Note 13.

CLG Ceiling Material and Finish. See Architectural Note 1. First character is ceiling material. Second and third characters are finish.

Ceiling material (first character)

A Acoustic ceiling tile.

C Concrete.

E No ceiling required, exposed to floor/roof above.

G Gypsum wallboard.

S Special. Determined by the Design and Construction Agent in coordination with the DoD Project Sponsor.

Ceiling Finish Material (Second and third characters)

CS Concrete sealer.

LG Liquid Glaze Coat.

PF Prefabricated.

PT Paint.

SP Special. Determined by the Design and Construction Agent in coordination with the DoD Project Sponsor.

EP Epoxy coating, seamless, with coved corners.

T1 Standard finish.

T2 Waterproof finish.

XP No ceiling or finish required, exposed to floor/roof above.

B-3.2 CEILING HEIGHT.

CLG HT Ceiling height in feet and inches (millimeters), unless noted otherwise.

A 10 ft (3050 mm) minimum.

B If ceiling is provided, 10 ft (3050 mm) minimum.

C No ceiling required, exposed to floor/roof above.

D 9 ft (2750 mm) minimum or as required to accommodate equipment usage.

VAR Varies (Designer's choice).

B-3.3 DOOR SIZE.

DR SIZE Door width in feet and inches (millimeters), unless noted otherwise.

A Pair 30 in. (760 mm) doors

B Pair 36 in. (915 mm) doors

C { not used }

D Double doors, uneven: 48 in. (1220 mm) and 18 in. (460 mm)

E Pair 36 in. (915 mm) doors or 48 in. (1220 mm) doors as directed by the DoD Project Sponsor.

F { not used }

G In clinics, provide 42 in. (1672 mm) doors
In hospitals, provide uneven double doors, 42 in. (1672 mm) and 18 in. (459 mm)

H Pair 48 in. (1220 mm) doors, 8 ft - 6 in. (2591 mm) breakaway glass doors, or uneven double doors (48 in. (1220 mm) and 18 in. (458 mm)) as directed by the DoD Project Sponsor.

I 10 ft (3050 mm) by 10 ft (3050 mm) minimum. Number as required by dock.

J Main OR door, pair 36 in. (915 mm) doors. Staff door from clean corridor, 48 in. (1220 mm) door. Door to sub-sterile, 42 in. (1220 mm) door.

K Main OR door, pair 36 in. (915 mm) doors or 48 in. (1220 mm) and 18 in. (458 mm) uneven doors or 42. in (1672 mm) and 18 in. (458 mm) uneven doors as directed by the DoD Project Sponsor. Staff door from clean corridor, 48 in. (1220 mm) door. Door to sub-sterile, 42in. (1672 mm) door.

L Open (no door).

M Open (no door) or 36 in. (915 mm) door as directed by the DoD Project Sponsor.

N Open (no door) or 48 in. (1220 mm) door as directed by the DoD Project Sponsor.

O Open (no door) unless directed otherwise by the DoD Project Sponsor.

P Open (no door). Provide cubicle curtain only at entrance to cubicle and minimum 48 in. (1220 mm) door into area where the cubicles are located.

Q Open (no door). Provide cubicle curtain only at entrance to cubicle and minimum 48 in. (1220 mm) door into area where the cubicles are located.

SP Special. Determined by the Design and Construction Agent in coordination with the DoD Project Sponsor.

VAR Varies (Designer's choice).

VET Special door in veterinary facility. See Architectural Note 10.

B-3.4 NOISE.

NC The first line indicates the allowable range (minimum to maximum) noise coefficient (NC) required in the room. See Architectural Note 7.

STC The second line indicates the composite Sound Transmission Class (STC) required. See Architectural Note 8.

SP Special requirements. Determined by the Design and Construction Agent in coordination with the DoD Project Sponsor.

STC 50* An asterisk after the 50 designates that the STC requirement is 50 for all facilities except those where Navy provides facility maintenance, in which case the STC requirement is 40.

B-4 ARCHITECTURAL NOTES.

1. When two finishes are appropriate for a room, provide the preferred finish (1st line) shown in Table B-1, unless the Design and Construction Agent selects the alternate finish (2nd line) after coordinating with the DoD Project Sponsor. Provide the finishes shown in Appendix B used unless otherwise coordinated and approved by the DoD Project Sponsor and directed by the Design and Construction Agent.

2. Rubber Base. Rubber coved base for use with resilient tile and carpet. Coved base must terminate and butt at the face return of steel door jambs. Fire-retardant wood blocking or metal runners must be provided at the steel stud base channel runner for all gypsum board corridor walls.

3. Sheet Vinyl. Solid, seamless vinyl in roll format with routed, welded, grooved seams where melted vinyl is used for an impervious, waterproof seal. Chemical sealants are unacceptable. Cushioned sheet vinyl may not be used. Provide seamless sheet vinyl base integral with the flooring, using the same joint sealing application technique of grooved, melted, welded, vinyl, for an impervious waterproof seal.

4. Gypsum wallboard. Minimum 5/8 in. (15.9 mm). Ensure that the proper gypsum wallboard product used is appropriate for the application (wet areas, fire resistance, damp conditions, radiation protection, etc.). Utilize lead lined gypsum board where lead lined walls are determined to be required, reference Architectural Note 11.

5. Liquid Glaze Coat (LGC). This coating is a seamless, sprayed-on, lusterless, semi-gloss, two-component, polyester epoxy or polyurethane finish. As an alternative, water-based epoxy with semi-gloss finish may be used. In humid climates, avoid the use of LGC on interior surface of exterior wall.

6. Sheet Rubber. Solid, seamless rubber in roll format with routed, welded, grooved seams where melted rubber is used for an impervious, waterproof seal. Provide seamless sheet rubber base integral with the flooring, using the same joint sealing application technique of grooved, melted, welded, rubber for an impervious waterproof seal. Sheet rubber flooring requires heat and chemical welds for a proper installation (chemical welds for vertical seams and sanitary wall base applications). Provide thickness of sheet rubber flooring as required for the space or application, with a minimum thickness of 1/8 in. (3.0 mm).

7. The acoustical noise level range in the room is the design value for the NC-level for the background (ambient) noise level.

8. The STC specifies the performance of the room enclosure in isolating against airborne sound. The wall partition/ceiling system, including penetrations, must be designed to this composite value. This design value is generally considered as a minimum rating. For corridor walls that contain a door, window, or other penetration, a composite STC 35 may be used, unless the room has special acoustical privacy concerns as determined by the DoD Project Sponsor. The composite STC rating is the calculated value that considers the STC rating and the area percentages of the individual wall, door, and other components. Maintain the specified STC for common walls with public spaces, service areas, and rooms with higher STC requirements.

9. Provide non-slip finishes in corridors and all areas where pedestrian traffic is anticipated. Provide smooth finish where greater degree of cleanability is required (under cage racks, for example).

10. Provide vermin-proof hollow metal doors, 48 x 96 in (1220 x 2440 mm), with 12 x 12 in (305 x 305 mm) red glass vision panel and recessed hardware. Provide door seals. Do not provide door lock.

11. A health physicist must determine the required degree of protection to minimize exposure to primary and secondary radiation, as required to achieve compliance with NCRP Report No. 147. Shielding must be designed by the health physicist. Due to the intended use, rooms BMCW2, XDR01 and XDRF1 require a minimum of 1/16-inch thick lead shielding, or more if so determined by the health physicist. Rooms requiring shielding must be certified in accordance with NCRP Report No. 102 and the MilDep qualified expert.

12. Carpet Tile must meet TARR (Texture Appearance Retention Rating) classification ratings based on location areas where it is being used. Reference the Carpet and Rug Institute (CRI) Fact Sheet for more information.

Space Definition	Traffic Classification	TARR Classification
Chapel, Staff sleeping & watch areas	Moderate	≥ 2.5 TARR
Training Rooms, Conference, Private Offices, Classrooms, Consultation Rooms, Libraries, Lounges	Heavy	≥ 3.0 TARR
Open Office, Cafeteria, Corridors, Lobbies, Clinical Waiting Areas (outpatient/pharmacy/ancillary zones), Entrance Areas, Playrooms-OB/GYN-Peds Clinics,	Severe	≥ 3.5 TARR

13. Solid surface material wall cladding. Minimum ¼ in (6.4 mm) thickness and full height wall application. Follow manufacturer's recommended installation methods for seaming and for properly integrating wall cladding with flooring materials and ceilings.

B-5 STRUCTURAL.

Minimum uniformly distributed live load in psf (kpa), unless noted otherwise.

A Design for minimum of actual wheel loads or 150 psf (7.2 kpa).

B Design for minimum actual equipment loads or 150 psf (7.2 kpa).

C Design for minimum actual equipment loads or 100 psf (4.8 kpa).

D Design for minimum actual weight of shelves plus 3.1 lb/filling inch (55 kg/filling meter) or 150 psf (7.2 ka).

E Floor loading is being reviewed. Obtain required floor loading from the Design and Construction Agent.

F Reference UFC 3-301-01 for floor loading requirements.

B-6 ELECTRICAL.

B-6.1 LIGHTING.

LEV Maintained lighting level in lux with permanently installed building fixtures. Where multi-level lighting levels are indicated, provide multi-level switching for fluorescent fixtures and full range dimming for LED fixtures with conventional on/off switching unless otherwise noted. The first line is the general lighting level and the second line is the task illumination level provided by permanently installed building light fixtures. These lighting levels are in addition to supplemental lighting provided with furniture or equipment. However, the DoD Project Sponsor may direct that the task lighting be provided with the office furniture in administrative areas, except for dual purpose clinical/administrative rooms, rather than permanently installed light fixtures.

N Lighting Notes.

A Provide full range dimming in room.

B Provide recessed ceiling exam fixture that provides required task illumination on bed or patient area controlled at the headwall.

C { not used }

D Provide sealed and gasketed recessed troffers, suitable for use in operating rooms. Those fixtures that have battery backup must have full illumination when energized by battery or uninterruptable power supply (UPS).

E Explosion Proof design typically required.

F Provide lighting control at individual task location in lieu of multi-level switching.

G Provide Safelight for film processing as required by Equipment List.

H Provide full range dimming at task location.

I Provide recessed ceiling mounted task illumination with full range dimming.

J Ceiling mounted lights must be switch controlled to achieve 50 percent and 100 percent illumination levels.

K Provide Violet Fraction of the light source between 4% and 6%. Reference Chapter 11.

B-6.2 ESSENTIAL POWER.

ES PWR Essential power required in room. Provide additional essential power as required by NFPA 99.

PW Approximate percentage of general power outlets on essential system or note as listed below.

R Selected receptacles (not less than 50 percent of the receptacles).

R1 One receptacle per bed.

RA All receptacles.

RC Dedicated receptacles for critical care (reference NFPA 70, Article 517).

LT Approximate percentage of lighting on essential system or note as listed below.

L Task Lighting.

LB Task Lighting, General Illumination, and battery powered lighting. Reference Chapter 11.

LG General Illumination.

LS Task Lighting and Selected General Illumination identified and coordinated with the DoD Project Sponsor.

N Essential Power notes.

E Selected equipment connections.

U Provide essential power only as required by the DoD Project Sponsor.

S Special (Non-standard areas).

B-7 MEDICAL GASES.

The number of outlets/inlets required for each gas type is listed in the appropriate column. The number of outlets/inlets must be increased as required to support the equipment listed in the PRC.

MA Medical Compressed Air

DA Dental Compressed Air

LA Laboratory Compressed Air

PA Process Compressed Air

MV Medical Vacuum

DSV Dental Surgical Vacuum

OE Oral Evacuation

LDE Laboratory Dust Evacuation

O Oxygen

NO Nitrous Oxide

CO2 Carbon Dioxide

IA Instrument Compressed Air

WAGD Waste Anesthetic Gas Disposal

N See Medical Gas Notes.

B-7.1 MEDICAL GAS NOTES.

N Notes

A. Each patient is provided with the number of outlet(s) listed.

Each patient is provided medical vacuum inlet(s). See individual listing.

Each patient is provided access to a medical air outlet. Where two patients share a common wall, they may share a single outlet, excluding behavioral health patients. Do not provide in pediatric play area.

B. The medical gases specified must be per patient station, workstation, etc.

C. Coordinate with the DoD Project Sponsor for location of outlets/inlets.

D. All anesthetizing locations must have a WAGD system. Use of medical vacuum system is not recommended for evacuation in DoD facilities. DSV may be used in DTRs for anesthesia scavenging where a central system is installed.

E. One each O, MA, and MV is required at the headwall unit and the infant resuscitation area of the birthing room.

F. { not used }

G. The medical gases specified must be per bassinet or infant station.

H. The medical gases specified must be per 4 bassinets or infant stations. Where the LDR birthing room concept is used, a minimum of one grouping must be provided in each LDR.

I. For equipment testing and calibration, equipment must be tested with the specific gas used in normal operation.

J. Provide valve regulator station for PA. **\1**

K. Locate 1 DA and 1 OE at each 12 o'clock column and each DTR chair as called out in the PRC. **/1/**

L. A natural gas outlet (mounted under counter) and a LA outlet (mounted under counter) must be provided at each dental work station as shown in Table B-1.

M. All contingency beds require 1 O, 1 MV, and 1 MA per bed station. In bed expansion situations in "peace time" facilities also provide 1 O, 1 MV, and 1 MA per contingency bed expansion requirements noted in the PFD.

B-8 HVAC.

BL Air Balance

++ Room exhaust, return, or both, is 20 percent less than supply*

\+ Room exhaust, return, or both, is 10 percent less than supply

nr No requirement. Room exhaust, return, or both, may equal supply **\1**

\- **/1/** Room exhaust, return, or both, is 10 percent more than supply

\- - Room exhaust, return, or both, is 20 percent more than supply*

EX Room exhausted. If supply is provided, exhaust room Air Change must be in addition to the amount of supply provided.

R Letter "r" indicates the HVAC Notes provide the required air balance

*Note: for "++" and "- -"spaces, the required differential pressurization is 0.02 inch water column, reference paragraph 10-7.5. Utilize the 20 percent offset as a baseline and adjust air flows and/or increase room integrity as required in order to achieve the required pressure differential.

AC Air Change is the minimum total air changes per hour (AC/H) required to meet ventilation requirements. These rates are considered the minimum required for normal health and comfort consideration. Additional air may be required for temperature, dilution, and odor control, as well as air requirements for such items as hoods, glove boxes, clean air stations, combustion equipment, and dust collectors.

- A Letter "a" indicates that the total air changes must be based on calculations.
- r Letter "r" indicates the HVAC Notes provide the required minimum air change.

OA Outdoor Air is the minimum outdoor air changes per hour required to meet ventilation requirements.

- A Letter "a" Indicates that the outdoor air changes are to be based on ANSI/ASHRAE 62.1.

TEMP Interior design temperature in degrees Fahrenheit (degrees Celsius) for cooling and heating load calculations. When cooling is required during winter, such as in interior zones, temperature listed under summer conditions should be used.

- SM Design temperature for summer months.
- WN Design temperature for the space during heating season.
- * Summer Design Temperature must be 15 ^{o}F (8.3 ^{o}C) less than 1 percent Outside Design Temperature but must not be less than 75 ^{o}F (23.9 ^{o}C) or greater than 78 ^{o}F (25.6 ^{o}C) unless otherwise noted.
- R Design must accommodate a variable (to user) temperature range of 68–75 ^{o}F (20.0–23.9 ^{o}C).
- SP Special. Determined by the Design and Construction Agent.

RH Relative Humidity. This is the relative humidity to be maintained in a space as part of the designed conditions. Relative humidity range is 30–60 percent unless noted otherwise.

- Y Provide relative humidity range of 30-60 percent

R Provide a user adjustable humidistat in the space, accommodating a variable humidity range of 30-60 percent

S Maintain relative humidity of 20-60 percent. Design to provide minimum 30% RH

T Maintain relative humidity of 55 percent, +/-5 percent.

FL Filtration indicates the level and location of filtration required. See HVAC Note B.

IN. Intermediate filtration in MERV.

FN. Final filtration in MERV.

Hepa HEPA filter required.

r Letter “r” indicates that the HVAC Notes provide the required filtration.

EX Exhaust.

Y Indicates room air to be exhausted, not recirculated.

R See HVAC Notes.

B-8.1 HVAC Notes.

N Notes.

A. Nursery Isolation Room relative pressurization requirements may vary among individual facilities, depending upon functional requirements. A/Es must coordinate with the DoD Project Sponsor for each facility to determine whether disease isolation (negative pressurization) or protective isolation (positive pressurization) is required.

B. General Filtration. Filter efficiencies noted here are in accordance with the Minimum Efficiency Reporting Value (MERV) ratings of ANSI/ASHRAE Standard 52.2. Filters with a MERV rating of 8 must be provided for all outdoor air. These filters must be located upstream of air-conditioning equipment. Intermediate Filters indicated in column “IN” must be located downstream of the supply fan. Final filters indicated in column “FN” must be located at air outlets or in close proximity to outlets (coordinate with the DoD Project Sponsor). All filters should be installed to prevent leakage between the filter segments and between the filter and its supporting frame.

C. During periods of non-use, the air volume may be reduced to 6 air changes per hour, while maintaining the required air balance.

D. When the DoD Project Sponsor intends the routine usage of nitrous oxide in the DTR, routine being defined as exceeding 5 hours per week, this criteria must apply:

- DTR room air changes must be not less than 12 total AC/H.
- The room must be totally exhausted.
- Provide a minimum of one low-level exhaust register, sized to remove a minimum of 20 percent of the total room exhaust volume.
- During period of non-use, air change rate may be reduced to 3 total AC/H.

E. General, Isolation Rooms. For Airborne Infection Isolation Bedrooms, bedroom to be negative to anteroom, anteroom to be negative to corridor. For Protective Environment Bedrooms, bedroom to be positive to anteroom, anteroom to be positive to corridor.

F. Minimum air change and pressure relationship is based on this room supporting both bronchoscopy and endoscopy procedures. If the facility CONOPS specifically states that this room is intended to provide both proctoscopy and endoscopy procedures, the minimum air change required is 10 AC/H and room exhaust is 10% more than the room supply. If the facility CONOPS specifically states that this room is intended to provide endoscopy procedures only, the minimum air change required is 6 AC/H and room exhaust is 10 percent more than the room supply.

G. Design in accordance with NFPA 99.

H. May require vehicle exhaust, carbon monoxide (CO) detection.

I. Same as Note D, except the following:

- During period of non-use, air change rate may be reduced to 5 total AC.
- Positive pressurization must be maintained.

J. For projects incorporating brace/appliance fitting or shop applications, evaluate room and equipment exhaust requirements for removal of toxic or flammable fumes and dust.

K. Consult manufacturer recommendations for temperature requirements for electrical/electronic equipment. In humid climates, fan rooms must not be ventilated with unconditioned outdoor air.

L. Up to 50 percent of supply air may be air that is transferred from administrative areas of the building.

M. Provide exhaust or fume hoods, and localized exhaust.

N. Verify computer heat load requirement.

O. Provide adjustable (to user) humidistat within the room.

P. Provide adjustable (to user) thermostat within the room.

Q. HEPA filtration of room exhaust is required unless an exhaust reentrainment analysis (wind tunnel or computational fluid dynamics modelling) demonstrates sufficient separation from public areas (for example sidewalks), building openings (for example windows, doors) and outdoor air intakes. Exhaust of tuberculosis (TB) isolation room, toilet, and anteroom to be by dedicated exhaust system, in other words exhaust system serving only TB isolation room(s). Isolation room pressure to remain constant—not switchable from Disease Isolation mode to Protective Isolation mode, or vice versa.

R. Consult with the Design and Construction Agent and DoD Project Sponsor to determine if compliance with USP 797 and/or USP 800 is required. If compliance is required, design in accordance with the applicable USP(s). Reference paragraph 10-16.11. If compliance is not required, then provide an air balance of “++”, a minimum of 4 air changes per hour, minimum MERV 13 intermediate filtration and room air can be recirculated.

S. Provide emergency, pediatric, and radiology waiting rooms with 20% more exhaust than supply, 12 air changes, 2 outdoor air changes, and exhaust these rooms directly to the outside, independent from other exhausts. If the space is an enclosed room with a door, meet the requirements for a “room with critical pressurization” per paragraph 10-7.5. For all other waiting areas there is no requirement for pressure balance, provide 6 air changes, 1 outdoor air change, and the space may be recirculated.

T. Provide a minimum of one low-level exhaust register, sized to remove a minimum of 20 percent of the total room exhaust volume.

U. Comply with UFC 4-010-01 requirements for mail room and loading dock ventilation.

V. Provide ability for user to select temperature and humidity in the ranges specified. Once set, the temperature must not deviate from setpoint by more than 1 ^{o}F (0.6 ^{o}C) within a 10 minute period and the RH must not deviate from setpoint by more that 2 percent RH per 10 minute period. The temperature and RH must be maintained at all times (24/7/365). Also provide a fluorine gas detection system, alarms, and emergency exhaust system with low level exhaust inlets to evacuate the room in the event of a fluorine gas leak.

W. Design in accordance with the applicable USP 797 and/or USP 800. Reference paragraph 10-16.11.

X. Provide exhaust canopies near all steam utilizing equipment loading and unloading doors.

Table B-1 Architectural and Engineering Design Criteria

\3\\2\

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES POWER PWR	LT	N	MEDICAL GAS AND VACUUM MA	DA	LA	PA	MV	DSV	OE	LD	EO	NO	IA	WAD	N	MECHANICAL TEMP BL	AC	OA	SM	WN	RH	IN	FN	EX	N	/2/
ANCW1	Anesthesia, Clean Workroom	4	US	GLG	AT2	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	700	.	R	L	.	1	.	.	.	1	.	.	.	1	1	.	1	D	-	4	1.5	75 (23.9)	68 (20.0)	Y	14	.	Y	.	
ANSW1	Anesthesia, Soiled Workroom	4	US	GLG	AT2	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	300	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	75 (23.9)	68 (20.0)	Y	14	.	Y	.	
APAM1	Appliance, Adjust / Modify	4	PR CS	GPT	AT1	8'-0" (2440)	48" (1220)	30-45 STC 40	C	500	.	R	.	.	.	.	1	1	.	.	.	1	.	.	.	.	J	nr	6	1.5	*	70 (21.1)	Y	13	.	.	J,M	
APFB1	Appliance, Brace Shop	4	PR CS	GPT	AT2 AT1	8'-0" (2440)	48" (1220)	30-80 STC 40	100 (4.8)	500	.	.	.	.	.	.	1	1	.	.	.	1	.	.	.	.	J	nr	6	1.5	*	70 (21.1)	Y	13	.	.	J,M	
APFR1	Appliance, Fitting Room	4	PR CS	GPT	AT1	8'-0" (2440)	36" (915)	30-45 STC 40	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	1.5	*	70 (21.1)	Y	13	.	.	J,M	
APLA1	Appliance, Lamination / Molding	4	PR CS	GPT	AT1	8'-0" (2440)	48" (1220)	30-45 STC 40	C	500	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	J	-	6	1.5	*	70 (21.1)	Y	13	.	Y	J,M	
APMS1	Appliance, Machine Shop	4	PR CS	GPT	AT2 AT1	8'-6" (2590)	48" (1220)	30-60 STC 40	D	500	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	J	-	6	1.5	*	70 (21.1)	Y	13	.	Y	J,M	
APSH1	Appliance, Sewing / Shoe Shop	4	PR CS	GPT	AT1	8'-6" (2590)	48" (1220)	30-60 STC 40	C	500	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	J	-	6	1.5	*	70 (21.1)	Y	13	.	Y	J,M	
APWA1	Appliance, Welding Area	4	CS PR	GPT	AT2 AT1	8'-6" (2590)	48" (1220)	30-45 STC 40	D	500	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	-	6	1.5	*	70 (21.1)	Y	13	.	Y	J,M	
AUD01	Auditorium	N	CP	SSP	SSP	VAR	B	25-35 STC 50	100 (4.8)	300 500	A,H	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.	
AVB01	Projection Booth	N	SP	SPF	SPF	VAR	36" (915)	25-35 STC 50	60 (2.9)	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.	
BF000	Banking Facility (equipped by others)	N	SP	GPT GAT	AT1	8'-6" (2590)	A	35-45 STC 40	60 (2.9)	500 1100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.	
BF001	ATM Alcove (equipped by others)	Space Parameter Notes: a and c								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
BHVS1	Behavioral Health, Vestibule, Inpatient	4	US UT	GPT	AT2 AT1	8'-6" (2590)	G	30-40 STC 45	60 (2.9)	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.	
BLND1	Special Needs Vendor Area (equipped by others)	N	SP	SSP GPT	SSP AT1	VAR	36" (915)	35-45 STC 45	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	1	*	68 (20.0)	Y	13	.	.	.	
BMCW1	Biomedical, Common Work Area	4	US	GPT GLG	AT1	8'-6" (2590)	48" (1220)	35-45 STC 40	C	500	.	.	.	.	1	.	.	.	1	.	.	.	1	.	1	.	D	nr	4	1	*	68 (20.0)	Y	13	.	.	M	
BMCW2	Biomedical Work Area, All-Inclusive	4	US	GPT GLG	AT1	8'-6" (2590)	48" (1220)	35-45 STC 40	C	500	.	.	.	.	1	.	.	.	1	.	.	.	1	.	1	.	D	nr	4	1	*	68 (20.0)	Y	13	.	.	M	
BMER1	Biomedical, Electronic Repair	4	US	GLG GPT	AT1	8'-6" (2590)	48" (1220)	35-45 STC 40	C	1100	.	.	.	.	1	.	.	.	1	.	.	.	1	.	1	.	D	-	4	1	*	68 (20.0)	Y	13	.	.	M	
BMER2	Biomedical, Mobile Imaging Equipment Repair	4	US UT	LLG LPT	AT1	8'-6" (2590)	48" (1220)	35-45 STC 40	C	1100	.	.	.	.	1	.	.	.	1	.	.	.	1	.	1	.	D	nr	4	1	*	68 (20.0)	Y	13	.	.	M	
BMRA1	Biomedical, Receiving Area	4	US UT	GPT GLG	AT1	8'-6" (2590)	48" (1220)	35-45 STC 40	60 (2.9)	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.	
BMWS1	Biomedical, Workstation	4	US UT	GPT GLG	AT1	8'-6" (2590)	48" (1220)	35-45 STC 40	60 (2.9)	1100	.	.	.	.	1	.	.	.	1	.	.	.	1	.	1	.	D	nr	4	1	*	68 (20.0)	Y	13	.	.	M	
BRAR1	Anteroom, Airborne Infection Isolation	4	US	GPT GLG	GPT GLG	8'-6" (2590)	48" (1220)	30-40 STC 45	60 (2.9)	300	.	.	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	75 (23.9)	75 (23.9)	Y	14	.	Y	E,Q	
BRAR2	Anteroom, Protective Environment	4	US	GPT GLG	GPT GLG	8'-6" (2590)	48" (1220)	30-40 STC 45	60 (2.9)	300	.	.	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	10	2	75 (23.9)	75 (23.9)	Y	14	hepa	.	E	
BRIC1	Bedroom, ICU / CCU	1	US	GPT GLG	AT2 AT1	8'-6" (2590)	H	30-40 STC 45	60 (2.9)	300 1100	B	RC	L	.	1	.	.	.	6	.	.	.	3	.	.	.	.	+	6	2	75 (23.9)	75 (23.9)	T	14	.	.	P	

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES PWR	POWER LT	N	MEDICAL GAS AND VACUUM MA	DA	LA	PA	MV	DSV	OE	LDE	OO	NA	IA	WAD	N	MECHANICAL BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
BRII1	Bedroom, ICU / CCU, Airborne Infection Isolation	2	US	GPT GLG	GPT GLG	8'-6'' (2590)	H	30-40 STC 45	60 (2.9)	300 1100	B	RC	L	.	1	.	.	.	6	.	.	.	3	.	.	.	.	- -	12	2	75 (23.9)	75 (23.9)	T	14	.	Y	E,P,Q
BRII2	Bedroom, ICU / CCU, Protective Environment	1	US	GPT GLG	GPT GLG	8'-6'' (2590)	H	30-40 STC 45	60 (2.9)	300 1100	B	RC	L	.	1	.	.	.	6	.	.	.	3	.	.	.	.	++	12	2	75 (23.9)	75 (23.9)	T	14	hepa	.	E,P
BRIT1	Bedroom, Airborne Infection Isolation	2	US	GPT GLG	GPT GLG	8'-6'' (2590)	48'' (1220)	30-40 STC 45	60 (2.9)	300 1100	B	RC	L	.	1	.	.	.	2	.	.	.	2	.	.	.	.	- -	12	2	75 (23.9)	75 (23.9)	Y	14	.	Y	E,P,Q
BRIT2	Bedroom, Protective Environment	2	US	GPT GLG	GPT GLG	8'-6'' (2590)	48'' (1220)	30-40 STC 45	60 (2.9)	300 1100	B	RC	L	.	1	.	.	.	2	.	.	.	2	.	.	.	.	++	12	2	75 (23.9)	75 (23.9)	Y	14	hepa	.	E,P
BRMS1	Bedroom, Medical / Surgical	2	US UT	GPT	AT1	8'-6'' (2590)	48'' (1220)	30-40 STC 45	60 (2.9)	300 1100	B	RC	L	.	1	.	.	.	2	.	.	.	2	.	.	.	A,M	nr	4	2	75 (23.9)	75 (23.9)	Y	14	.	.	P
BRNP1	Bedroom, Behavioral Health	3	US PR	GPT	GPT	8'-6'' (2590)	48'' (1220)	30-40 STC 45	60 (2.9)	100 300	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
BRNP2	Bedroom, Behavioral Health, 2 Beds	3	US PR	GPT	GPT	8'-6'' (2590)	48'' (1220)	30-40 STC 45	60 (2.9)	100 300	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
BRNP5	Bedroom, Behavioral Health, Seclusion	3	US	GPT	GPT	9'-0'' (2740)	48'' (1220)	30-40 STC 45	60 (2.9)	100 300	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
BRNP6	Anteroom, Behavioral Health, Seclusion	3	US	GPT	GPT AT1	9'-0'' (2740)	48'' (1220)	30-40 STC 45	60 (2.9)	300 .	.	.	LG	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
BRUN1	Bedroom, Acuity Adaptable	1	SM UT	GPT GLG	AT2 AT1	8'-6'' (2590)	H	30-40 STC 45	60 (2.9)	300 1100	B	RC	L	.	1	.	.	.	6	.	.	.	3	.	.	.	A	+	6	2	75 (23.9)	75 (23.9)	T	14	.	.	P
BSL03	Lab, Clinical, Biosafety Level 3	Space Parameter Notes: b								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
BX000	Exchange, Retail (equipped by others)	N	SP LV	GPT	AT1	8'-6'' (2590)	48'' (1220)	35-45 STC 45	60 (2.9)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	75 (23.9)	75 (23.9)	Y	13	.	.	.
BX001	Exchange, Vending (equipped by others)	N	SP LV	GPT	AT1	8'-6'' (2590)	48'' (1220)	35-45 STC 50	C	150 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	.	.	Y	13	.	.	.
CASH1	Cashier	N	SP	GPT	AT1	8'-0'' (2440)	M	30-40 STC 50	60 (2.9)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	.	.
CASH2	Cashier Station, Food Service	Space Parameter Notes: a and c								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CHC01	Cart Holding, Clean	4	UT	GPT	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 40	100 (4.8)	50 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	70 (21.1)	Y	14	.	.	.
CHS01	Cart Holding, Soiled	4	UT	GLG	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 40	100 (4.8)	50 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	70 (21.1)	Y	13	.	Y	.
CLR01	Classroom, Table / Chair	N	CP	GPT GAT	AT1	8'-6'' (2590)	36'' (915)	25-35 STC 45	60 (2.9)	700 .	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	.	.
CLR02	Classroom, Writing Arm Chairs	N	CP	GPT GAT	AT1	8'-6'' (2590)	36'' (915)	25-35 STC 45	60 (2.9)	700 .	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	.	.
CLR03	Classroom, Computer Training	N	CP	GPT GAT	AT1	8'-6'' (2590)	36'' (915)	25-35 STC 45	60 (2.9)	700 .	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	.	N
CLR04	Classroom, Bedroom Mock-Up	N	UT	GPT GAT	AT1	8'-6'' (2590)	48'' (1220)	25-35 STC 45	60 (2.9)	100 300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	.	.
CLR06	Simulation Control Room	4	US UT	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.
CLR07	Classroom, Simulation Lab, Multifunction	N	UT US	GPT GAT	AT1	8'-6'' (2590)	48'' (1220)	25-35 STC 45	100 (4.8)	700 .	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	.	.
CLR08	Classroom, Practical Training	N	UT US	GPT GAT	AT1	8'-6'' (2590)	48'' (1220)	25-35 STC 45	60 (2.9)	700 .	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	ARCHITECTURAL							STRUCTURAL	ELECTRICAL					MEDICAL GAS AND VACUUM												MECHANICAL											
		CODE	MATL & FIN			CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES PWR	POWER LT	N	MA	DA	LA	PA	MV	DSV	OE	LDE	O	NO	IA	WAGD	N	BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
			FL	WL	CLG																																
CLSC1	Kiosk, Patient	Space Parameter Notes: a																																			
CLSC2	Cubicle, Patient Education	Space Parameter Notes: a																																			
CLSC3	Patient Education	N	CP UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 50	60 (2.9)	500	A																	a	a	*	70 (21.1)	Y	13				
CMP01	Server Room	N	CS SD	GPT	AT1	10'-0" (3050)	36" (915)	30-40 STC 50	C	500		R		U													+	4	1	68 (20.0)	68 (20.0)	Y	13			N	
CMP03	Computer, Archive Storage	4	CS SD	GPT	AT1	10'-0" (3050)	36" (915)	30-40 STC 50	D	500				U													+	4	1	68 (20.0)	68 (20.0)	Y	13			N	
CMP04	Communications, Server Support Equipment	4	CS SD	GPT	EXP AT1	B	36" (915)	30-40 STC 50*	C	500		R		U													+	4	1	*	68 (20.0)	Y	13			N	
COM02	Communications, Ambulance Dispatch	4	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	200			L	E													nr	4	1	*	70 (21.1)	Y	13				
COM03	Communications, Security, Central Alarm	4	UT	GPT	AT1	8'-0" (2440)	36" (915)	25-35 STC 40	60 (2.9)	200		R	L														nr	4	1	*	70 (21.1)	Y	13				
COM04	Communications, Radio Equipment	4	CS	GPT	EXP	C	36" (915)	25-45 STC 40	C	500		R	LS														+	1		*	68 (20.0)	Y	13			N	
COMC1	Communications Room	4	CS	GPT	EXP	C	36" (915)	25-45 STC 40	B	500		R	LS														+	1		*	68 (20.0)	Y	13			N	
COMC2	Communications, Service Entrance Facility	4	CS	GPT	EXP	C	36" (915)	25-45 STC 40	C	500		R	LS														+	1		*	68 (20.0)	Y	13			N	
CRA01	Conference Room, Small	N	CP UT	GPT SSP	AT1	8'-6" (2590)	36" (915)	25-35 STC 45	60 (2.9)	300																	nr	a	a	*	70 (21.1)	Y	13			P	
CRA02	Conference Room, Medium	N	CP UT	GPT SSP	AT1	8'-6" (2590)	36" (915)	25-35 STC 45	60 (2.9)	300																	nr	a	a	*	70 (21.1)	Y	13			P	
CRA03	Conference Room, Large	N	CP UT	GPT SSP	AT1	8'-6" (2590)	36" (915)	25-35 STC 45	60 (2.9)	300 700																	nr	a	a	*	70 (21.1)	Y	13			P	
CRC01	Conference Room, Commanders	N	CP	GPT SSP	AT1	8'-6" (2590)	36" (915)	25-35 STC 45	60 (2.9)	300																	nr	a	a	*	70 (21.1)	Y	13			P	
CROP1	Conference Room, Emergency Operations	4	SP CP	GPT SSP	AT1	8'-6" (2590)	36" (915)	25-35 STC 45	60 (2.9)	300 700			L	U													nr	a	a	*	70 (21.1)	Y	13			P	
CRR01	Conference Room, Radiology	N	CP UT	GPT SSP	AT1	8'-6" (2590)	36" (915)	25-35 STC 45	60 (2.9)	500	A																nr	a	a	*	70 (21.1)	Y	13			P	
CSCQ1	Central Sterile, Clean Cart, Queuing	4	PR US	GLG	GLG	9'-0" (2740)	48" (1220)	30-50 STC 40	100 (4.8)	50																	+	6	2	*	68 (20.0)	Y	14				
CSCR1	Central Sterile, Soiled Cart, Receiving	4	PR US	GLG	GLG	9'-0" (2740)	48" (1220)	30-50 STC 40	100 (4.8)	100																	-	6	2	*	68 (20.0)	Y	13		Y		
CSDE1	Central Sterile, Decontamination, Small	4	PR US	GLG	GLG	9'-0" (2740)	48" (1220)	30-50 STC 40	100 (4.8)	700			LS	U											1		-	10	2	73 (22.8)	68 (20.0)	Y	14		Y		
CSDE2	Central Sterile, Decontamination, Medium	4	PR US	GLG	GLG	9'-0" (2740)	48" (1220)	30-50 STC 40	100 (4.8)	700			LS	U											1		-	10	2	73 (22.8)	68 (20.0)	Y	14		Y		
CSDE3	Central Sterile, Decontamination, Large	4	PR US	GLG	GLG	9'-0" (2740)	48" (1220)	30-50 STC 40	100 (4.8)	700			LS	U											1		-	10	2	73 (22.8)	68 (20.0)	Y	14		Y		
CSIA1	Central Sterile, Assembly, Small	4	PR US	GLG GPT	GLG AT2	9'-0" (2740)	48" (1220)	30-50 STC 40	100 (4.8)	700 1100				U				1							1		+	6	2	73 (22.8)	68 (20.0)	Y	14				
CSIA2	Central Sterile, Assembly, Medium	4	PR US	GLG GPT	GLG AT2	9'-0" (2740)	48" (1220)	30-50 STC 40	100 (4.8)	700 1100				U				1							1		+	6	2	73 (22.8)	68 (20.0)	Y	14				

Table B-1 (cont.) Architectural and Engineering Design Criteria

			ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM												MECHANICAL											
Room Code	ROOM FUNCTION	CODE	MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES	POWER PWR	LT	N	MA	DA	LA	PA	MV	DSV	OVE	LDE	NOO	NIA	WAGD	N	BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
CSIA3	Central Sterile, Assembly, Large	4	PR US	GLG GPT	GLG AT2	9'-0'' (2740)	48'' (1220)	30-50 STC 40	100 (4.8)	700 1100	.	.	.	U		.	.	.	.	1	.	.	.	.	1	.	.	+	6	2	73 (22.8)	68 (20.0)	Y	14	.	.	.
CSSS1	Central Sterile, Sterilization Equipment, Small	4	PR US	GLG	EXP	C	36'' (915)	30-50 STC 40	100 (4.8)	700 1100	.	.	.	U		.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	73 (22.8)	68 (20.0)	Y	14	.	Y	M
CSSS2	Central Sterile, Sterilization Equipment, Medium	4	PR US	GLG	EXP	C	36'' (915)	30-50 STC 40	100 (4.8)	700 1100	.	.	.	U		.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	73 (22.8)	68 (20.0)	Y	14	.	Y	M
CSSS3	Central Sterile, Sterilization Equipment, Large	4	PR US	GLG	EXP	C	36'' (915)	30-50 STC 40	100 (4.8)	700 1100	.	.	.	U		.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	73 (22.8)	68 (20.0)	Y	14	.	Y	M
CSSS4	Clinic Sterilization Room, Ophthalmological Instrument	4	PR US	GLG	GLG	9'-0'' (2740)	48'' (1220)	30-50 STC 40	100 (4.8)	700 1100	.	.	.	U		.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	*	68 (20.0)	Y	14	.	Y	M
CSWS1	Central Sterile, Scope / Wash	4	PR US	GLG	GLG AT2	9'-0'' (2740)	48'' (1220)	30-50 STC 40	100 (4.8)	700 .	.	.	.	U		.	.	.	.	1	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	14	.	Y	M
CWSH1	Cart Wash, Manual (Steam Gun)	4	PR SF	GCT SSS	GLG	9'-0'' (2740)	48'' (1220)	30-50 STC 40	100 (4.8)	300 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	14	.	Y	M
CWSH2	Cart Wash, Automated (Washer)	4	PR SF	GCT SPF	GCT SPF	9'-0'' (2740)	48'' (1220)	30-50 STC 40	C	300 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	14	.	Y	M
DAYR1	Dayroom	3	SM 0	GPT	AT1 GPT	9'-0'' (2740)	48'' (1220)	30-40 STC 40	60 (2.9)	150 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
DNMS1	Dental, Model Storage	4	US UT	GLG GPT	AT1	8'-6'' (2590)	36'' (915)	30-50 STC 50	60 (2.9)	700 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
DNPB1	Dental, Prosthodontic / Orthodontic, Laboratory	4	US UT	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-45 STC 40	60 (2.9)	700 1100	K	.	.	U		.	1	.	.	.	.	.	1	.	.	.	B,L	-	6	2	*	68 (20.0)	Y	13	.	Y	M
DNPC1	Dental, Porcelain / Ceramics, Small	4	PR 0	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-45 STC 50	60 (2.9)	700 1100	K	.	.	U		.	1	.	.	.	.	.	1	.	.	.	B,L	+	10	2.5	*	68 (20.0)	Y	13	.	Y	M
DNPC2	Dental, Porcelain / Ceramics, Medium	4	PR 0	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 1100	K	.	.	U		.	1	.	.	.	.	.	1	.	.	.	B,L	+	10	2.5	*	68 (20.0)	Y	13	.	Y	M
DNPC3	Dental, Porcelain / Ceramics, Large	4	PR 0	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 1100	K	.	.	U		.	1	.	.	.	.	.	1	.	.	.	B,L	+	10	2.5	*	68 (20.0)	Y	13	.	Y	M
DNPL1	Dental, Prosthodontic Laboratory, Small	4	US UT	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 1100	K	.	.	U		.	1	.	.	.	.	.	1	.	.	.	B,L	-	10	2.5	*	68 (20.0)	Y	13	.	Y	M
DNPL2	Dental, Prosthodontic Laboratory, Medium	4	US UT	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 1100	K	.	.	U		.	1	.	.	.	.	.	1	.	.	.	B,L	-	10	2.5	*	68 (20.0)	Y	13	.	Y	M
DNPL3	Dental, Prosthodontic Laboratory, Large	4	US UT	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 1100	K	.	.	U		.	1	.	.	.	.	.	1	.	.	.	B,L	-	10	2.5	*	68 (20.0)	Y	13	.	Y	M
DNSC1	Dental, Instrument Decontamination, Small	4	PR US	GLG	GLG AT2	8'-6'' (2590)	36'' (915)	30-45 STC 40	60 (2.9)	700 .	.	.	.	U		.	1	.	.	.	.	.	.	.	.	.	B	- -	10	2	73 (22.8)	68 (20.0)	Y	14	.	Y	.
DNSC2	Dental, Instrument Sterilization, Small	4	PR US	GLG	GLG AT2	8'-6'' (2590)	36'' (915)	30-45 STC 40	60 (2.9)	700 .	.	.	.	U		.	1	.	.	.	.	.	.	.	.	.	B	++	6	2	73 (22.8)	68 (20.0)	Y	14	.	.	X
DNSC3	Dental, Instrument Storage, Small	4	PR US	GLG	GLG AT2	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	++	6	2	75 (23.9)	68 (20.0)	Y	13	.	.	X
DNSC4	Dental, Instrument Decontamination, Medium	4	PR US	GLG	GLG AT2	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 .	.	.	.	U		.	1	.	.	.	.	.	.	.	.	.	B	- -	10	2	73 (22.8)	68 (20.0)	Y	13	.	Y	.
DNSC5	Dental, Instrument Sterilization, Medium	4	PR US	GLG	GLG AT2	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 .	.	.	.	U		.	1	.	.	.	.	.	.	.	.	.	B	++	6	2	73 (22.8)	68 (20.0)	Y	13	.	.	X
DNSC6	Dental, Instrument Storage, Medium	4	PR US	GLG	GLG AT2	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	++	6	2	75 (23.9)	68 (20.0)	Y	13	.	.	X
DNSC7	Dental, Instrument Decontamination, Large	4	PR US	GLG	GLG AT2	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 .	.	.	.	U		.	1	.	.	.	.	.	.	.	.	.	B	- -	10	2	73 (22.8)	68 (20.0)	Y	13	.	Y	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES PWR	POWER LT	N	MEDICAL GAS AND VACUUM MA	DA	LA	PA	MV	DSV	OE	LDE	OO	NO	IA	WAD	N	MECHANICAL BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
DNSC8	Dental, Instrument Sterilization, Large	4	PR US	GLG	GLG AT2	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 .	.	.	.	U	.	1	.	.	.	.	.	.	.	.	.	.	B	++	6	2	73 (22.8)	68 (20.0)	Y	13	.	.	X
DNSC9	Dental, Instrument Storage, Large	4	PR US	GLG	GLG AT2	8'-6'' (2590)	36'' (915)	30-50 STC 40	60 (2.9)	700 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	++	6	2	75 (23.9)	68 (20.0)	Y	13	.	.	X
DNSS1	Dental, Support, Substerile	4	US	GLG	AT2 AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	500 .	.	.	.	.	. \1\	1	.	.	.	1	.	.	.	.	.	.	B	nr	6	2	*	68 (20.0)	Y	13	.	.	.
DNTB1	Dental Treatment Room, Orthodontic	3	US	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	1600 .	A,K	.	.	U	.	1	.	.	.	1	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	.
DNTC1	Dental Treatment Room, Comprehensive	2	US	GLG	AT2 AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	2100 .	A,D,K	R	LB	U	. \2\	1	.	.	1	1	.	1	1	1	1	1	D	++	12	3	75 (23.9)	68 (20.0)	Y	14	.	.	I
DNTE1	Dental Treatment Room, Endodontic	3	US	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	1600 .	A,K	.	.	U	.	1	.	.	.	1	.	.	.	.	.	.	. /2/	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	I
DNTG1	Dental Treatment Room, General	3	US	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	1600 .	A,K	.	.	U	.	1	.	.	.	1	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	D
DNTG2	Dental Treatment Room, Oral Hygiene	3	US	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	1600 .	A,K	.	.	U	.	1	.	.	.	1	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	D
DNTG3	Dental Treatment Room, Two Chair	3	US	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	35-45 STC 40	60 (2.9)	1600 .	A,K	.	.	U	.	4	.	.	.	4	.	.	.	.	.	.	K	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	D
DNTG4	Dental Treatment Room, Multi-Chair	3	US	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	35-45 STC 40	60 (2.9)	1600 .	A,K	.	.	U	.	6	.	.	.	6	.	.	.	.	.	.	K	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	D
DNTP1	Dental Treatment Room, Prosthodontic	3	US	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	1600 .	A,K	.	.	U	.	1	1	.	.	1	.	.	.	.	.	.	L	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	D
DNTP2	Dental Treatment Room, Periodontic	2	US	GLG	AT2 AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	2100 .	A,D,K	R	LB	U	.	1	.	.	1	1	.	1	1	1	1	D /1/	++	12	3	68 (20.0)	75 (23.9)	Y	14	.	.	I
DNTR1	Dental, Recovery	3	US	GLG GPT	AT2 AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	300 .	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	.
DNTS1	Dental Treatment Room, Oral Surgery	2	US	GLG	GLG	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	2100 .	A,D,K	R	LB	U	.	2	.	.	1	2	.	1	1	1	1	D	++	12	3	68 (20.0)	78 (25.6)	Y	14	.	.	I
DNTS2	Dental Treatment Room, Oral Surgery Support	4	US	GLG GPT	AT2 AT1	8'-6'' (2590)	42'' (1065)	30-40 STC 40	60 (2.9)	700 .	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	.
DNTT1	Dental Treatment Room, Training	3	US	GLG GPT	AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	1600 .	A	.	.	U	.	2	.	.	.	2	.	.	.	.	.	.	K	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	D
DNXC1	Dental X-Ray, Cone Beam CT	3	UT US	LPT	AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	100 300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	.
DNXR1	Dental X-Ray, PACS	N	UT US	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	.
DNXS1	Dental X-Ray, Intraoral / Panoramic / Cephalometric	3	UT US	GPT	AT1	8'-6'' (2590)	36'' (915)	30-40 STC 40	60 (2.9)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	.
DOCK1	Loading Dock	N	CS PR	SSP	SSP EXP	VAR	I	. .	200 (9.6)	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	.	.	Y	.	.	.	.
DR001	Dressing Room / Cubicle	4	CP UT	GPT	AT1	8'-0'' (2440)	36'' (915)	25-40 STC 40	60 (2.9)	100 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
DUTY1	On-Call Room	N	CP UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 45	60 (2.9)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
EVPR1	Evoked Potential Response	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	100 (4.8)	500 .	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
EXB01	Exam, Bariatric	3	UT	GPT	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 50*	E	300 500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES	POWER PWR	LT	N	MEDICAL GAS AND VACUUM MA	DA	LA	PA	MV	DSV	OE	LDE	OO	NA	IA	WAGD	N	MECHANICAL BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
EXEB1	Exam / Treatment, Emergency Department, Bariatric	2	US UT	GLG GPT	GLG AT2	8'-0'' (2440)	H	30-40 STC 50*	E	500 1100	.	R	LB	.		1	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXEN1	Exam, ENT	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	1	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXEN2	Exam / Treatment, Emergency Department, ENT	2	US PR	GLG GPT	GLG AT2	8'-0'' (2440)	H	30-40 STC 50*	60 (2.9)	500 1100	.	R	LB	.		1	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXER1	Exam / Treatment, Emergency Room	2	US PR	GLG GPT	GLG AT2	8'-0'' (2440)	H	30-40 STC 50*	60 (2.9)	500 1100	.	R	LB	.		1	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXER2	Exam / Treatment, Emergency Department, Airborne Infection Isolation	2	US PR	GLG GPT	GLG GPT	8'-0'' (2440)	48'' (1220)	30-40 STC 50*	60 (2.9)	500 1100	.	R	LB	.		1	.	.	.	1	.	.	.	1	.	.	.	.	- -	12	2	*	73 (22.8)	Y	14	.	Y	Q
EXOS1	Exam, Speech-Language Pathology	3	CP	GAT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXP01	Exam, Podiatry	3	UT US	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXR10	Exam, Consult	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXR11	Alcove, Height / Weight	Space Parameter Notes: a								.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
EXRG1	Exam	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXRG4	Exam, Screening	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXRG5	Exam, Screening, Height/Weight, Alcove	Space Parameter Notes: a								.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
EXRG6	Exam, Airborne Infection Isolation	3	US PR	GLG GPT	GLG GPT	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	- -	12	2	*	73 (22.8)	Y	14	.	Y	Q
EXRG7	Exam, Protective Environment	3	US PR	GLG GPT	GLG GPT	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	++	12	2	*	73 (22.8)	Y	14	hepa	.	.
EXRG8	Exam, OB / GYN	3	UT LV	GPT	AT1	8'-0'' (2440)	42'' (1065)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXRG9	Exam, Forensics	3	US PR	GLG GPT	AT1	8'-0'' (2440)	42'' (1065)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXTH1	Exam, Telehealth	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXUD1	Exam, Urodynamics	3	US UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EXVE1	Exam, Vestibular	3	UT	GPT GAT	AT1	8'-0'' (2440)	36'' (915)	25-35 STC 50*	60 (2.9)	500 .	A	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
EYCL1	Eye, Contact Lens Fitting / Dispensing	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
EYCT1	Eye, Diagnostic, Optical Coherence Tomography	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	200 .	A	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
EYCT2	Eye, Procedure, Optical Coherence Tomography	2	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	200 .	A	R	L	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
EYEL1	Eye Lane	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	200 500	H	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
EYEL2	Eye Lane, Electronic	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	200 .	H	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

			ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM												MECHANICAL														
Room Code	ROOM FUNCTION	COD E	MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES	POWER PWR	LT	N	MA	DA	LA	PA	MV	DSV	OE	LDE	OO	NA	IA	WAD	N	BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
EYER1	Eye, Electroretinography	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	200 .	A	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	6	2	*	68 (20.0)	Y	14	.	.	.
EYFC1	Eye, Fundus Camera	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	200 .	A	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	6	2	*	68 (20.0)	Y	14	.	.	.
EYFD1	Eyeglass, Fitting and Dispensing	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	4	2	*	68 (20.0)	Y	14	.	.	.
EYOF1	Eye, Laboratory, Optical Fabrication	4	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	500 1000	F	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		-	6	2	*	68 (20.0)	Y	13	.	Y	M
EYOT2	Eye, Exam, Ophthalmology	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	200 500	A	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	6	2	*	68 (20.0)	Y	14	.	.	.
EYOT3	Eye, PRK / Lasik Evaluation	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	500 1100	A	R	LB	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	6	2	*	68 (20.0)	Y	14	.	.	.
EYVF1	Eye, Visual Field / Perimetry	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	200 .	A	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	6	2	*	68 (20.0)	Y	14	.	.	.
EYVS1	Eye, Vision Screening	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	500 .	F	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	6	2	*	68 (20.0)	Y	14	.	.	.
FILE1	File, General Use	N	UT CP	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	150 (7.2)	150 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	a	a	*	68 (20.0)	Y	13	.	.	.
FSBR1	Food Service, Bake and Roast Center	N	PS SF	GLG	GLG AT2	9'-0" (2740)	B	30-45 STC 50	F	700 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	10	2	*	68 (20.0)	Y	13	.	Y	M
FSCB1	Food Service, Carbonated Beverage	N	PS SF	GLG	GLG AT2	9'-0" (2740)	B	30-45 STC 50	F	200 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSCD1	Food Service, Cafeteria Dining Room	N	ER UT	GPT	AT1	9'-0" (2740)	B	30-45 STC 50	F	200 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	12	2	*	68 (20.0)	Y	13	.	.	.
FSCD2	Food Service, Executive Dining Area	N	CP LV	GPT	AT1	9'-0" (2740)	B	30-45 STC 50	F	200 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	12	2	*	68 (20.0)	Y	13	.	.	.
FSCN1	Food Service, Condiment Area	Space Parameter Notes: a								.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.
FSCS1	Food Service, Cart Storage	N	PS SF	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 40	F	200 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	4	2	*	68 (20.0)	Y	13	.	.	.
FSCS2	Food Service, Tray Retherm Cart Area, Centralized	Space Parameter Notes: a								.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.
FSDA1	Food Service, Dessert Assembly	N	PS SF	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 40	F	700 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSDS1	Food Service, Dish Storage Area	N	PS SF	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 40	F	200 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	4	2	*	68 (20.0)	Y	13	.	.	.
FSDW1	Food Service, Dish Washing	N	PS SF	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 50	F	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		-	10	2	*	68 (20.0)	Y	13	.	Y	M
FSDW2	Food Service, Dish / Tray Handling, Remote	N	PS SF	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 50	F	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		-	10	2	*	68 (20.0)	Y	13	.	Y	M
FSFC1	Food Service, Fry Center	N	PS SF	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 50	F	700 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		-	10	2	*	68 (20.0)	Y	13	.	Y	M
FSFPX	Food Preparation / Production Areas	N	PS SF	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 50	F	700 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		-	10	2	*	68 (20.0)	Y	13	.	Y	M
FSFV1	Food Service, Fresh Fruit / Vegetable	N	PS SF	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 50	F	700 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSGB1	Food Service, Grill and Broil Area	N	PS SF	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 50	F	700 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.		-	10	2	*	68 (20.0)	Y	13	.	Y	M

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	CODE	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES	POWER PWR	LT	N	MEDICAL GAS AND VACUUM MA	DA	LA	PA	MV	DSV	OE	LDE	OO	NA	IA	WAD	N	MECHANICAL TEMP BL	AC	OA	SM	WN	RH	IN	FN	EX	N
FSIR1	Food Service, Ingredient Room	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 40	F	150 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSMC1	Food Service, Mixing Center	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	700 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSMP1	Food Service, Meat Processing	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	700 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSNP1	Food Service, Nourishment Preparation Area	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSPP1	Food Service, Pastry Preparation	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	700 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSPT1	Food Service, Patient Tray Line	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	700 .	.	R	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSPT2	Food Service, Patient Tray Carousel	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	150 .	.	R	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	Y	.
FSPW1	Food Service, Pot Washing	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	M
FSRC1	Food Service, Rapid Chill / Freeze	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSRH1	Food Service, Clean Pots / Pans Holding Area	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSRT1	Food Service, Bulk Food Rethermalization	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSSA1	Food Service, Salad Assembly	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	700 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	.	.
FSSC1	Food Service, Steam Center	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	M
FSSLX	Food Service Servery Areas	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	12	2	*	68 (20.0)	Y	13	.	Y	.
FSSSX	Food Service Station Areas	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	12	2	*	68 (20.0)	Y	13	.	Y	M
FSTAX	Food Service, Tray Assembly Areas	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 50	F	700 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	.
FSTD1	Food Service, Therapeutic Diet Preparation	N	PS SF	GLG	GLG	9'-0'' (2740)	36'' (915)	30-40 STC 50	F	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	68 (20.0)	Y	13	.	Y	.
HAFR1	Hearing Aid Fitting	3	CP	GAT	AT1	8'-6'' (2590)	36'' (915)	20-25 STC 40	60 (2.9)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
HATL1	Hearing Aid Testing Lab / Shop	4	UT CS	GPT	AT1	8'-6'' (2590)	36'' (915)	25-35 STC 40	60 (2.9)	700 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
HYPR1	Hyperbaric Chamber	C	SP SP	SSP	SSP	VAR	VAR	SP	100 (4.8)	300 1100	B	RA	.	LB	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
ICE01	Alcove, Ice Machine	Space Parameter Notes: a, d, and e								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ICHT1	Alcove, Hydocollator	Space Parameter Notes: a								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
IPK01	Kitchenette	4	UT	GLG	GLG	VAR	36'' (915)	35-45 STC 50	150 (7.2)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	.
JANC1	Janitor Closet	N	CS CT	GLG GPT	GPT AT1	8'-0'' (2440)	36'' (915)	35-45 STC 40	100 (4.8)	50 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	.	.	.	Y	13	.	Y	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	CODE	ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM														MECHANICAL										
			MATL & FIN			CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES	POWER PWR	LT	N	MA	DA	LA	PA	MV	DSV	OE	LDE	O	N	OA	IA	WAGD	N	BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
			FL	WL	CLG																																	
KEY01	Key / Access Control	N	UT MA	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	500 .	.	.	.	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
LAC01	Lactation Room	3	UT SM	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 45	60 (2.9)	500 .	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
LAUN1	Laundry Room, Inpatient	N	UT	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 40	150 (7.2)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	.
LAUN2	Laundry Room, Inpatient, Behavioral Health	N	UT	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 40	150 (7.2)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	.
LBAL1	Laboratory, Automated, Small	4	US UT	GLG GPT	AT2	9'-0" (2740)	G	30-40 STC 40	100 (4.8)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBAL2	Laboratory, Automated, Medium	4	US UT	GLG GPT	AT2	9'-0" (2740)	G	30-40 STC 40	100 (4.8)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBAL3	Laboratory, Automated, Large	4	US UT	GLG GPT	AT2	9'-0" (2740)	G	30-40 STC 40	100 (4.8)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBAP1	Allergen Preparation	4	UT US	GLG GPT	AT2 AT1	9'-0" (2740)	36" (915)	30-40 STC 40	100 (4.8)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	14	14	.	M
LBAR1	Laboratory, Autopsy	4	ER	GLG	GLG	9'-0" (2740)	48" (1220)	30-50 STC 40	60 (2.9)	700 D 1600	D	.	.	.	.	.	.	2	.	2	.	.	.	.	.	.	.	.	.	-	-	12	3	R	R	Y	13	.	Y	M,T
LBBD1	Laboratory, Blood Donor Station	3	PR US	GLG GPT	AT2	8'-6" (2590)	48" (1220)	35-45 STC 40	60 (2.9)	750 .	.	.	LS	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	-	6	2	R	R	Y	14	.	.	.
LBBD2	Laboratory, Blood / Phoresis Processing	4	PR US	GLG GPT	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	.
LBBG2	Laboratory, Blood Gas	4	US	GLG GPT	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 . 1100	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	.
LBBP1	Laboratory, Body Preparation	4	ER	GLG	GLG	9'-0" (2740)	48" (1220)	30-50 STC 40	100 (4.8)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	R	R	Y	13	.	Y	M
LBBS1	Laboratory, Blood Shipping	4	US	GLG GPT	AT2	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	500 .	.	.	LS	E	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	.	M
LBBS2	Laboratory, Blood Shipping – Frozen Blood	4	PR US	GLG	AT2	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	500 . 1100	.	.	LS	E	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	.	M
LBBV1	Laboratory, Body Viewing	4	PR	GLG GPT	AT2	9'-0" (2740)	48" (1220)	30-40 STC 40	100 (4.8)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	12	3	R	R	Y	13	.	Y	M
LBCP1	Laboratory, Cytogenetics Preparation	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	500 . 1100	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBCR1	Laboratory, Cytogenetics Reading	4	UT	GPT	AT1	9'-0" (2740)	36" (915)	30-40 STC 40	100 (4.8)	500 .	A	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBDE1	Laboratory, Dermatology	4	UT US	GPT GLG	AT2	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	500 . 1100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	.	M
LBDR1	Laboratory, Decontamination	4	US UT	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	500 . 1100	.	R	L	.	.	.	.	.	1	.	.	.	1	.	1	.	B	.	.	-	10	2	R	R	Y	13	.	Y	M
LBDS1	Laboratory, Bone Dissection (ENT use)	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	500 . 1100	.	.	.	U	.	.	1	.	1	.	.	.	.	.	.	.	B	.	.	-	6	2	R	R	Y	13	.	Y	M
LBEM2	Laboratory, Electron Microscope	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 .	A	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	R	R	Y	13	.	.	.
LBEM3	Laboratory, Electron Microscope, Specimen Preparation	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 . 1100	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	R	R	Y	13	.	.	.
LBEN1	Laboratory, Entomology	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 . 1100	.	R	L	.	.	.	1	.	1	.	.	.	.	.	.	.	B	.	.	-	6	2	R	R	Y	13	.	Y	M

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	CODE	ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM														MECHANICAL									
			MATL & FIN			CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES PWR	POWER LT	N	MA	DA	LA	PA	MV	DSV	OE	LDE	O	NO	OA	IA	WAD	N	BL	TEMP AC	OA	SM	WN	RH	IN	FN	EX	N
			FL	WL	CLG																																
LBFC1	Laboratory, Flow Cytometer	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBGW1	Laboratory, Glassware Washing	4	US	GLG	GLG	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	200 .	.	.	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2.5	R	R	Y	13	.	Y	M
LBIH1	Laboratory, Industrial Hygiene	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	500 1100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBIR1	Laboratory, Incubation Room, Walk-In	4	SP	GLG	GLG	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	500 1100	.	.	LS	E	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBMH1	Laboratory, Multi-Head Microscope And Collaboration Room	4	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-50 STC 40	100 (4.8)	500 .	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	R	R	Y	13	.	.	.
LBMR1	Laboratory, Morgue Refrigerator	4	SP PR	GLG SPF	GLG SSP	9'-0" (2740)	SP	30-50 STC 40	C	150 .	.	.	LS	E	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	SP (SP)	SP (SP)	Y	13	.	Y	.
LBMR2	Laboratory, Morgue Refrigerator, Walk-In	4	SP PR	GLG	GLG	9'-0" (2740)	SP	30-50 STC 40	C	150 .	.	.	LS	E	.	.	.	.	.	.	.	.	.	.	.	.	.	-	.	2	SP (SP)	SP (SP)	Y	13	.	.	.
LBOB1	Laboratory, OB / GYN Clinic - Specimens	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBPC1	Laboratory, Point of Care	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	60 (2.9)	300 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	.
LBRB1	Laboratory, Research Biochemistry	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	.	LS	E	.	.	1	.	1	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LBRC1	Laboratory, Research Clean	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	.	LS	E	.	.	1	.	1	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	.	M
LBRC2	Laboratory, Research Containment	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	60 (2.9)	500 1100	.	.	LS	E	.	.	1	.	1	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LBRI1	Laboratory, Radioimmunoassay	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	.	LS	E	.	.	1	.	1	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	.	.
LBRP1	Laboratory, Radiation Protection	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	.	.
LBSC1	Laboratory, Small Clinic – Standard	4	SM	GLG	AT2	8'-0" (2440)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	.	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBSH1	Laboratory, Specimen Holding	4	SM	GLG SSP	GLG	9'-0" (2740)	36" (915)	30-45 STC 40	60 (2.9)	300 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	13	.	Y	M
LBSM1	Laboratory, Solution and Media Preparation	4	SM	GLG GPT	AT2 AT1	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 .	.	R	L	.	.	.	1	.	1	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	14	hepa	.	M
LBSP1	Laboratory, Satellite	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	300 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	.	.
LBSP2	Laboratory, Satellite, Operating Room	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	300 .	.	R	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	.
LBSSX	Laboratory, Shipping and Receiving Areas	4	SM	GPT	AT1	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	300 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	.	.
LBTS1	Laboratory, Tissue Storage	4	SM	GLG GPT	AT2 AT1	9'-0" (2740)	36" (915)	30-50 STC 40	100 (4.8)	300 .	.	.	LS	E	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	.	.
LBUL1	Laboratory, Ultra Low Temp Freezer	4	PF	SPF	SPF	9'-0" (2740)	36" (915)	.	100 (4.8)	200 .	.	.	LS	E	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	SP (SP)	SP (SP)	Y	13	.	.	.
LBUR1	Laboratory, Urology	4	SM	GEP GLG	AT2 AT1	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	Y	M
LBVP1	Laboratory, Venipuncture	3	SM 0	GLG GPT	AT2 AT1	9'-0" (2740)	42" (1065)	35-45 STC 40	100 (4.8)	700 1100	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	14	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES POWER PWR	LT	N	MEDICAL GAS AND VACUUM MA	DA	LA	PA	MV	DSV	OE	LD	NO	OO	NA	IA	WAGD	N	MECHANICAL TEMP BL	AC	OA	SM	WN	RH	IN	FN	EX	N
LBVP2	Laboratory, Venipuncture, Multi-Station	3	SM 0	GLG GPT	AT2 AT1	9'-0'' (2740)	42'' (1065)	35-45 STC 40	100 (4.8)	700 1100	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	14	.	.	.
LBWA1	Laboratory, Water	4	SM 0	GLG	AT2	9'-0'' (2740)	36'' (915)	30-50 STC 40	100 (4.8)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	R	R	Y	13	.	.	.
LCCL1	Linen Control, Clean	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-45 STC 40	150 (7.2)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	70 (21.1)	Y	14	.	.	.
LCCL2	Linen Room, Clean	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-45 STC 40	150 (7.2)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	70 (21.1)	Y	14	.	.	.
LCCL3	Linen Alcove, Clean	Space Parameter Notes: a								. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
LCCL4	Linen Room, Clean, Scrubs Distribution	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-45 STC 40	100 (4.8)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	70 (21.1)	Y	14	.	.	.
LCCL5	Linen, Medical Attire, Distribution Conveyor	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-45 STC 40	B	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	70 (21.1)	Y	14	.	.	.
LCFA1	Linen Control, Folding Area	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	150 (7.2)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	70 (21.1)	Y	14	.	.	.
LCSL1	Linen Control, Soiled	4	SM	GPT GLG	AT1	8'-0'' (2440)	36'' (915)	30-45 STC 40	100 (4.8)	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	.
LCSL2	Linen Room, Soiled	4	SM	GPT GLG	AT1	8'-0'' (2440)	36'' (915)	30-45 STC 40	100 (4.8)	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	.
LCSL3	Linen Alcove, Soiled	Space Parameter Notes: a								. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
LDAT1	Antepartum Testing	3	UT US	GLG GPT	AT1 AT2	9'-0'' (2740)	42'' (1065)	30-40 STC 45	60 (2.9)	500 1100	.	R	L	.	1	.	.	1	.	.	.	1	.	.	.	.	B	nr	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
LDAT2	Antepartum Testing, Multi-Station	3	UT US	GLG GPT	AT1 AT2	9'-0'' (2740)	42'' (1065)	30-40 STC 45	60 (2.9)	500 1100	.	R	L	.	1	.	.	1	.	.	.	1	.	.	.	.	B	nr	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
LDDR1	Operating Room, Labor and Delivery, C Section	1	PS ER	GSS GEP	GLG	10'-0'' (3050)	J	30-40 STC 45	60 (2.9)	2100 .	D,J	RA	LB	.	7	.	.	13	.	.	.	5	2	2	2	C,D	++	20	4	R	R	S	14	14	.	C,O,P
LDEP1	Labor and Delivery, Exam and Preparation	3	US UT	GLG	AT2	8'-0'' (2440)	48'' (1220)	30-40 STC 50*	60 (2.9)	500 1100	.	R	L	.	1	.	.	1	.	.	.	1	.	.	.	.	B	nr	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
LDPR1	Labor and Delivery, Infant Preparation Room	4	SM UT	GLG	AT1 AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	.
LDRP1	Labor and Delivery, LDR / LDRP	1	US SP	GLG SSP	AT2	9'-0'' (2740)	48'' (1220)	30-40 STC 45	60 (2.9)	300 2100	D,F	RA	LB	.	2	.	.	2	.	.	.	2	.	.	.	.	E	nr	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	P
LDRP3	Labor and Delivery, LDR / LDRP, Airborne Infection Isolation	1	US SP	GLG SSP	GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 45	60 (2.9)	300 2100	D,F	RA	LB	.	2	.	.	2	.	.	.	2	.	.	.	.	E	- -	12	2	75 (23.9)	75 (23.9)	Y	14	.	Y	E,P,Q
LIBB1	Library, Book / Periodical, Stacks	N	CP	GAT GPT	AT1	10'-0'' (3050)	L	20-30 STC 45	D	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
LIBD1	Library, Reference Desk	N	CP	GAT GPT	AT1	10'-0'' (3050)	36'' (915)	20-30 STC 45	100 (4.8)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
LIBV1	Library, Education / Resource	N	CP	GAT GPT	AT1	10'-0'' (3050)	36'' (915)	20-30 STC 45	150 (7.2)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
LIBW1	Library, Staff Workroom	N	CP UT	GPT GAT	AT1	9'-0'' (2740)	36'' (915)	20-30 STC 45	100 (4.8)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
LMAB1	Laboratory, Anaerobic Bacteria – TB	4	US	GLG	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	1	.	1	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMBB1	Laboratory, Blood Bank, Small	4	US	GLG	AT2	9'-0'' (2740)	42'' (1065)	30-45 STC 40	100 (4.8)	500 1100	.	.	LS	E	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	R	R	Y	13	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES	POWER PWR	LT	N	MEDICAL GAS AND VACUUM MA	DA	LA	PA	MV	DSV	OE	LD	EO	NO	IA	WAD	N	MECHANICAL TEMP BL	AC	OA	SM	WN	RH	IN	FN	EX	N
LMBB2	Laboratory, Blood Bank, Medium	4	US	GLG	AT2	9'-0" (2740)	42" (1065)	30-45 STC 40	C	500 1100	.	.		LS	E	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	R	R	Y	13	.	.	.
LMBB3	Laboratory, Blood Bank, Large	4	US	GLG	AT2	9'-0" (2740)	42" (1065)	30-45 STC 40	C	500 1100	.	.		LS	E	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	R	R	Y	13	.	.	.
LMCH2	Laboratory, Chemistry, Small	4	US	GLG	AT2	9'-0" (2740)	G	30-45 STC 40	100 (4.8)	500 1100	.	R		L	.	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMCH3	Laboratory, Chemistry, Medium	4	US	GLG	AT2	9'-0" (2740)	G	30-45 STC 40	100 (4.8)	500 1100	.	R		L	.	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMCH4	Laboratory, Chemistry, Large	4	US	GLG	AT2	9'-0" (2740)	G	30-45 STC 40	100 (4.8)	500 1100	.	R		L	.	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMCY1	Laboratory, Cytology, Small	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	.	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMCY2	Laboratory, Cytology, Medium	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	.	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMCY3	Laboratory, Cytology, Large	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	.	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMHC1	Laboratory, Histopathology, Medium	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMHC2	Laboratory, Histopathology, Large	4	US	GLG	AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMHI2	Laboratory, Hematology, Small	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMHI3	Laboratory, Hematology, Medium	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMHI4	Laboratory, Hematology, Large	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMHS1	Laboratory, Histology, Medium	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMHS2	Laboratory, Histology, Large	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMM02	Laboratory, Microbiology, Small	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMM03	Laboratory, Microbiology, Medium	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMM04	Laboratory, Microbiology, Large	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	1	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMML1	Laboratory, Automated, Molecular, Diagnostic	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	1	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMML2	Laboratory, Reagent Preparation, Amplification Room	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	1	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMML3	Laboratory, Specimen Processing, Preamplification Room	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	1	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMML4	Laboratory, Amplification / Instrument Room	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	E	.	.	1	.	1	.	.	.	.	.	.	B	- -	6	2	R	R	Y	13	.	Y	M
LMMP1	Laboratory Microbiology / Parasitiology	4	US	GLG	GLG	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	.	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMMY1	Laboratory Mycology	4	US	GLG	GLG AT2	9'-0" (2740)	36" (915)	30-45 STC 40	100 (4.8)	500 1100	.	R		L	.	.	.	1	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M

Table B-1 (cont.) Architectural and Engineering Design Criteria

			ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM													MECHANICAL											
Room Code	ROOM FUNCTION	CODE	MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES PWR	POWER LT	N	MA	DA	LA	PA	MV	DSV	OE	LDE	O	NO	IA	WAD	N	BL	TEMP AC	OA	SM	WN	RH	IN	FN	EX	N
LMS01	Laboratory, Serology, Small	4	US	GLG	GLG AT2	9'-0'' (2740)	36'' (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	1	.	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMS02	Laboratory, Serology, Medium	4	US	GLG	GLG AT2	9'-0'' (2740)	36'' (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	1	.	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMS03	Laboratory, Serology, Large	4	US	GLG	GLG AT2	9'-0'' (2740)	36'' (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	1	.	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMT01	Laboratory, Toxicology	4	US	GLG	GLG AT2	9'-0'' (2740)	36'' (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	1	.	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMU02	Laboratory, Urinalysis, Small	4	US	GLG	GLG AT2	9'-0'' (2740)	36'' (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	1	.	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMU03	Laboratory, Urinalysis, Medium	4	US	GLG	GLG AT2	9'-0'' (2740)	36'' (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	1	.	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMU04	Laboratory, Urinalysis, Large	4	US	GLG	GLG AT2	9'-0'' (2740)	36'' (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	1	.	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMV01	Laboratory, Virology, Medium	4	US	GLG	GLG AT2	9'-0'' (2740)	36'' (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	1	.	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LMV02	Laboratory, Virology, Large	4	US	GLG	GLG AT2	9'-0'' (2740)	36'' (915)	30-45 STC 40	100 (4.8)	500 1100	.	R	L	.	.	.	1	.	.	.	.	.	.	.	.	.	B	-	6	2	R	R	Y	13	.	Y	M
LOB01	Lobby, Seating Area	N	PR	GPT SSP	AT1 SSP	VAR	SP	35-45 STC 40	100 (4.8)	150 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
LOB02	Lobby, Vestibule	N	SP	GPT SSP	AT1 SSP	VAR	SP	. .	100 (4.8)	150 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	a	a	*	68 (20.0)	Y	13	.	.	.
LOB03	Lobby, Main	N	PR	GPT SSP	AT1 SSP	VAR	SP	35-45 STC 40	100 (4.8)	150 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
LOB05	Lobby, Vestibule, Ambulance Entrance	N	SP	GPT SSP	AT1 SSP	VAR	SP	. .	100 (4.8)	150 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	a	a	*	68 (20.0)	Y	13	.	.	.
LR001	Lockers, Personal Property	Space Parameter Notes: a								. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
LR002	Lockers, Changing	N	CT UT	GLG GCT	GLG AT2	8'-0'' (2440)	36'' (915)	30-45 STC 40	100 (4.8)	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	.	.
MAGV1	Medical Material AGV Charging Station	4	UT	GPT	AT1	10'-0'' (3050)	E	30-45 STC 40	C	50 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
MAGV2	Medical Material AGV Dispatch	4	UT	GPT	AT1	10'-0'' (3050)	E	30-45 STC 40	C	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
MAGV3	Medical Material AGV Repair	4	UT	GPT	AT1	10'-0'' (3050)	E	30-45 STC 40	C	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
MECH1	Mechanical Rooms / Electrical Rooms	N	CS	SSP	EXP	C	VAR	40-70 STC 55	B	300 .	.	R	LS	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	.	50 (10.0)	Y	13	.	.	K
MECH2	Air Handling Rooms	N	CS	SSP	EXP	C	VAR	40-70 STC 55	B	300 .	.	R	LS	S	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	.	50 (10.0)	Y	13	.	.	K
MEDP1	Medication Room	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 45	100 (4.8)	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	70 (21.1)	Y	13	.	.	.
MMCR1	Medical Material, Cart Receiving	4	UT CS	GPT	AT1	10'-0'' (3050)	E	30-45 STC 40	100 (4.8)	50 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
MMCR2	Medical Material, Cart Restocking	4	UT CS	GPT	AT1	10'-0'' (3050)	E	30-45 STC 40	100 (4.8)	50 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
MMGS1	Medical Material, General Storage	4	UT CS	GPT	AT1	10'-0'' (3050)	48'' (1220)	30-45 STC 40	125	100 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES	POWER R	LT	N	MEDICAL GAS AND VACUUM M A	D A	L A	P A	M V	D S V	O E	L D E	O	N O	I A	WAG D	N	MECHANICAL TEMP BL	AC	OA	SM	WN	RH	IN	FN	EX	N
MMRP1	Medical Material, Receiving / Process	4	UT	GPT	AT1	10'-0'' (3050)	48'' (1220)	30-45 STC 40	100 (4.8)	200	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	75 (23.9)	55 (12.8)	Y	13	.	.	.
MRMB1	Mail Room, Distribution Area	N	UT	GPT	AT1	9'-0'' (2740)	36'' (915)	30-40 STC 50	100 (4.8)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
MRPS1	Mail Room, U.S. Post Office	N	UT	GPT	AT1	9'-0'' (2740)	36'' (915)	30-40 STC 50	100 (4.8)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	4	1	*	68 (20.0)	Y	13	.	Y	U
MRRS1	Mail Room, Receiving / Sorting	N	UT	GPT	AT1	9'-0'' (2740)	B	30-40 STC 50	125	500 1100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
MRS01	Med Records, Storage, Fixed	4	UT	GPT	AT1	9'-0'' (2740)	36'' (915)	30-40 STC 40	150 (7.2)	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
MRS02	Med Records, Storage, Movable	4	UT CP	GPT	AT1	9'-0'' (2740)	36'' (915)	30-40 STC 40	D	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
MRWK1	Med Records, Workroom	Space Parameter Notes: a and f								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NBCD1	NBC Decontamination Suite	3	CS	SSP	SSP	VAR	VAR	30-40 STC 50	100 (4.8)	500	.	R	L	.	\1\.	.	.	.	.	.	.	.	.	.	.	.	/1/	-	12	2	*	68 (20.0)	Y	14	.	Y	M
NBCD2	Decontamination Shower	3	CT ER	SSP GLG	SSP GLG	VAR	VAR	30-40 STC 40	60 (2.9)	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	\1\./1/	.	.	-	12	2	*	68 (20.0)	Y	14	.	Y	M
NBCD3	Decontamination, Anteroom	4	US CT	SSP GLG	SSP GLG	VAR	VAR	30-40 STC 40	100 (4.8)	300	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	12	2	*	68 (20.0)	Y	14	.	Y	M
NBCD4	Decontamination, Patient Preparation	3	CS	SSP	SSP	VAR	VAR	30-40 STC 40	100 (4.8)	500	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	12	2	*	68 (20.0)	Y	14	.	Y	M
NBCD5	Decontamination, Patient Transition	3	CS	SSP	SSP	VAR	VAR	30-40 STC 40	100 (4.8)	500	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	12	2	*	68 (20.0)	Y	14	.	Y	M
NCWD1	Nourishment Center	4	UT US	GLG GPT	AT2 AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
NCWD4	Nourishment Alcove	Space Parameter Notes: a								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NMBP1	Nuclear Medicine, Blood Product Compounding	4	US	LLG	AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500 1100	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	2	*	68 (20.0)	Y	r	r	Y	M,W
NMCR1	Nuclear Medicine, Computer Room	4	US	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
NMDC1	Nuclear Medicine, Dose Calibration	4	US	LLG	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	500 1100	.	.	LS	.	.	1	.	.	1	.	.	.	1	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	14	.	Y	M
NMDS1	Nuclear Medicine, Decay Storage	4	US	LLG	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	300	.	.	LS	E	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	14	.	Y	.
NMGS1	Nuclear Medicine, General Scanning	3	US	GLG	AT1	10'-0'' (3050)	48'' (1220)	30-40 STC 40	100 (4.8)	500	A	.	LS	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
NMIR1	Nuclear Medicine, Injection Room	3	US	LLG	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 40	60 (2.9)	700	A	.	LS	.	.	1	.	.	1	.	.	.	1	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	14	.	Y	.
NMLA1	Nuclear Medicine, Anteroom, Radiopharmacy	4	US	GLG	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	14	.	Y	M
NMPC1	Nuclear Medicine, Radiopharmacy, Non-Sterile Compounding	4	US	LLG	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500 1100	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	14	.	Y	M
NMRP1	Nuclear Medicine, Radiopharmacy	C	US	LLG	AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	13	.	Y	M
NMSS1	Nuclear Medicine, Special Scanning	3	US	GLG	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 40	100 (4.8)	500	A	.	LS	E	.	1	.	.	1	.	.	.	1	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	14	.	Y	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	CODE	ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM													MECHANICAL											
			MATL & FIN			CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES	POWER PWR	LT	N	MA	DA	LA	PA	MV	DSV	OVE	LDE	OO	NOA	IA	WAGD	N	BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
			FL	WL	CLG																																
NMUR1	Nuclear Medicine, Uptake Room	3	US	GLG	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	100 (4.8)	200 .	.	.	LS	E	1	.	.	.	1	.	.	.	1	.	.	.	.	-	6	2	*	68 (20.0)	Y	13	.	Y	.
NMVC1	Nuclear Medicine, Vestibule, Radiopharmacy	4	US	GLG	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	100 (4.8)	500 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	14	.	Y	M
NMWB1	Nuclear Medicine, Whole Body	3	US	GLG	AT1	10'-0" (3050)	48" (1220)	30-40 STC 40	100 (4.8)	500 .	.	.	LS	E	1	.	.	.	1	.	.	.	1	.	.	.	.	-	6	2	*	68 (20.0)	Y	14	.	Y	.
NMWR1	Nuclear Medicine, Waiting Room Hot	4	US	LPT	AT1	8'-0" (2440)	48" (1220)	30-40 STC 45	60 (2.9)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	1	*	68 (20.0)	Y	14	.	Y	.
NSTA1	Nurse Station	4	MA	GPT	AT1	8'-0" (2440)	M	30-40 STC 40	100 (4.8)	300 700	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
NSTA3	Nurse Station, Substation	4	MA	GPT	AT1	8'-0" (2440)	M	30-40 STC 40	100 (4.8)	300 700	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
NSTA4	Nurse Station, Outpatient	4	MA	GPT SSP	AT1	9'-0" (2740)	M	35-45 STC 40	60 (2.9)	300 500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	14	.	.	.
NSTA5	Nurse Station, Control, Operating Room	4	PR	GLG SSP	GLG	9'-0" (2740)	M	30-45 STC 40	100 (4.8)	300 700	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
NT001	Pneumatic Tube Station	Space Parameter Notes: a								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NYAF1	Nursery, Anteroom, Feeding Preparation	4	US UT	GLG GPT	AT2	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	500 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	*	68 (20.0)	Y	14	.	.	.
NYAR1	Nursery, Anteroom with Scrub Sink	4	US	GLG	AT2	8'-0" (2440)	48" (1220)	25-35 STC 45	60 (2.9)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	12	3	74 (23.3)	80 (26.7)	Y	14	.	.	P
NYEC1	Nursery, Extracorporeal Membrane Oxygenation (ECMO) Room	2	US	GLG	AT2	9'-0" (2740)	48" (1220)	25-35 STC 50	60 (2.9)	500 1000	.	R	L	.	3	.	.	.	3	.	.	.	3	.	.	.	G	++	6	2	74 (23.3)	80 (26.7)	T	14	14	.	P
NYFA1	Nursery, Feeding Area	3	US	GLG GPT	AT2 AT1	9'-0" (2740)	48" (1220)	25-35 STC 45	60 (2.9)	500 .	A	.	LS	.	.	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	1.5	74 (23.3)	80 (26.7)	Y	14	.	.	P
NYFP1	Nursery, Infant Feeding Preparation Room	4	US	GLG GPT	AT2	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	500 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	2	*	68 (20.0)	Y	r	r	r	M,R
NYFS1	Nursery, Storage, Breast Milk / Formula	4	US	GLG GPT	AT2	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	500 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	*	68 (20.0)	Y	14	.	.	.
NYIC1	Nursery, Level II	2	US UT	GLG GPT	AT2	9'-0" (2740)	48" (1220)	25-35 STC 50	60 (2.9)	700 .	A	R	L	.	2	.	.	.	2	.	.	.	2	.	.	.	G	++	6	2	74 (23.3)	80 (26.7)	T	14	.	.	P
NYIC2	Nursery, Level III	1	US UT	GLG	AT2	9'-0" (2740)	48" (1220)	25-35 STC 50	60 (2.9)	700 .	A	RC	L	.	3	.	.	.	3	.	.	.	3	.	.	.	G	++	12	4	74 (23.3)	80 (26.7)	T	14	.	.	O,P
NYIR1	Nursery, Isolation	2	US	GLG	GLG	9'-0" (2740)	48" (1220)	25-35 STC 50	60 (2.9)	700 .	A	R	L	.	3	.	.	.	3	.	.	.	3	.	.	.	A	-	-	12	2	74 (23.3)	80 (26.7)	T	14	.	Y	A,P,Q
NYNN1	Nursery, Level I	3	US UT	GLG	AT2	9'-0" (2740)	48" (1220)	25-35 STC 50	60 (2.9)	700 .	A	R	L	.	1	.	.	.	1	.	.	.	1	.	.	.	H	++	6	2	74 (23.3)	80 (26.7)	T	14	.	.	P
NYPR1	Nursery, Procedure	2	US	GLG	AT2	9'-0" (2740)	48" (1220)	25-35 STC 50	60 (2.9)	500 1100	.	R	L	.	1	.	.	.	1	.	.	.	1	.	.	.	G	++	6	2	74 (23.3)	80 (26.7)	T	14	14	.	P
NYPT1	Nursery, Parent Education	4	CP UT	GPT	AT1	8'-0" (2440)	48" (1220)	25-35 STC 45	60 (2.9)	700 .	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	74 (23.3)	80 (26.7)	T	13	.	.	P
NYTU1	Nursery, Storage, Transport Unit	4	UT	GPT	AT1	8'-0" (2440)	L	35-45 STC 45	60 (2.9)	500 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	14	.	.	.
NYUN1	Bedroom, NICU, Single Birth	1	US	GLG	AT2	9'-0" (2740)	48" (1220)	25-35 STC 50	60 (2.9)	700 .	A,D	RC	L	.	3	.	.	.	3	.	.	.	3	.	.	.	G	++	12	4	74 (23.3)	80 (26.7)	T	14	.	.	O,P
NYUN2	Bedroom, NICU, Multiple Births	1	US	GLG	AT2	9'-0" (2740)	48" (1220)	25-35 STC 50	60 (2.9)	700 .	A,D	RC	L	.	3	.	.	.	3	.	.	.	3	.	.	.	G	++	12	4	74 (23.3)	80 (26.7)	T	14	.	.	O,P

Table B-1 (cont.) Architectural and Engineering Design Criteria

			ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM												MECHANICAL													
Room Code	ROOM FUNCTION	CODE	MATL & FIN			CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES	POWER PWR	LT	N	MA	DA	LA	PA	MV	DSV	OE	LDE	NO	NO	IA	WAD	N	BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
			FL	WL	CLG																																	
OFA03	Cubicle, Administrative	N	CP UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
OFA04	Office, Administrative, Private	N	CP UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
OFA05	Office, Administrative, Shared, 2-Person	N	CP UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
OFC01	Office, Commander	N	CP	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
OFD01	Office, Provider, Private	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OFD02	Office, Provider, Shared	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OFDC1	Office, Provider, Behavioral Health	N	CP UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	14	.	.	.
OFDC2	Office, Consultation	N	CP UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	14	.	.	.
OFDR1	Office, Provider, Radiology	N	CP UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 50*	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
OFM01	Office, Executive	N	CP UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	300 500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
OFP01	Office, Pathologist	N	CP UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	500 .	A	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
OOHR1	Observation / Hydration	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	500 .	.	.	.	.		.	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OOTR1	Observation / Treatment Room	2	US UT	GLG GPT	AT1	8'-0" (2440)	48" (1220)	30-40 STC 50*	60 (2.9)	500 1100	.	R	LB	.		1	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
OPAE1	Auditory Electrophysiological Lab	3	CP UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	300 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPAI1	Allergy Injection Room	3	UT US	GPT GLG	AT1	8'-0" (2440)	42" (1065)	30-40 STC 50*	60 (2.9)	500 1100	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPAP1	Posturography	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 50*	60 (2.9)	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
OPAR1	Rotary Chair	3	UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 50*	60 (2.9)	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
OPAS1	Allergy Skin Testing	3	UT US	GPT GLG	AT1	8'-0" (2440)	36" (915)	30-40 STC 50*	60 (2.9)	500 1100	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPCR1	Cast Room	3	UT US	GLG	AT1 GPT	9'-0" (2740)	G	30-40 STC 50	60 (2.9)	500 .	.	.	.	.		1	.	.	.	1	.	.	.	1	.	.	.	.	nr	10	2	*	70 (21.1)	Y	14	.	Y	.
OPCR2	Cast Room, Multi-Station	3	UT US	GLG	AT1 GPT	9'-0" (2740)	G	30-40 STC 50	60 (2.9)	500 .	.	.	.	.		1	.	.	.	1	.	.	.	1	.	.	.	B	nr	10	2	*	70 (21.1)	Y	14	.	Y	.
OPCT1	Intravenous Infusion, Therapy	3	US	GPT GLG	AT1 AT2	8'-0" (2440)	48" (1220)	30-40 STC 50*	60 (2.9)	500 .	.	.	.	.		.	.	.	.	1	.	.	.	1	.	.	.	B	+	6	2	*	68 (20.0)	Y	14	.	.	.
OPCT2	Intravenous Infusion, Preparation	4	US	GPT GLG	AT1	8'-0" (2440)	36" (915)	30-40 STC 50*	60 (2.9)	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPDC1	Dermatology, Cryotherapy	3	UT US	GPT GLG	AT1	8'-0" (2440)	36" (915)	30-40 STC 50*	60 (2.9)	500 1100	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPDU1	Dermatology, UV Booth	3	UT	GPT	AT1	9'-0" (2740)	48" (1220)	30-40 STC 50*	60 (2.9)	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES	POWER PWR	LT	N	MEDICAL GAS AND VACUUM M A	D A	L A	P A	M V	D S V	O E	L D E	O	N O	I A	WAG D	N	MECHANICAL TEMP BL	AC	OA	SM	WN	RH	IN	FN	EX	N
OPEC1	ECG (Electrocardiogram)	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	70 (21.1)	Y	14	.	.	.
OPEE1	EEG (Electroencephalogram)	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	300	A	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPHM1	Holter Monitor	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPIR1	Immunization Room	3	US 0	GPT GLG	AT1	8'-0'' (2440)	42'' (1065)	30-40 STC 50*	60 (2.9)	500	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPMH1	Group Therapy	3	SV UT	GPT GAT	AT1	9'-0'' (2740)	36'' (915)	30-40 STC 50*	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
OPMH2	Behavioral Health, Testing	3	SV UT	GPT GAT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPMH3	Biofeedback	3	SV UT	GPT GAT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	700	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPMH4	Secured Observation	3	SV	GPT	GPT	9'-0'' (2740)	36'' (915)	30-40 STC 50*	60 (2.9)	500	A	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
OPMP1	Outpatient, Group Therapy, Speech / Language	3	CP UT	GPT GAT	AT1	VAR	36'' (915)	30-40 STC 50	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
OPNR1	Nephrology Renal Study	3	US UT	GLG GPT	AT2 AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	500 1100	.	.	.	.	.	1	.	.	.	1	.	.	.	1	.	.	.	.	+	6	2	*	70 (21.1)	Y	14	.	.	.
OPPE1	Echocardiograph	3	UT	GPT GPT	AT1	8'-0'' (2440)	42'' (1065)	30-40 STC 50*	60 (2.9)	500	A	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	70 (21.1)	Y	14	.	.	.
OPPE2	Echocardiograph, Stress	3	UT	GPT GAT	AT1	8'-0'' (2440)	42'' (1065)	30-40 STC 50*	60 (2.9)	500	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	70 (21.1)	Y	14	.	.	.
OPPF1	Pulmonary Function, Screening	3	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 50*	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	14	.	.	.
OPPF2	Pulmonary Function, Analysis	3	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 50	60 (2.9)	500	.	.	.	.	.	1	.	.	.	1	.	.	.	1	.	.	.	B	nr	6	2	*	70 (21.1)	Y	14	.	.	.
OPPF4	Pulmonary Function, Whole Body Analysis	3	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 50	60 (2.9)	500	.	.	.	.	.	1	.	.	.	1	.	.	.	1	.	.	.	B	nr	6	2	*	70 (21.1)	Y	14	.	.	.
OPPF5	Pulmonary Function, Treadmill	3	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 50	60 (2.9)	500	.	.	.	.	.	1	.	.	.	1	.	.	.	1	.	.	.	B	nr	6	2	*	70 (21.1)	Y	14	.	.	.
OPPF6	Pulmonary Function, Sleep Study	3	CP	GPT	AT1	8'-6'' (2590)	42'' (1065)	30-40 STC 50	60 (2.9)	100	A	.	.	.	.	1	.	.	.	1	.	.	.	1	.	.	.	B	nr	6	2	*	70 (21.1)	Y	13	.	.	.
OPPF7	Pulmonary Function, Sleep Study, Monitoring	4	CP	GPT	AT1	8'-6'' (2590)	36'' (915)	30-40 STC 50	60 (2.9)	300	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.
OPPM1	Pacemaker Workroom	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	1100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	14	.	.	.
OPRC1	Respiratory, Equipment, Clean	N	UT US	GLG GPT	AT1	8'-0'' (2440)	42'' (1065)	30-40 STC 50*	60 (2.9)	1100	.	.	.	.	.	1	.	.	.	1	.	.	.	1	.	.	.	B	+	6	2	*	68 (20.0)	Y	14	.	.	.
OPRS1	Respiratory, Equipment, Soiled	N	UT US	GLG GPT	AT1	8'-0'' (2440)	42'' (1065)	30-40 STC 50*	60 (2.9)	1100	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	14	.	Y	M
OPRT1	Respiratory, Treatment, Multi-Station	3	UT US	GLG GPT	AT1	8'-0'' (2440)	48'' (1220)	35-45 STC 50*	60 (2.9)	500	.	.	.	.	.	1	.	.	.	1	.	.	.	1	.	.	.	B	nr	6	2	*	70 (21.1)	Y	14	.	.	.
OPTM1	Stress Testing, Treadmill	3	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 50*	60 (2.9)	500	.	.	.	.	.	1	.	.	.	1	.	.	.	1	.	.	.	B	nr	6	2	*	70 (21.1)	Y	14	.	.	.
OPTM2	Cardiac, Tilt Table	3	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 50*	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	14	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES	POWER PWR	LT	N	MEDICAL GAS AND VACUUM M A	D A	L A	P A	M V	D S V	O E	L D E	O	N O	I A	WAG D	N	MECHANICAL TEMP BL	AC	OA	SM	WN	RH	IN	FN	EX	N
OPTM3	Outpatient, Treadmill, Underwater Chamber	3	CT	GPT GCT	AT1 GLG	9'-0'' (2740)	42'' (1065)	35-45 STC 40	C	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	B	-	6	2	*	70 (21.1)	Y	13	.	Y	.
OPVL1	Laboratory, Vascular	3	US UT	GLG GPT	AT1	8'-0'' (2440)	42'' (1065)	30-45 STC 50*	60 (2.9)	500 1100	.	.	.	.	.	1	.	.	1	.	.	.	1	.	.	.	B	nr	6	2	*	70 (21.1)	Y	14	.	.	.
ORCC1	Operating Room, Clean Core	4	PS ER	GLG SSP	GLG	9'-0'' (2740)	42'' (1065)	30-45 STC 40	125	500 .	.	RA	LB	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
ORCM1	Operating Room, Storage, Cardiac	4	UT US	GPT GLG	AT1	9'-0'' (2740)	36'' (915)	30-45 STC 45	60 (2.9)	500 .	.	R	LB	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	68 (20.0)	Y	14	.	.	.
ORCS1	Operating Room, Cystoscopic	1	PS ER	LLG SSP	GLG	10'-0'' (3050)	K	30-45 STC 45	60 (2.9)	2100 .	D,J	RA	LB	.	.	6	.	.	12	.	.	.	8	2	4	2	C	++	20	4	R	R	S	14	hepa	.	C
ORCT1	Operating Room, Cardiothoracic	1	PS ER	GSS GEP	GLG	10'-0'' (3050)	K	30-45 STC 45	60 (2.9)	2100 .	D,J	RA	LB	.	.	6	.	.	12	.	.	.	8	2	4	2	C	++	20	4	R	R	S	14	hepa	Y	C
ORCW1	Operating Room, Workroom, Clean	4	PS ER	GLG SSP	GLG	9'-0'' (2740)	42'' (1065)	30-45 STC 45	60 (2.9)	1100 .	D	R	L	.	.	1	.	.	1	.	.	.	1	.	.	.	I	+	6	2	68 (20.0)	68 (20.0)	Y	14	.	.	.
ORDA1	Operating Room, Decontamination	4	PS ER	GLG SSP	GLG	9'-0'' (2740)	42'' (1065)	30-45 STC 45	60 (2.9)	300 .	.	R	L	.	.	1	.	.	1	.	.	.	.	.	1	.	.	-	6	2	*	68 (20.0)	Y	14	.	Y	M
OREC1	Operating Room, Equipment Cleanup	4	UT US	GLG SSP	GLG	9'-0'' (2740)	36'' (915)	30-45 STC 45	60 (2.9)	300 .	.	R	L	.	.	1	.	.	1	.	.	.	.	.	1	.	.	+	6	2	75 (23.9)	68 (20.0)	Y	14	.	Y	.
ORGE1	Operating Room, General, Equipment Storage	4	US	GLG SSP	GLG	9'-0'' (2740)	48'' (1220)	30-45 STC 40	125	200 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	1.5	75 (23.9)	68 (20.0)	Y	14	.	.	.
ORGS1	Operating Room, Integrated	1	PS ER	GSS GEP	GLG	10'-0'' (3050)	K	30-45 STC 45	60 (2.9)	2100 .	D,J	RA	LB	.	.	6	.	.	12	.	.	.	8	2	4	2	C	++	20	4	R	R	S	14	hepa	.	C
ORHC1	Operating Room, Hybrid, Control	4	PS ER	GLG SSP	GLG	9'-0'' (2740)	SP	30-45 STC 45	60 (2.9)	500 .	A	RA	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	R	R	Y	14	.	.	N
ORHE1	Operating Room, Hybrid, Equipment Storage	4	US	GLG SSP	GLG	9'-0'' (2740)	48'' (1220)	30-45 STC 40	125	200 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	1.5	75 (23.9)	68 (20.0)	Y	14	.	.	.
ORHL1	Operating Room, Equipment, Heart Lung Pump	4	UT US	GLG SSP	GLG	10'-0'' (3050)	K	30-45 STC 45	60 (2.9)	200 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	R	R	Y	14	.	.	.
ORHY1	Operating Room, Hybrid	1	PS ER	LLG SSP	GLG	10'-0'' (3050)	K	30-45 STC 40	60 (2.9)	2100 .	D,J	RA	LB	.	.	6	.	.	12	.	.	.	8	2	4	2	C	++	20	4	R	R	S	14	hepa	.	C,N
ORNE1	Operating Room, Equipment, Neurology	4	UT	GLG SSP	GLG	10'-0'' (3050)	48'' (1220)	30-45 STC 45	125	200 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	1.5	75 (23.9)	75 (23.9)	Y	14	.	.	.
ORNS1	Operating Room, Neurology	1	PS ER	GSS GEP	GLG	10'-0'' (3050)	K	30-45 STC 45	60 (2.9)	2100 .	D,J	RA	LB	.	.	6	.	.	12	.	.	.	8	2	4	2	C	++	20	4	R	R	S	14	hepa	.	C
OROE1	Operating Room, Equipment, Orthopaedic	4	UT US	GLG SSP	GLG	10'-0'' (3050)	48'' (1220)	30-45 STC 45	125	200 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	1.5	75 (23.9)	68 (20.0)	Y	14	.	.	.
OROS1	Operating Room, Orthopaedic	1	PS ER	GSS GEP	GLG	10'-0'' (3050)	K	30-45 STC 45	60 (2.9)	2100 .	D,J	RA	LB	.	.	6	.	.	12	.	.	.	8	2	4	2	C	++	20	4	R	R	S	14	hepa	.	C
ORPC1	Operating Room, Storage, Plaster Cart	4	US	GLG SSP	GLG	9'-0'' (2740)	42'' (1065)	30-45 STC 40	60 (2.9)	50 .	.	.	LB	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	75 (23.9)	68 (20.0)	Y	14	.	.	.
ORPH2	Operating Room, Workstation, Preparation / Hold	4	UT US	GLG SSP	GLG	9'-0'' (2740)	L	30-45 STC 40	60 (2.9)	300 500	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
ORPP1	Operating Room, Patient Preparation / Induction	3	UT US	GLG SSP	GLG	9'-0'' (2740)	48'' (1220)	30-45 STC 40	60 (2.9)	500 1100	.	R	L	.	.	1	.	.	1	.	.	.	1	.	.	.	B	nr	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
ORPP2	Operating Room, Patient Preparation / Induction, Multi-Station	2	UT US	GLG SSP	GLG	9'-0'' (2740)	P	30-45 STC 40	60 (2.9)	500 1100	D	R	L	.	.	1	.	.	1	.	.	.	1	.	.	.	B	nr	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
ORSA1	Operating Room, Scrub Sink	4	PS ER	GLG SSP	GLG	9'-0'' (2740)	L	30-45 STC 40	60 (2.9)	1100 .	.	.	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES	POWER PWR	LT	N	MEDICAL GAS AND VACUUM MA	DA	LA	PA	MV	DSV	OE	LD	EO	NO	IA	WAD	N	MECHANICAL TEMP BL	AC	OA	SM	WN	RH	IN	FN	EX	N
ORSR1	Operating Room, Sterile Processing	4	PS ER	GLG SSP	GLG	9'-0'' (2740)	42'' (1065)	30-45 STC 40	60 (2.9)	500 .	.	.		L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	75 (23.9)	75 (23.9)	Y	14	.	Y	.
ORSS1	Operating Room, Storage, Sterile	4	PS ER	GLG SSP	GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 45	125	200 .	.	.		LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
OTDL1	Occupational Therapy, Daily Living Skills	3	SP UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 45	60 (2.9)	500 .	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
OTEV1	Occupational Therapy, Exam	3	UT CP	GPT	AT1	8'-0'' (2440)	42'' (1065)	30-40 STC 45	60 (2.9)	500 .	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
OTGC1	Occupational Therapy, General Clinic Area	3	UT CP	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 45	60 (2.9)	500 .	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
OTNR1	Occupational Therapy, Neuro-Rehab Training	3	CP UT	GPT	AT1	10'-0'' (3050)	42'' (1065)	30-40 STC 40	60 (2.9)	500 .	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
OTWT1	Occupational Therapy, Simulation Laboratory	3	SP UT	GPT	AT1	8'-0'' (2440)	42'' (1065)	30-40 STC 50	60 (2.9)	500 .	A	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
PAIA1	Patient Admin Interview Area	4	CP UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	500 .	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)	Y	13	.	.	.
PEHS1	Hearing / Screening, Booth, 1-Person	3	CP UT	GAT GPT	AT1	9'-0'' (2740)	36'' (915)	30-40 STC 50*	60 (2.9)	500 .	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
PEHS2	Hearing / Screening, Booth, Multi-Person	3	CP UT	GAT GPT	AT1	9'-0'' (2740)	36'' (915)	30-40 STC 50*	60 (2.9)	500 .	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
PEHS3	Hearing / Diagnostic, Booth, 1-Person	3	CP UT	GAT GPT	AT1	9'-0'' (2740)	36'' (915)	30-40 STC 50*	60 (2.9)	500 .	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
PEVH2	Vision / Hearing, Pediatric	3	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	500 .	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
PHAR1	Pharmacy, Anteroom, Chemo-therapeutics Compounding Area	4	US	GLG	AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500 .	.	.		LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	2	.	.	.	r	r	r	M,W
PHBS1	Pharmacy, Storage, Bulk, Low Volume	4	UT UT	GPT	AT1	VAR	42'' (1065)	30-40 STC 40	100 (4.8)	500 .	.	.		.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.
PHBS2	Pharmacy, Storage, Bulk, Medium Volume	4	SV UT	GPT	AT1	VAR	42'' (1065)	30-40 STC 40	100 (4.8)	500 .	.	.		.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.
PHBS3	Pharmacy, Storage, Bulk, High Volume	4	SV UT	GPT	AT1	VAR	42'' (1065)	30-40 STC 40	100 (4.8)	500 .	.	.		.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.
PHC01	Pharmacy, Clean Room, Chemotherapeutics Compounding	4	US	GLG GPT	GLG AT2	9'-0'' (2740)	36'' (915)	30-40 STC 40	60 (2.9)	1100 .	.	R		L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	2	*	68 (20.0)	Y	r	r	r	M,W
PHDC1	Pharmacy, Dispensing / Consult Room	4	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 50	100 (4.8)	1100 .	.	R		L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	14	.	.	.
PHDS1	Pharmacy, Off Site Satellite, Medium Volume	4	UT	GPT	AT1	VAR	42'' (1065)	30-40 STC 40	60 (2.9)	1100 .	.	R		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.
PHDS2	Pharmacy, Off Site Satellite, High Volume	4	UT	GPT	AT1	VAR	42'' (1065)	30-40 STC 40	60 (2.9)	1100 .	.	R		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.
PHDS3	Pharmacy, On-Site, Satellite	4	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 40	100 (4.8)	1100 .	.	R		L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.
PHEV1	Pharmacy, Documentation Station, Receiving	4	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	30-40 STC 40	100 (4.8)	500 .	.	.		.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.	\1\
*PHHR1	Pharmacy, Receiving / Unpacking, Hazardous Drug	4	US	GLG	AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500 .	.	.		LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	r	r	Y	W	/1/
PHIV1	Pharmacy, IV Admixture, Low Volume	4	US UT	GLG GPT	GLG AT2	9'-0'' (2740)	36'' (915)	30-40 STC 40	60 (2.9)	1100 .	.	R		L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	2	*	68 (20.0)	Y	r	r	r	M,R

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	CODE	ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM												MECHANICAL														
			MATL & FIN			CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES PWR	POWER LT	N	MA	DA	LA	PA	MV	DSV	OE	LD	EO	NO	IA	WAD	N	BL	AC	OA	TEMP SM	TEMP WN	RH	IN	FN	EX	N		
			FL	WL	CLG																																			
PHIV2	Pharmacy, IV Admixture, Medium Volume	4	US UT	GLG GPT	GLG AT2	9'-0" (2740)	36" (915)	30-40 STC 40	60 (2.9)	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	2	*	68 (20.0)	Y	r	r	r	M,R	
PHIV3	Pharmacy, IV Admixture, High Volume	4	US UT	GLG GPT	GLG AT2	9'-0" (2740)	36" (915)	30-40 STC 40	60 (2.9)	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	2	*	68 (20.0)	Y	r	r	r	M,R	
PHMP1	Pharmacy, Manufacturing and Prepack, Low Volume	4	UT	GPT	AT1	9'-0" (2740)	36" (915)	30-40 STC 40	100 (4.8)	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.	
PHMP2	Pharmacy, Manufacturing and Prepack, Medium Volume	4	UT	GPT	AT1	9'-0" (2740)	36" (915)	30-40 STC 40	100 (4.8)	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.	
PHMP3	Pharmacy, Manufacturing and Prepack, High Volume	4	UT	GPT	AT1	9'-0" (2740)	36" (915)	30-40 STC 40	100 (4.8)	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.	
PHOD1	Pharmacy, Storage / Dispensing, Low Volume	4	UT	GPT	AT1	9'-0" (2740)	42" (1065)	30-40 STC 40	100 (4.8)	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.	
PHOD2	Pharmacy, Storage / Dispensing, Medium Volume	4	UT	GPT	AT1	9'-0" (2740)	42" (1065)	30-40 STC 40	100 (4.8)	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.	
PHOD3	Pharmacy, Storage / Dispensing, High Volume	4	UT	GPT	AT1	9'-0" (2740)	42" (1065)	30-40 STC 40	100 (4.8)	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.	
PHR01	Pharmacy, Prescription Assembly, Robotics / Automation	4	UT	GPT	AT1	9'-0" (2740)	N	30-40 STC 40	100 (4.8)	1100 .	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.	
PHUD1	Pharmacy, Unit Dose	4	UT	GPT	AT1	9'-0" (2740)	36" (915)	30-40 STC 40	60 (2.9)	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.	
PHVS1	Pharmacy, Inpatient, Vestibule	4	UT	GPT	AT1	9'-0" (2740)	36" (915)	30-40 STC 40	60 (2.9)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	.	
PLAY1	Play Room	3	LV CP	GPT GAT	AT1	9'-0" (2740)	36" (915)	35-45 STC 45	60 (2.9)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	1.5	*	70 (21.1)	Y	13	.	.	.	
PMCC1	Plant Maintenance, Control Center	N	CS UT	GPT SSP	AT1 SSP	9'-0" (2740)	VAR	30-40 STC 50	100 (4.8)	500 .	.	R	LS	S	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.	
PMCF1	Plant Maintenance, CADD / File Room	N	CS UT	GPT	AT1	8'-0" (2440)	36" (915)	30-40 STC 40	D	300 500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.	
PMCW1	Plant Maintenance, Common Area	N	CS UT	GPT SSP	AT1 SSP	9'-0" (2740)	VAR	30-40 STC 50	100 (4.8)	300 700	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	Y	M	
PMWSX	Plant Maintenance Workstation Areas	N	CS PS	GPT SSP	AT1 SSP	9'-0" (2740)	VAR	30-40 STC 50	100 (4.8)	300 700	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	Y	M	
PTAP1	Physical Therapy, Aquatic Pool, Small	Space Parameter Notes: b								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
PTAP2	Physical Therapy, Aquatic Pool, Medium	Space Parameter Notes: b								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
PTAP3	Physical Therapy, Aquatic Pool, Large	Space Parameter Notes: b								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
PTAT1	Physical Therapy, Amputee Training	3	SP	GPT	AT1	D	42" (1065)	30-40 STC 40	60 (2.9)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	75 (23.9)	70 (21.1)	Y	13	.	.	.	
PTBT1	Physical Therapy, Back Treatment	3	UT CP	GPT	AT1	9'-0" (2740)	42" (1065)	30-40 STC 40	60 (2.9)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	.	.	
PTCW1	Physical Therapy, Tech Workstation	4	UT	GPT	AT1	D	L	30-40 STC 40	60 (2.9)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	70 (21.1)	Y	13	.	.	.	
PTEA1	Physical Therapy, Exercise Gym	3	US	GPT	AT1	D	48" (1220)	35-45 STC 40	60 (2.9)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	70 (21.1)	Y	13	.	Y	.	
PTEM1	Physical Therapy, EMG (Electromyography)	3	UT	GPT	AT1	9'-0" (2740)	42" (1065)	35-45 STC 40	60 (2.9)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.	

Table B-1 (cont.) Architectural and Engineering Design Criteria

			ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM														MECHANICAL																	
Room Code	ROOM FUNCTION	COD E	MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES	POWER PWR	LT	N	M A	D A	L A	P A	M V	D S V	O E	L D E	O	N O	A	I A	W A G D	N	BL	AC	OA	SM	TEMP WN	RH	IN	FN	EX	N
PTES1	Physical Therapy, Exercise Stations	3	UT	GPT	AT1	D	L	35-45 STC 40	60 (2.9)	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	70 (21.1)	Y	13	.	.	.
PTGL1	Physical Therapy, Gait Obs. Lane	3	UT US	GPT	AT1	D	L	35-45 STC 40	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.
PTIS1	Physical Therapy, Isokinetic Station, Diagnostic	3	UT	GPT	AT1	D	42'' (1065)	35-45 STC 40	C	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	70 (21.1)	Y	13	.	Y	.
PTPR1	Physical Therapy, Rehab, Private	3	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	35-45 STC 40	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.
PTTC1	Physical Therapy, Treatment, Cubicle	3	UT US	GPT	AT1	D	P	35-45 STC 40	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	70 (21.1)	Y	13	.	.	.
PTTS1	Physical Therapy, Treatment Support	3	UT US	GPT	AT1	D	L	35-45 STC 40	60 (2.9)	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.
PTWT1	Physical Therapy, Whirlpool	3	CT	GPT GCT	AT1 GLG	9'-0'' (2740)	42'' (1065)	35-45 STC 40	C	500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	70 (21.1)	Y	13	.	Y	.
RAA01	Chapel, Altar	N	CP SP	GPT SSP	AT1 SSP	9'-0'' (2740)	L	20-30 STC 40	60 (2.9)	300	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
RABS1	Chapel, Chancel	N	CP SP	GPT SSP	AT1 SSP	9'-0'' (2740)	36'' (915)	20-30 STC 40	60 (2.9)	300	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
RAMR1	Chapel, Meditation	N	CP SP	GPT SSP	AT1	9'-0'' (2740)	36'' (915)	20-30 STC 40	60 (2.9)	300	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
RAS01	Chapel, Seating	N	CP SP	GPT SSP	AT1	VAR	L	20-30 STC 40	60 (2.9)	150	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
RASR1	Chapel, Storage, Sacristy	N	CP SP	GPT	AT1	9'-0'' (2740)	36'' (915)	20-30 STC 40	125	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
RCA01	Alcove, AED (Automatic External Defibrillator)	Space Parameter Notes: a and c								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
RCA02	Alcove, Portable Patient Lift	Space Parameter Notes: a								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
RCA04	Alcove, Warmer, Blanket / Fluid	Space Parameter Notes: a								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
RDC01	Renal Dialysis, Airborne Infection Isolation	3	PR SM	GLG GPT	GLG GPT	8'-6'' (2590)	48'' (1220)	35-45 STC 40	60 (2.9)	500 1100	.	R	L	.	2	.	.	1	.	.	1	.	.	.	.	.	.	-	-	12	2	*	70 (21.1)	Y	14	.	Y	.
RDC02	Renal Dialysis, Multi-Station	3	US UT	GPT GLG	AT1 AT2	8'-6'' (2590)	P	35-45 STC 40	60 (2.9)	500 1100	.	R	L	.	2	.	.	1	.	.	1	.	.	.	.	.	B	nr	6	2	*	70 (21.1)	Y	14	.	.	.
RDP01	Renal Dialysis, Storage, Equipment Portable	N	UT US	GPT GLG	AT1 AT2	8'-6'' (2590)	48'' (1220)	35-45 STC 40	60 (2.9)	500 1100	.	R	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	14	.	.	.
RDWT1	Renal Dialysis, Support, Reverse Osmosis	N	UT US	GPT GLG	AT1 AT2	8'-6'' (2590)	36'' (915)	30-45 STC 40	60 (2.9)	500	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	50 (10.0)	Y	.	.	Y	.
RECP1	Reception	4	SP UT	GPT SSP	AT1	9'-0'' (2740)	36'' (915)	35-45 STC 40	60 (2.9)	300 500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	14	.	.	.
RECP2	Reception, Administration	4	SP UT	GPT SSP	AT1	9'-0'' (2740)	36'' (915)	35-45 STC 40	60 (2.9)	300 500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	14	.	.	.
RECP3	Reception, Information Desk	4	SP UT	GPT SSP	AT1	VAR	L	35-45 STC 40	60 (2.9)	300 500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	14	.	.	.
RER01	Refrigeration Equipment Room	N	CS	GPT	SSP	VAR	48'' (1220)	30-45 STC 50	B	200	.	.	LS	E	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	a	a	SP (SP)	SP (SP)	Y	13	.	.	.
RMF01	Mask Fit, Respirator	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	300 500	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	13	.	Y	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	CODE	ARCHITECTURAL					NC & STC	STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM												MECHANICAL									
			MATL & FIN			CLG HT	DOOR SIZE		FLR LD	LIGHT LEV	N	ES	POWER PWR	LT	N	MA	DA	LA	PA	MV	DSV	OE	LDE	OO	NA	IA	WAD	N	BL	AC	OA	TEMP SM	TEMP WN	RH	IN	FN	EX	N
			FL	WL	CLG																																
RPR01	Copier	N	SP UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-45 STC 50	100 (4.8)	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	70 (21.1)	Y	13	.	.	.
RPR02	Copier, High Volume	N	SP UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-45 STC 50	150 (7.2)	700 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	10	2	*	70 (21.1)	Y	13	.	.	.
RRIR1	Recovery, Isolation	2	US	GLG	GLG GPT	9'-0'' (2740)	48'' (1220)	30-40 STC 40	60 (2.9)	300 1100	B	R	L	.		1	.	.	3	.	.	3	.	.	.	.	.	- -	12	2	75 (23.9)	70 (21.1)	S	14	.	Y	Q
RROP1	Recovery, Phase II	2	US UT	GLG GPT	AT2 AT1	9'-0'' (2740)	48'' (1220)	35-45 STC 40	60 (2.9)	300 1100	B	R	L	.		1	.	.	3	.	.	3	.	.	.	.	B	+	6	2	*	70 (21.1)	S	14	.	.	.
RROP2	Recovery, Phase II, Multi-Station	2	US UT	GLG GPT	AT2 AT1	9'-0'' (2740)	P	35-45 STC 40	60 (2.9)	300 1100	D	R	L	.		1	.	.	3	.	.	3	.	.	.	.	B	+	6	2	*	70 (21.1)	S	14	.	.	.
RRSS1	Recovery, Phase I	1	US UT	GLG	GLG AT2	9'-0'' (2740)	48'' (1220)	35-45 STC 40	60 (2.9)	300 1100	B	R	L	.		1	.	.	3	.	.	3	.	.	.	.	B	+	6	2	75 (23.9)	70 (21.1)	S	14	14	.	.
SEC01	Secretary	N	CP	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SEC02	Secretary, Command	N	CP	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SHWR1	Shower Room	4	CT	GCT SSP	GLG GPT	8'-0'' (2440)	36'' (915)	30-40 STC 45	75 (3.6)	200 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.
SINK1	Sink, Staff Handwashing	Space Parameter Notes: a								.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SL001	Staff Lounge	N	LV UT	GPT	AT1	8'-0'' (2440)	36'' (915)	35-45 STC 45	60 (2.9)	300 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SRCH1	Storage, Charging, Battery / Equipment	4	UT CS	GPT	AT1 GPT	8'-0'' (2440)	42'' (1065)	30-40 STC 40	200 (9.6)	50 .	.	.	.	E		.	.	.	.	.	.	.	.	.	.	.	.	.	-	a	a	85 (29.4)	65 (18.3)	Y	13	.	Y	M
SRCS1	Storage, Crutch / Splint	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	125	100 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SRE01	Storage Room, Equipment	4	UT CS	GPT	AT1	9'-0'' (2740)	42'' (1065)	35-45 STC 40	D	100 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SRF01	Storage, Freezer, Walk-In	4	SP	SPF	SPF	VAR	SP	. .	275 (13.2)	200 .	.	.	LB	E		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	SP (SP)	SP (SP)	Y	13	.	.	.
SRF02	Storage, Freezers, Freestanding	4	UT	GLG GPT	GLG GPT	VAR	SP	30-45 STC 40	B	200 .	.	.	LB	E		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	Y	.
SRGC1	Storage, Gas Cylinders, Exterior	4	CS	BPT GPT	GPT SSP	9'-0'' (2740)	36'' (915)	30-50 STC 40	150 (7.2)	50 .	.	.	.	E		.	.	.	.	.	.	.	.	.	.	.	.	.	-	a	a	.	.	Y	.	.	Y	G
SRGC2	Storage, Gas Cylinders, Interior	4	CS UT	GLG GPT	GLG SSP	8'-0'' (2440)	36'' (915)	30-45 STC 40	150 (7.2)	200 .	.	.	LB	E		.	.	.	.	.	.	.	.	.	.	.	.	.	-	a	a	*	68 (20.0)	Y	13	.	Y	G
SRHM1	Storage, Hazardous Material	4	CS	BPT GPT	GPT	8'-0'' (2440)	36'' (915)	30-50 STC 40	125	100 .	E	.	LB	.		.	.	.	.	.	.	.	.	.	.	.	.	.	-	a	a	.	.	Y	13	.	Y	G	\1\
*SRHM2	Storage, Hazardous Drug	4	US	GLG	AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500 .	.	.	LS	.		.	.	.	.	.	.	.	.	.	.	.	.	.	EX	12		.	.	Y	r	r	Y	W	/1/
SRL01	Storage, Laboratory, Microscope Slides	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	125	100 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	+	a	a	*	70 (21.1)	Y	13	.	.	.
SRL02	Storage, Laboratory, Paraffin Blocks	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	125	100 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	+	a	a	*	70 (21.1)	Y	13	.	.	.
SRLW1	Storage, Wheelchair	4	MA UT	GPT	AT1	8'-0'' (2440)	L	30-40 STC 40	125	100 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	.	.
SRLW2	Storage, Litter	N	MA UT	GPT	AT1	8'-0'' (2440)	L	30-40 STC 40	125	100 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	70 (21.1)	Y	13	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

			ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM														MECHANICAL													
Room Code	ROOM FUNCTION	CODE	MATL & FIN			CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES PWR	POWER LT	N	MA	DA	LA	PA	MV	DSV	OE	LD	EO	NO	IA	WAGD	N	BL	TEMP AC	OA	SM	WN	RH	IN	FN	EX	N
			FL	WL	CLG																																		
SRPB1	Storage, Patient Baggage	4	UT	GPT	AT1	8’-0” (2440)	36” (915)	30-40 STC 40	125 (13.2)	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SRPS1	Storage, Parts	4	UT	GPT	AT1	8’-0” (2440)	36” (915)	30-40 STC 40	125 (13.2)	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SRR01	Storage, Refrigerator, Walk-In	4	SP	SPF	SPF	VAR	SP	.	275 (13.2)	200	.	.	LB	E	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	.	.	Y	13	.	.	.
SRR02	Storage, Refrigerators, Freestanding	4	UT	GLG GPT	GLG GPT	VAR	SP	30-40 STC 40	B	200	.	.	LB	E	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	.	.	Y	13	.	.	.
SRS01	Storage, Shelving	4	UT CS	GPT	AT1	9’-0” (2740)	36” (915)	35-45 STC 40	D	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SRS02	Central Storage Room, Medium	4	UT CS	GPT	AT1	9’-0” (2740)	36” (915)	35-45 STC 40	D	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SRS03	Central Storage Room, Large	4	UT CS	GPT	AT1	9’-0” (2740)	36” (915)	35-45 STC 40	D	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SRS04	Storage Room, Sterile	4	US ER	GLG	AT2	9’-0” (2740)	36” (915)	30-50 STC 40	D	200	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	75 (23.9)	68 (20.0)	Y	13	.	.	.
SRSE1	Storage, Equipment And Shelving	4	UT CS	GPT	AT1	9’-0” (2740)	42” (1065)	35-45 STC 40	D	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SRVE1	Storage Room, Ventilator	4	UT CS	GPT	AT1	9’-0” (2740)	42” (1065)	30-40 STC 40	150 (7.2)	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SSC01	Secure Storage, Cage	4	CS MA	GPT	AT1	9’-0” (2740)	SP	.	125	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
SSFE1	Secure Storage, Forensic Evidence	4	UT	GPT	AT1	8’-0” (2440)	36” (915)	30-40 STC 40	125 (13.2)	300	.	R	LS	U	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
SSS01	Secure Storage, Safe	4	UT CS	SSP	SSP	VAR	SP	.	C	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	.	.	Y	13	.	.	.
SSV01	Secure Storage, Vault	4	CS	CCS SSP	CCS SSP	VAR	SP	.	125 (13.2)	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	a	a	*	68 (20.0)	Y	13	.	.	.
TLTB1	Toilet, Bariatric	N	CT	GLG GCT	GLG GPT	8’-0” (2440)	48” (1220)	30-40 STC 45	75 (3.6)	200	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.
TLTF2	Toilet, Public, Female	4	CT	GLG GCT	GLG GPT	8’-0” (2440)	36” (915)	35-45 STC 45	75 (3.6)	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.
TLTM2	Toilet, Public, Male	4	CT	GLG GCT	GLG GPT	8’-0” (2440)	36” (915)	35-45 STC 45	75 (3.6)	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.
TLTP1	Toilet, Behavioral Health	4	CT SP	GPT GCT	GPT SSP	8’-0” (2440)	42” (1065)	30-40 STC 45	75 (3.6)	200	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.
TLTP2	Toilet, Behavioral Health, Seclusion	4	CT SP	GPT GCT	GPT SSP	8’-0” (2440)	L	30-40 STC 45	75 (3.6)	200	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.
TLTP3	Toilet / Shower, Behavioral Health	4	CT SP	GCT GLG	GLG SSP	8’-0” (2440)	42” (1065)	30-40 STC 45	75 (3.6)	200	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.
TLTS1	Toilet / Shower, Staff	N	CT	GCT GLG	GLG SSP	8’-0” (2440)	36” (915)	30-40 STC 45	75 (3.6)	200	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.
TLTS2	Toilet / Shower, Inpatient	4	CT	GCT GLG	GLG SSP	8’-0” (2440)	36” (915)	30-40 STC 45	75 (3.6)	200	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.
TLTU1	Toilet	4	CT	GLG GCT	GLG GPT	8’-0” (2440)	36” (915)	30-40 STC 45	75 (3.6)	200	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

			ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM												MECHANICAL											
Room Code	ROOM FUNCTION	CODE	MATL & FIN			CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES PWR	POWER LT	N	MA	DA	LA	PA	MV	DSV	OVE	LDE	OO	NO	IA	WAD	N	BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
			FL	WL	CLG																															
TRCS2	Procedure, Cystoscopic	2	US	LLG	GLG	9'-0'' (2740)	VAR	30-40 STC 50	60 (2.9)	500 1100	D	R	L	.	1	.	.	.	1	.	.	.	1	.	.	.	.	+	15	3	*	73 (22.8)	Y	14	.	.	.
TREE1	Procedure, Endoscopy	2	US	GLG	GLG	9'-0'' (2740)	D	30-40 STC 50*	60 (2.9)	500 1100	D	R	LS	.	1	.	.	.	2	.	.	.	1	.	.	.	.	- -	12	2	*	73 (22.8)	S	14	.	Y	F
TREN1	Treatment, ENT	3	US	GLG	GLG	9'-0'' (2740)	42'' (1065)	25-35 STC 50*	60 (2.9)	500 1100	A,D	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	S	14	.	.	.
TREN2	Voice Lab	3	CP UT	GPT	AT1 GPT	VAR	36'' (915)	SP STC 50	60 (2.9)	500 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
TRET1	Treatment, Emergency Trauma, Multi-Bed	1	US	GLG GPT	GLG AT2	9'-0'' (2740)	H	30-40 STC 50	60 (2.9)	1100 .	D	RA	LB	.	1	.	.	.	3	.	.	.	2	.	.	.	B	+	15	3	75 (23.9)	82 (27.8)	S	14	.	.	.
TRET3	Treatment, Emergency Trauma	1	US	GLG GPT	GLG AT2	9'-0'' (2740)	48'' (1220)	30-40 STC 50	60 (2.9)	1100 .	D	RA	LB	.	1	.	.	.	3	.	.	.	2	.	.	.	B	+	15	3	75 (23.9)	82 (27.8)	S	14	.	.	.
TRET4	Treatment, Emergency Care	2	US UT	GLG GPT	GLG AT2	9'-0'' (2740)	48'' (1220)	30-40 STC 50	60 (2.9)	500 1100	D	RA	LB	.	1	.	.	.	2	.	.	.	2	.	.	.	B	+	12	3	75 (23.9)	73 (22.8)	S	14	.	.	.
TRET5	Treatment, Emergency Care, Multi-Bed	2	US UT	GLG GPT	GLG AT2	9'-0'' (2740)	P	30-40 STC 50	60 (2.9)	500 1100	D	RA	LB	.	1	.	.	.	2	.	.	.	2	.	.	.	B	+	12	3	75 (23.9)	73 (22.8)	S	14	.	.	.
TREY1	Treatment, Ophthalmology	3	US	GPT	AT2 GPT	9'-0'' (2740)	36'' (915)	30-40 STC 50*	60 (2.9)	500 1100	A,D	.	LS	U	.	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	S	14	.	.	.
TREY2	Treatment, Eye – Laser	2	US	GPT	AT2	8'-0'' (2440)	36'' (915)	30-40 STC 50*	60 (2.9)	700 .	A	R	LS	U	.	.	.	.	1	.	.	.	1	.	.	.	.	+	15	3	R	R	S	14	.	.	.
TREY3	Treatment, Eye – Lasik / PRK	2	US UT	GLG	AT2	8'-0'' (2440)	42'' (1065)	30-40 STC 50*	60 (2.9)	700 .	A	R	LS	U	.	.	.	.	1	.	.	.	1	.	.	.	.	+	15	3	R	R	R	14	hepa	.	O,P,V
TRGM1	Treatment, General	3	US UT	GLG GPT	GLG AT2	9'-0'' (2740)	48'' (1220)	30-40 STC 50*	60 (2.9)	500 1100	D	.	LS	U	.	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	S	14	.	.	.
TRGM2	Treatment, General, Multi-Bed	3	US UT	GLG GPT	GLG AT2	9'-0'' (2740)	48'' (1220)	30-40 STC 50	60 (2.9)	500 1100	D	.	.	.	1	.	.	.	1	.	.	.	1	.	.	.	B	nr	6	2	*	73 (22.8)	S	14	.	.	.
TRGS1	Treatment, General Surgical	3	US	GLG	GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 50*	60 (2.9)	500 1100	D	.	LS	U	1	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	S	14	.	.	.
TRGS2	Treatment, General Surgical, Airborne Infection Isolation	3	US	GLG	GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 50*	60 (2.9)	500 1100	D	.	LS	U	1	.	.	.	1	.	.	.	1	.	.	.	.	- -	12	2	*	73 (22.8)	S	14	.	Y	.
TRGS3	Treatment, General Surgical, Laser	3	US	GLG	GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 50*	60 (2.9)	500 1100	A,D	.	LS	U	1	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	68 (20.0)	S	14	.	.	.
TROB1	Treatment, OB / GYN	C	US	GLG	GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 50*	60 (2.9)	500 1100	D	.	LS	U	1	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	S	14	.	.	.
TROR1	Procedure, Orthopaedic	3	US	GLG	GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 50*	60 (2.9)	500 1100	D	.	LS	U	1	.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	S	14	.	.	.
TRPE1	Procedure, Proctoscopy (LGI)	2	US	GLG	GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 50*	60 (2.9)	500 1100	D	R	LS	.	1	.	.	.	2	.	.	.	1	.	.	.	.	-	10	2	*	73 (22.8)	S	14	.	Y	.
TRPE2	Procedure, Bronchoscopy	2	US	GLG	GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 50*	60 (2.9)	500 1100	D	R	LS	.	1	.	.	.	2	.	.	.	1	.	.	.	.	- -	12	2	*	73 (22.8)	S	14	.	Y	.
TUB01	Tub Room, Patient	3	CT	GCT GLG	GLG GPT	8'-0'' (2440)	48'' (1220)	30-40 STC 45	C	200 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	EX	10	.	.	68 (20.0)	Y	13	.	Y	.
UCCL1	Utility, Clean	4	UT	GPT	AT1	8'-0'' (2440)	42'' (1065)	30-40 STC 40	100 (4.8)	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	14	.	.	.
UCCL2	Utility, Scope Wash, Clean	4	US	GPT	AT1 AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	14	.	.	.
USCL1	Utility, Soiled	4	US 0	GLG	AT1 AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES	POWER PWR	LT	N	MEDICAL GAS AND VACUUM MA	DA	LA	PA	MV	DSV	OE	LDE	OO	NO	IA	WAD	N	MECHANICAL TEMP BL	AC	OA	SM	WN	RH	IN	FN	EX	N
USCL2	Utility, Scope Wash, Soiled	4	PR SM	GLG	AT1 AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500 .	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	-	10	2	*	68 (20.0)	Y	14	.	Y	M
USDD1	Utility, Soiled, Detergent Dispensing	4	PR SM	GLG	AT1 AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	C	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	.
UTC01	Utility, Trash Collection	4	CS	GLG SSP	GLG SSP	8'-0'' (2440)	36'' (915)	30-40 STC 40	125	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	1	*	68 (20.0)	Y	13	.	Y	.
UTC02	Utility, Trash Can Decon	4	CS	CCS SSP	GLG SSP	8'-0'' (2440)	36'' (915)	30-40 STC 40	B	50 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	1	.	.	Y	13	.	Y	.
UTLC1	Utility, Trash and Linen Collection	4	UT	GLG SSP	GLG SSP	8'-0'' (2440)	36'' (915)	30-40 STC 40	C	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	1	*	68 (20.0)	Y	13	.	Y	.
UTMW1	Utility, Medical Waste Holding	4	PR SM	GLG	AT1 AT2	8'-0'' (2440)	42'' (1065)	30-40 STC 40	100 (4.8)	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	.
UTR01	Utility, Waste Recycling	4	UT US	GLG	AT1 AT2	8'-0'' (2440)	42'' (1065)	30-40 STC 40	125	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	.
UTR02	Utility Room, Waste Pulper System	4	UT US	GLG	AT1 AT2	8'-0'' (2440)	36'' (915)	30-40 STC 40	F	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2	*	68 (20.0)	Y	13	.	Y	.
VCSS1	Veterinary, Instrument Preparation	N	ER	GEP	AT2 GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 50	C	700 .	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	-	10	2	*	68 (20.0)	Y	14	.	Y	.
VCWA1	Veterinary, Cage Wash	N	ER	BEP GEP	AT2	9'-0'' (2740)	48'' (1220)	30-40 STC 50	C	200 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	1	*	68 (20.0)	Y	13	.	Y	.
VEX01	Veterinary, Examination / Treatment	3	US ER	GEP	AT2	9'-0'' (2740)	36'' (915)	30-40 STC 50	C	500 1100	D	R	LB	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	Y	.
VEX02	Veterinary, General Treatment	3	US ER	GEP	AT2	9'-0'' (2740)	48'' (1220)	30-40 STC 50	C	500 1100	D	R	LB	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	-	4	2	*	68 (20.0)	Y	13	.	Y	.
VFP01	Veterinary, Food Preparation	N	US	GEP	AT2	9'-0'' (2740)	48'' (1220)	30-40 STC 50	C	500 .	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	*	68 (20.0)	Y	14	.	Y	.
VHAU1	Veterinary, Holding Area Utility / Storage	N	ER	BEP GEP	AT2 GPT	9'-0'' (2740)	48'' (1220)	30-40 STC 50	C	150 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	13	.	Y	.
VKAR1	Veterinary, Kennel Confine, Anteroom	N	ER	GEP	GEP	9'-0'' (2740)	48'' (1220)	30-40 STC 50	C	100 300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	5	*	68 (20.0)	Y	13	.	Y	L
VKEN1	Veterinary, Kennel Area In / Outside	N	ER	BEP GEP	AT2 GEP	9'-0'' (2740)	48'' (1220)	30-40 STC 50	C	100 300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	5	*	68 (20.0)	Y	13	.	Y	L
VKEN2	Veterinary, Kennel Confine Canine	N	ER	BEP GEP	AT2 GPT	9'-0'' (2740)	48'' (1220)	30-40 STC 50	C	100 300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	5	*	68 (20.0)	Y	13	.	Y	L
VKEN3	Veterinary, Kennel Confine Feline	N	ER	BEP GEP	AT2 GPT	9'-0'' (2740)	48'' (1220)	30-40 STC 50	C	100 300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	5	*	79 (26.1)	Y	13	.	Y	L
VLAH1	Veterinary, Large Animal Holding	N	ER	BEP GEP	AT2 GPT	9'-0'' (2740)	VET	30-40 STC 50	C	100 300	.	.	LS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	5	*	79 (26.1)	Y	13	.	Y	L
VLB01	Veterinary, Laboratory	N	ER	GEP	GEP	9'-0'' (2740)	48'' (1220)	30-40 STC 40	C	500 1100	.	.	LB	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	13	.	.	M
VLBF1	Veterinary, Lab, Food Inspection	N	AR	GEP	GEP	9'-0'' (2740)	48'' (1220)	30-40 STC 40	C	500 1100	.	.	LB	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	13	.	Y	.
VLBF2	Veterinary, Lab, Food Testing	N	AR	GEP	AT2 GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 40	C	500 1100	.	.	LB	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	13	.	Y	.
VNEC1	Veterinary, Necropsy	4	ER	GEP	GEP	9'-0'' (2740)	48'' (1220)	30-40 STC 40	C	700 1600	D	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	-	12	3	R	R	Y	13	.	Y	M
VPH01	Veterinary, Pharmacy	N	ER	GEP	GEP	9'-0'' (2740)	48'' (1220)	30-40 STC 40	C	1100 .	.	R	L	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	4	2	*	68 (20.0)	Y	13	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

Room Code	ROOM FUNCTION	COD E	ARCHITECTURAL MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	STRUCTURAL FLR LD	ELECTRICAL LIGHT LEV	N	ES	POWER R	LT	N	MEDICAL GAS AND VACUUM M A	D A	L A	P A	M V	D S V	O E	L D E	O	N O	A	I	W A G D	N	MECHANICAL TEMP BL	AC	OA	SM	WN	RH	IN	FN	EX	N
VRHA1	Veterinary, Rodent Holding	N	ER	BEP	GEP	9'-0'' (2740)	VET	30-40 STC 50	C	100 300	.	R	LS	.		.	.	.	.	.	.	.	.	.	.	.	.	.	-	15	15	*	79 (26.1)	Y	13	.	Y	.
VRIC1	Veterinary, Recovery, Intensive Care	2	ER	GEP	AT2 GLG	9'-0'' (2740)	48'' (1220)	30-40 STC 50	C	500 .	.	R	LB	.		1	.	.	1	.	.	.	1	.	.	.	.	.	+	6	3	*	68 (20.0)	Y	13	.	Y	L
VRRP1	Veterinary, Recovery Room / Preparation	2	ER	GEP	AT1	9'-0'' (2740)	48'' (1220)	30-40 STC 40	C	500 .	.	R	LB	.		1	.	.	1	.	.	.	1	.	.	.	.	.	+	6	3	64 (17.8)	79 (26.1)	Y	13	.	Y	.
VRUN1	Veterinary, Animal Run	N	ER	BEP	GEP	9'-0'' (2740)	48'' (1220)	30-40 STC 40	C	100 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	3	*	68 (20.0)	Y	13	.	Y	L
VS001	Veterinary, Surgery	1	ER	GEP	GEP	9'-0'' (2740)	48'' (1220)	30-40 STC 40	C	2100 .	D	R	LB	.		1	.	.	2	.	.	.	1	.	.	1	.	.	+	15	7.5	64 (17.8)	79 (26.1)	Y	13	14	Y	C
VSPD1	Veterinary, Surgery, Preparation / Dental	1	ER	GEP	GEP	9'-0'' (2740)	48'' (1220)	30-40 STC 40	C	500 1100	D	R	LB	.		1	1	.	1	1	.	.	.	.	1	1	.	.	+	6	2	64 (17.8)	79 (26.1)	Y	13	.	Y	.
VSSG1	Veterinary, Surgery, Scrub / Gown	N	ER	GEP	GEP	9'-0'' (2740)	N	30-40 STC 40	C	1100 .	.	.	LB	.		.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	75 (23.9)	75 (23.9)	Y	14	.	.	.
VXER1	Veterinary, X-Ray Exposure	N	ER	LEP	GEP	9'-6'' (2900)	48'' (1220)	30-40 STC 40	C	500 .	I	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	Y	.
VXER2	Veterinary, Ultrasound	3	ER	GEP	AT2 GLG	9'-0'' (2740)	VET	30-40 STC 50	C	300 500	.	.	.	.		1	.	.	1	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	Y	.
WKTM1	Workroom, Team	4	UT CP	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	500 .	.	.	L	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	70 (21.1)	Y	13	.	.	.
WRC01	Waiting	4	PR UT	GPT	AT1 SSP	9'-0'' (2740)	O	35-45 STC 50*	100 (4.8)	300 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	*	68 (20.0)	Y	14	.	.	S
WRC02	Waiting, Isolation	4	US UT	GLG GPT	GLG GPT	9'-0'' (2740)	42'' (1065)	35-45 STC 50*	100 (4.8)	300 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	-	-	12	2	*	68 (20.0)	Y	13	.	Y	Q
WRC03	Sub-Waiting	4	SP UT	GPT	AT1	9'-0'' (2740)	O	35-45 STC 50*	100 (4.8)	300 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	*	68 (20.0)	Y	14	.	.	S
WRCH1	Team Collaboration	4	CP UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	60 (2.9)	500 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	70 (21.1)	Y	13	.	.	.
WRF01	Family Respite	4	CP UT	GPT	AT1	9'-0'' (2740)	36'' (915)	35-45 STC 50*	60 (2.9)	300 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	1	*	68 (20.0)	Y	14	.	.	S
WRL01	Litter, Patient Staging	4	UT	GPT	AT1	9'-0'' (2740)	42'' (1065)	35-45 STC 50*	60 (2.9)	300 .	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	70 (21.1)	Y	14	.	.	.
XABP1	X-Ray, Angiographic, Procedure	1	US UT	LLG LPT	AT1 GPT	10'-0'' (3050)	48'' (1220)	30-40 STC 40	100 (4.8)	500 .	D,I	R	LB	U		1	.	.	2	.	.	.	1	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XACR1	X-Ray, Angiographic, Control	4	US UT	GLG GPT	AT1 GPT	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	.	.	.	U		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.
XACV1	X-Ray, Angiographic, System Component	4	US UT	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	.	.	.	U		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	N
XAIR1	X-Ray, Angiographic, Instrument	4	US UT	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	.	.	.	U		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.
XCCA1	X-Ray, Cardiac, System Component	4	US UT	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500 .	.	RA	LB	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	68 (20.0)	75 (23.9)	Y	14	.	.	N
XCCC1	X-Ray, Cardiac Cath, Control	4	US UT	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	A	R	L	.		.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	68 (20.0)	75 (23.9)	Y	14	.	.	N
XCCE1	X-Ray, Cardiac Cath, Procedure	1	US UT	LLG LPT	AT1 GPT	10'-0'' (3050)	48'' (1220)	30-40 STC 40	100 (4.8)	300 .	A	R	L	.		1	.	.	2	.	.	.	3	1	.	1	.	.	+	15	3	75 (23.9)	73 (22.8)	Y	14	.	.	C
XCCI1	X-Ray, Cardiac Cath, Instrument	4	US UT	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	.	.	LS	.		.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	2	68 (20.0)	75 (23.9)	Y	14	.	.	.

Table B-1 (cont.) Architectural and Engineering Design Criteria

			ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM														MECHANICAL														
Room Code	ROOM FUNCTION	COD E	MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES	POWER PWR	LT	N	M A	D A	L A	P A	M V	D S V	O E	L D E	O	N O	A	I A	W A G D	N	BL	AC	OA	SM	TEMP WN	RH	IN	FN	EX	N
XCTC1	X-Ray, Computed Tomography, Control	4	US UT	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	A	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.
XCTC2	X-Ray, Computed Tomography, Component	4	US UT	GLG GPT	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 40	C	300 .	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	N
XCTI1	X-Ray, Computed Tomography, Independent View Console	4	US UT	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	A	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	70 (21.1)	Y	13	.	.	N
XCTS1	X-Ray, Computed Tomography, Scanner	C	US UT	LLG LPT	AT1 GPT	VAR	48'' (1220)	30-40 STC 40	100 (4.8)	500 .	D,I	.	.	U	.	.	.	.	1	.	.	1	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XDBD1	X-Ray, Bone Densitometer	3	US UT	GLG GLG	AT1 GPT	9'-0'' (2740)	48'' (1220)	30-40 STC 40	100 (4.8)	500 .	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XDCS1	X-Ray, Chest	3	US UT	LLG LPT	AT1 GPT	10'-0'' (3050)	48'' (1220)	30-40 STC 40	100 (4.8)	500 .	A	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XDCY1	X-Ray, Cystology / Radiology	2	US UT	LLG LPT	AT1 GPT	10'-0'' (3050)	48'' (1220)	30-40 STC 40	100 (4.8)	500 .	D,I	R	LB	.	1	.	.	3	.	.	1	.	.	.	D	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XDM01	X-Ray, Mammo	3	US UT	LLG LPT	AT1 GPT	9'-0'' (2740)	48'' (1220)	30-40 STC 40	100 (4.8)	500 .	A	.	LS	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	73 (22.8)	Y	14	.	.	.
XDM02	X-Ray, Mammo, Stereotactic	2	US UT	LLG LPT	AT1	9'-0'' (2740)	48'' (1220)	30-40 STC 40	100 (4.8)	500 .	A	.	LS	U	.	.	.	.	1	.	.	1	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XDMP1	X-Ray, Mammo, Process	4	US UT	GLG GPT	AT1 GPT	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	500 .	A	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	10	2.5	*	73 (22.8)	Y	14	.	Y	M
XDR01	X-Ray, Radiographic, General	3	UT	LLG LPT	AT1	9'-6'' (2900)	48'' (1220)	30-40 STC 40	100 (4.8)	500 .	I	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XDRF1	X-Ray, Rad / Fluoro	C	UT	LLG LPT	AT1	9'-6'' (2900)	48'' (1220)	30-40 STC 40	100 (4.8)	500 .	I	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XDUS1	X-Ray, Ultrasound	3	UT	GPT GLG	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 45	100 (4.8)	500 .	A	.	.	U	.	.	.	.	1	.	.	1	.	.	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XFDS1	X-Ray, Storage, Digital Files	4	UT	GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	6	1	*	68 (20.0)	Y	13	.	.	N
XFFA1	X-Ray, Storage, Film Files, Fixed Shelves	4	UT	GPT	AT1	VAR	36'' (915)	30-40 STC 40	250 (12.0)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	.
XFFA2	X-Ray, Storage, Film Files, Mobile Shelves	4	UT	GPT	AT1	VAR	36'' (915)	30-40 STC 40	350 (16.8)	300 .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	.
XMRC1	X-Ray, Magnetic Resonance, Control	4	UT US	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	A	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	.
XMRC2	X-Ray, Magnetic Resonance, System Component	4	UT US	GLG GPT	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 40	100 (4.8)	300 .	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	N
XMRE1	X-Ray, Magnetic Resonance, Equipment	4	UT US	GLG GPT	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 40	100 (4.8)	300 .	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	.
XMRF1	X-Ray, Magnetic Resonance, Ferromagnetic Detection	4	UT US	GLG GPT	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 40	100 (4.8)	300 .	.	R	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	.
XMRS1	X-Ray, Magnetic Resonance, Scanner	3	UT US	GLG GPT	AT1	VAR	48'' (1220)	30-40 STC 50	C	300 .	I	.	.	U	1	.	.	1	.	.	1	1	.	1	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XMRV1	X-Ray, Magnetic Resonance, Viewing	4	UT US	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	.	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	.
XPCC1	X-Ray, SPECT / PET / CT Control	4	US UT	GLG GPT	AT1	8'-0'' (2440)	36'' (915)	30-40 STC 40	100 (4.8)	300 .	A	R	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	70 (21.1)	Y	13	.	.	N
XPCC2	X-Ray, SPECT / PET / CT Component	4	US UT	GLG GPT	AT1	8'-0'' (2440)	48'' (1220)	30-40 STC 40	100 (4.8)	300 .	A	.	.	U	.	.	.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	N

Table B-1 (cont.) Architectural and Engineering Design Criteria

			ARCHITECTURAL						STRUCTURAL	ELECTRICAL				MEDICAL GAS AND VACUUM														MECHANICAL													
Room Code	ROOM FUNCTION	COD E	MATL & FIN FL	WL	CLG	CLG HT	DOOR SIZE	NC & STC	FLR LD	LIGHT LEV	N	ES	POWER PWR	LT	N	MA	DA	LA	PA	MV	DSV	LOE	DE	OO	NO	IA	WAD	N	BL	AC	OA	TEMP SM	WN	RH	IN	FN	EX	N
XRM01	X-Ray, Storage, Mobile Rad Unit	4	UT GPT US GPT		AT1	8'-0" (2440)	L	30-40 STC 40	100 (4.8)	150	.	.	.	E		.	.	.	.	.	.	.	.	.	.	.	.	nr	.	.	.	.	Y	13	.	.	.
XTBC1	X-Ray, Brachytherapy, Control	4	US GLG UT GPT		AT1	8'-0" (2440)	36" (915)	30-40 STC 40	E	300	A	R	.	U		.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	70 (21.1)	Y	13	.	.	N
XTBT1	X-Ray, Brachytherapy	2	UT LLG US LPT		AT1	8'-6" (2590)	48" (1220)	30-40 STC 40	100 (4.8)	700	A	.	LB	U		1	.	.	.	1	.	.	.	1	.	.	.	+	6	2	*	70 (21.1)	Y	14	.	Y	.
XTEM1	X-Ray, Therapy, Entry Maze	4	US GLG UT GPT		AT1	10'-0" (3050)	SP	30-40 STC 40	C	200	.	.	LS	.		.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
XTLA1	X-Ray, Therapy, Linear Accelerator	3	US GLG UT GPT		AT1	10'-0" (3050)	48" (1220)	30-40 STC 40	C	500	D,I	.	LB	.		.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	Y	.
XTLA2	X-Ray, Therapy, Linear Accelerator, High Voltage	3	US GLG UT GPT		AT1	10'-0" (3050)	48" (1220)	30-40 STC 40	C	500	D,I	.	LB	.		.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	Y	.
XTLA3	X-Ray, Therapy, Linear Accelerator, Dual Voltage	3	US GLG UT GPT		AT1	10'-0" (3050)	48" (1220)	30-40 STC 40	C	500	D,I	.	LB	.		.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	73 (22.8)	Y	14	.	Y	.
XTLB1	X-Ray, Therapy, Physics Laboratory	4	US GLG UT GPT		AT1	9'-0" (2740)	36" (915)	30-40 STC 40	100 (4.8)	500 1100	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	70 (21.1)	Y	13	.	.	.
XTLC1	X-Ray, Therapy, Linear Accelerator, Control	4	US GLG UT GPT		AT1	8'-0" (2440)	48" (1220)	30-40 STC 40	100 (4.8)	300	A	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
XTLE1	X-Ray, Therapy, Linear Accelerator, System Component	4	US GLG UT GPT		AT1	VAR	36" (915)	30-40 STC 40	100 (4.8)	500	A	.	LB	U		.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	14	.	.	N
XTMF1	X-Ray, Therapy, Mold Fabrication Shop	4	US GLG UT GPT		AT1	9'-0" (2740)	36" (915)	30-40 STC 40	100 (4.8)	500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	13	.	Y	M
XTRT1	X-Ray, Therapy, Radium Treatment Storage / Preparation	4	US LLG UT LPT		AT1	8'-0" (2440)	36" (915)	30-40 STC 40	100 (4.8)	500 1100	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	-	6	2	*	68 (20.0)	Y	13	.	Y	M
XTSC1	X-Ray, Therapy, Simulator Control	4	US GLG UT GPT		AT1	8'-0" (2440)	36" (915)	30-40 STC 40	100 (4.8)	300	A	.	LB	.		.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	68 (20.0)	Y	13	.	.	.
XTSC2	X-Ray, Therapy, Simulator, System Component	4	US GLG UT GPT		AT1	8'-0" (2440)	48" (1220)	30-40 STC 40	C	300	A	.	.	U		.	.	.	.	.	.	.	.	.	.	.	.	nr	4	2	*	68 (20.0)	Y	13	.	.	N
XTSG1	X-Ray, Therapy, Simulator Gantry	4	US GLG UT GPT		AT1	10'-0" (3050)	48" (1220)	30-40 STC 40	100 (4.8)	300	.	.	.	.		.	.	.	1	.	.	.	1	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.
XTSM1	X-Ray, Therapy, Simulator, Magnetic Resonance	4	UT GLG US GPT		AT1	VAR	48" (1220)	30-40 STC 50	E	300	I	.	.	.		1	.	.	1	.	.	.	1	1	.	1	.	nr	6	2	*	73 (22.8)	Y	14	.	.	.
XTTP1	X-Ray, Therapy, Treatment Planning	4	UT GLG US GPT		AT1	8'-0" (2440)	36" (915)	30-40 STC 40	100 (4.8)	500	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	nr	6	2	*	70 (21.1)	Y	13	.	.	.
XVC01	X-Ray, Viewing / Consultation	4	UT GPT US GLG		AT1	8'-0" (2440)	36" (915)	30-40 STC 40	60 (2.9)	300	A	.	LS	U		.	.	.	.	.	.	.	.	.	.	.	.	nr	4	1	*	68 (20.0)		13	.	.	.

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APPENDIX C DESIGN SUBMITTALS AND DOCUMENTATION

C-1 GENERAL.

This appendix contains mandatory criteria for design submittals and documentation. It addresses narratives, drawings, calculations, specifications, and cost estimates required at various submission levels during the production of contract documents for each project.

C-2 APPLICATION.

The submission requirements in this appendix identify minimum design deliverables related to medical-specific criteria. This list is not comprehensive and must be supplemented or incorporated into comprehensive project specific submission requirements by the Design and Construction Agent.

C-3 GENERAL REQUIREMENTS.

These general requirements apply to all projects, acquisition types and submissions.

C-3.1 Design Analysis.

The Design Analysis includes the narrative and calculations and serves as a documented design history of each technical discipline represented in the project. The descriptions of systems being proposed must continue to be elaborated and expanded through all subsequent design submissions. The Design Analysis must document all design directives provided to the designer(s) of record, as well as all major decisions by the designer(s) of record regarding the design for particular systems. Attention must be given to ensure that the Design Analysis provides a complete detailed narrative on the scope, equipment, function, operation, and design history of each system. The Design Analysis serves as the basic document against which the design shown on the drawings and in the specifications is checked.

Arrange the Design Analysis into indexed and tabulated PDF binders by discipline in the same order as the corresponding technical chapters of UFC 4-510-01 as well as a comprehensive binder with all disciplines. Identify and date all documents according to project title and level of submission. Project title must exactly reflect that which is noted on the enacted DD Form 1391.

C-3.2 Drawings and Format.

Drawing format and submissions must be as follows unless otherwise directed by the Design and Construction Agent.

C-3.2.1 Building Information Modeling (BIM).

Utilize BIM to develop all designs and produce all drawings. All plans must be of sufficient scale to be legible when printed at half size. Provide electronic drawings in

PDF, BIM, and CAD format. Provide PDF binders with all drawings in order as well as providing individual files. Provide electronic submissions on CD/DVD and via upload. Reference Chapter 18 for specific execution. Submittals to Health Information Technology (HIT) must commence with the 65% submittal stage.

C-3.2.2 Perspective Drawing Sketch and Final Rendering.

C-3.2.2.1 Perspective Drawing Sketch.

The perspective drawing sketch must best depict the proposed facility and its prominent design features as directed by the Design and Construction Agent. This sketch must be the basis for subsequent rendering requirements.

C-3.2.2.2 Rendering.

A final rendering must be prepared from the perspective drawing sketch that reflects all review comments. Digital copies of the photo-realistic rendering must be provided to the DoD Project Sponsor by the Design and Construction Agent via CD electronic format, or in framed format on a case by case basis when so requested by the DoD Project Sponsor. The framed photographs must be titled, single matted, framed, and glazed with non-glare tempered glass or plexiglass. The frame must be 28 in. by 20 in. (710 mm by 510 mm) in dimension and of a brushed aluminum finish. Other photographs must be distributed as determined by the Design and Construction Agent.

C-3.3 Specifications.

Provide specifications as required for each submission.

C-3.4 Cost Estimates.

Provide cost estimates as required for each submission in electronic format.

C-3.5 Building Systems Risk Assessment.

Not later than the 20 percent design (DBB process) submission, the Architect-Engineer (A/E) must conduct a risk assessment to confirm or establish the Building System Category for each of the various facility systems in accordance with NFPA 99. For the DB process, the assessment must be conducted by the A/E and included as part of the RFP development. In all cases, the assessment must be fully coordinated with the DoD Project Sponsor and the Design and Construction Agent at each submittal milestone, and document system requirements necessary to adequately safeguard occupant safety, health, and comfort based on the intended CONOPS and acuity of the patient population to be served by that facility. The completed Risk Assessment will be provided to the DoD Project Sponsor by the Design and Construction Agent for concurrence.

C-4 5 PERCENT SUBMITTAL.

C-4.1 5 Percent Submittal Design Analysis.

Include pros and cons of presented block plans, preliminary site information, and architectural, transportation, and engineering considerations. Provide an Executive Summary of the 5 Percent Report documenting the selected solution to be further developed to 20 percent design.

C-4.2 5 Percent Submittal Drawings.

C-4.2.1 Site Plans.

The A/E must develop and present alternative site plans supporting the three block plan proposals. For each site plan, show the following:

a. Site Master Plan of each alternative and include; location and orientation of all new building structures, Installation impacts, adjacent building/structures impact, environmental adjacencies, roads, paths and service access, previous demolished structures, potential site contaminants (firing range, fuel containment, etc.), known utilities location/layout overview, and any easements and land-use agreements. Include existing structures (note whether they are to remain or be considered for demolition).

b. Antiterrorism standoff distances.

c. Site views that will cause an impact to the orientation of the building such as, natural weather conditions, for example, wind/sandstorms and seasonal sun orientation.

d. Existing site topography that may impact building development.

e. Major utility connection locations (points of origin).

f. On- and offsite vehicular and service traffic patterns to include primary and secondary roadways surrounding the site.

g. Parking requirements as shown on the DD Form 1391 (surface or structured).

h. Future building expansion (20 percent of the enacted DD Form 1391 gross building area [in GSF (GSM)]); include future parking structure locations as applicable.

i. Site noise/sound, smell generating conditions, for example, proximity to major highway, adjacency to an airport, sewage treatment, etc.

j. Optional location or methodology to incorporate the VA or other organization’s program, if applicable.

C-4.2.2 Block Plans.

Up to three block plans and site access/orientation studies must be developed to convey the project requirements. Each block plan must show floor to floor and departmental relationships; exterior elevation views; location of vertical and horizontal transportation systems, for example, elevators, escalators, and stairs; interior circulation patterns; operational movement of materials, supplies and people; and impacts to corridor widths due to transportation solutions or other unique conditions, for example, AGVs, IBS, or similar systems. Include principle key dimensions. Site access/orientation must show placement of the facility and drives on the selected site, neighboring issues that may impact the project, and must convey pedestrian and vehicular movement across and within the site. The site plan should identify and convey restrictions that may impact the placement and orientation of the facility. The A/E must develop a final block plan representative of the selected solutions for the 20 percent submittal.

C-4.2.3 Rehabilitation Work.

Clearly delineate the extent and scope of rehabilitation work, including all associated work in these areas such as: connections, demolition, finishes, upgrades, utilities, ductwork, IT support, etc. Indicate limits of construction, access control means, interim life safety design, Infection Control Risk Assessment (ICRA) based temporary barriers, security monitoring, schematic HVAC reconfiguration, and any other relevant information to demonstrate how the rehabilitation work will be conducted without compromising life, health, or safety.

C-4.3 5 Percent Submittal Cost Estimates.

C-4.3.1 Parametric Cost Estimates.

Provide a parametric cost estimate for each block plan developed, including any requested design solution(s) that could exceed the budget.

C-5 20 PERCENT SUBMITTAL.

This Submittal includes development of the room-by-room floor plans, building elevations, and preliminary analysis of major architectural and engineering systems based on the selected block plan. It identifies and resolves all major PFD changes, solidifies all space requirements, coordinates departmental or mission realignment, and ensures that the designed scope complies with the appropriate authorization scope.

The Submittal must illustrate the building massing, aesthetics, exterior finishes, and identify specific architectural and engineering features. Include O&M access for primary MEP and communication equipment, primary distribution pathways, storm-water management strategy to meet the requirements of EISA, establish the cost and scope for providing necessary utility services to and from the building, and identify major building entrances from parking and pedestrian paths of travel. The Submittal must

consider and establish preliminary phasing considerations and scope impacts, and address transportation, logistics, and waste management requirements of the facility.

C-5.1 Scope Changes.

Scope changes must be submitted and authorized to the Design and Construction Agent by the DoD Project Sponsor with the 20 Percent Submittal. Scope changes are defined as those that materially affect the characteristics of the facilities (for example, Category Code) or increase the GSF as defined in Block 8 of the DD1391. Refer to Chapter 3. Provide a clear justification and basis for any increases to the GSF, for example, mission changes, workload increases, and increases in troop numbers due to troop or unit reassignments.

C-5.2 Record Copy.

The Design and Construction Agent must submit a record copy of the 20 percent submittal to the DoD Project Sponsor. No approval from the DoD Project Sponsor is required at the 20 percent submittal. However, a presentation to the DoD Project Sponsor will be required if the project has exceeded the authorized scope or is over budget.

C-5.3 20 Percent Design Analysis.

The following are minimum 20 Percent Design Analysis Submittal describing proposed architectural and engineering aspects of the project.

C-5.3.1 Executive Summary

The executive summary must include this narrative information:

a. Rationale for the selected block plan scheme;

b. Proposed architectural and engineering systems;

c. Approach to sustainable design, energy reduction, and other related energy compliant features to the project;

d. Designed scope and budget compared to the authorized scope and budget;

e. Specific military base requirements impacting the design of the project, for example, building exterior finishes, excessive noise factors, and other site/building constraints; and

f. Utility services available and their points of entry into the project's site, including privatized utilities and their impact on scope and cost to the project.

C-5.3.2 Codes and Criteria

Include a separate chapter to identify a single, consolidated list of applicable criteria, with an effective date noted with each criterion, for all disciplines to follow in the project. List all mandatory criteria, codes, and standards with which the project must comply.

C-5.3.3 World-Class Checklist.

A World-Class Checklist in accordance with the World Class Toolkit requirements must be developed for every project providing direct patient care and must include all architectural and engineering disciplines. It must be applied across the entire life of a project, from conception to recapitalization, and apply to rehabilitation of a facility. For projects involving rehabilitation work including addition/renovation projects, refer to the original project's World-Class Checklist and documentation to ensure these standards are maintained and continued.

C-5.3.4 Civil.

Refine the 5 percent submittal site investigation and utilities report. Discuss approach to Storm-water Management and "Low Impact Development". Address pedestrian circulation, parking requirements, and vehicular circulation for all selected vehicle types. Refer to Chapter 2 and Appendix G.

C-5.3.5 Architectural.

Address the overall architectural concept including: exterior wall systems and finish materials, acoustics (both exterior and interior), base architectural plan, floor-to-floor heights, roofing materials, slope(s), styles, energy conservation features, sustainable design, commissioning, as well as accessibility provisions for the disabled. Describe how proposed material selections and finishes must support aseptic environments, infection control and patient/staff safety.

Address impact of technically complex equipment and medical systems (for example imaging equipment; MRI, lithotripsy units; audiology booths; sterilizers, etc.) and determine scope in preparation for future design development requiring specialty consultant involvement (for example health physicist report). Refer to Chapter 15 and Appendix D.

Further develop the Safety Risk Assessment (SRA) initiated by the DoD Project Sponsor during predesign, as indicated in paragraph 3-7.7. Refer to Appendix A for requirements for Behavioral Health.

C-5.3.6 Interstitial Building System (IBS).

If applicable to the project, address IBS to include its design, documentation, and technical requirements in accordance with Appendix E.

C-5.3.7 Structural.

Discuss and describe the justification and basis for the proposed system.

C-5.3.8 Seismic.

Discuss the seismic design considerations and the level of protection required. Evaluate the seismic impacts to the structural design system being proposed for new facilities. For projects involving rehabilitation work including addition/alteration projects, provide a preliminary Facility Upgrade Report that includes a Seismic Structural Assessment and Evaluation Study.

C-5.3.9 Heating, Ventilation, and Air Conditioning.

Identify the project specific design weather data to be utilized. Discuss design considerations and space requirements for the primary and secondary HVAC systems being considered and how they compare based on Life Cycle cost Analysis. Identify equipment redundancies, continuity of service, spare capacity, and space provisions for future expansion of energy plants and mechanical rooms. Identify required minimum zoning to coordinate with continuity of service and smoke compartments (for example defend-in-place strategy). Also, demonstrate how the design will provide weather-protection; direct floor-to-ground access for equipment O&M, for example, pallet transport via hydraulic hand carts; and practical means of future replacement. Prepare a preliminary Air Balance Summary identifying each room in the project, corresponding room code, summer/winter design temperature and relative humidity, and applicable ventilation requirements such as the minimum total air changes, outdoor air changes, as well as special ventilation requirements to be developed in further design stages (for example USP 797, USP 800, BSL criteria etc.).

Perform a preliminary analysis of site specific and building specific considerations for air intakes and exhausts per paragraph 10-11.4 including considering the impacts of surrounding buildings. Address health and odor aspects for air intakes. Identify all intakes and exhaust sources which must be evaluated including those for surrounding buildings (for example laboratory exhaust, sanitary vents, standby generators exhaust, boiler exhaust, cooling tower discharge, kitchen exhaust, vehicle exhaust etc.). Provide any building siting or orientation recommendations to reduce noted risks. Provide a recommended analysis approach for the detailed 35% analysis (for example basic prescriptive separation, numerical dispersion modelling, computational fluid dynamics analysis, wind tunnel modeling analysis etc.) supported by the building and site specific risks and considerations.

C-5.3.10 Plumbing and Medical Gas.

Discuss design considerations and space requirements for plumbing systems to include: domestic hot, cold, recirculation water, high purity water systems, water supply, water quality, existing water management program coordination, conceptual water system analysis, waterborne pathogen control, water treatment, continuity of service,

hot water generation, storage requirements, temperatures; and distribution systems, fuel gas, sanitary waste and vent, and storm drains. Provide a water chemistry analysis IAW Chapter 9 or utilize local historical test data to conceptualize water treatment requirements. Address compliance with post-seismic storage and water conservation criteria and regulations, if applicable.

Discuss design considerations and space requirements for medical gas systems to include types, storage, and distribution systems. Identify the System Category of each medical gas system in accordance with the Risk Assessment. Identify all locations where medical gas is utilized and how it is to be served (and stored) whether provided centralized with on-site producers, bottle manifolds or with portable bottles, as coordinated with the DoD Project Sponsor.

C-5.3.11 Electrical.

The Design Analysis must present design considerations and interior/exterior space requirements for electrical systems as required by UFC 3-501-01, paragraphs 3-2.1, 3-2.2, and 3-2.3. Include voltage selection; availability of primary power as required by Chapter 11; reliability of the primary distribution system; normal and essential (Type 1 or 2) or standby (Emergency, Legally-Required, Non-Essential / Optional) electrical systems; and lighting systems. Address compliance with seismic requirements in Chapter 7.

C-5.3.12 Communications.

Discuss design considerations and space requirements for all communications systems required for the project. Include listing of each technology system to be included per the project room contents list and brief discussion of its functionality. Discuss method for inclusion of ports per room type and/or equipment requirements.

C-5.3.13 Fire Protection and Life Safety.

Address the fire detection, fire alarm, fire extinguishment, and fire suppression systems and features for the project. In addition, address life safety and means of egress.

Address anticipated active and passive fire protection features and systems, type(s) of construction, height, and area limitations, building separation, fire rating of materials, and occupancy classification(s) in the project. For projects involving rehabilitation work, provide an LSA as described in Chapter 14.

C-5.3.14 Physical Security.

Discuss the physical security system design, consideration, parameters, major features, and space requirements for the overall facility and specialized areas such as those processing classified or sensitive information. Refer to Appendix A for requirements for Behavioral Health.

C-5.3.15 Antiterrorism/Force Protection (AT/FP).

Discuss site, design, space considerations and requirements for AT/FP systems. Project must conform to requirements of UFC 4-010-01. Deviations to include improvements or detriments to the UFC 4-010-01 standards must remain within the limits specified by UFC 4-010-01 paragraph 1-1.3.2 and all requirements of the remaining document.

C-5.3.16 Sustainability and Energy Conservation Compliance.

Discuss status toward meeting the requirements of UFC 1-200-02; update sustainable rating system points; refine energy consumption status relative to achieving the required 30% (minimum) energy reduction as compared to the ANSI/ASHRAE 90.1 baseline; and update status of additional sustainability goals for the project. This narrative must include separate sections for Architecture, Site, Mechanical, and Electrical. Include proposed checklist.

C-5.3.17 Commissioning.

A preliminary Commissioning Plan must be developed and submitted that defines the method by which commissioning must be performed. The Commissioning Plan must outline and define its processes to include; commissioned systems, participants, roles and responsibilities, communication procedures, and deliverables. Discuss procedures for achieving required commissioning of all commissioned systems. Reference Chapter 19 for additional information.

C-5.3.18 Transportation and Logistics.

Provide a preliminary, overall Transportation Logistics Analysis (TLA) that discusses the rationale for the proposed transportation, logistics, waste management, and food service solutions. The TLA must include impacts to programmed scope and cost and: (1) an Elevator Traffic Study and Analysis (ETSA); (2) an LCCA for automatic and manual material handling systems; (3) a Waste Management Analysis (WMA), and (4) a Food Service Study, as applicable. The WMA must include the major design parameters and features that address trash removal; hazardous, infectious, and biological waste; retort sterilizers; incinerators; and other waste handling features of the design. See Chapter 16 and Appendix F for additional requirements regarding these studies. In addition, address and discuss PTS's, as well as dumbwaiters and AGV systems.

C-5.3.19 Interior/Exterior Signage and Wayfinding.

A preliminary Interior/Exterior Signage and wayfinding master plan must be provided that addresses necessary orientation cues and information for patients, staff and visitors who navigate in and around a facility. Identify travel paths major interior intersections, and other benchmarks to successfully move from one destination to another. Analyze a facility's spatial organization and layout to identify specific areas, directional challenges, and wayfinding tools that can help in navigation. Consider all types of functions and

activities a person must perform when in a medical facility. Reference Chapter 6 for further requirements in developing this master plan.

C-5.3.20 Food Service.

If applicable, discuss the food service design and considerations to include optimal movement of food products to ensure effective monitoring and control of food temperatures through conventional flow while minimizing personnel cross-traffic, backtracking, and queuing conditions.

C-5.3.21 Specifications.

Provide a list of project specific specifications to be utilized.

C-5.3.22 Construction Phasing.

Develop a written narrative of the overall requirements for a phased approach to the construction that addresses all work associated with all the major disciplines. Develop a preliminary construction phasing plan that addresses “major” areas of work requiring specific parameters, sequence, or milestones. This phasing plan is not a detailed technical sequence of normal construction work, but describes any constraints that would prevent the contractor from doing all areas of the work simultaneously or at his discretion. Preliminary identification of phased areas and durations should be identified with reference to scope, constructability, timing, and overall construction length. Provide duration for relocation where subsequent construction activity is dependent on staff relocation from existing facility to new facility. Requirements unique to phased projects such as swing space, utilities that must serve two areas simultaneously, demolition sequence, and engineering system support for isolated or independent areas, must be addressed in reference to the operational, constructability, and cost constraints of the project.

C-5.3.23 Rehabilitation Work.

For projects involving rehabilitation work including addition/alteration projects, develop and discuss a preliminary construction phasing plan that supports continued/uninterrupted operations of the existing facility during construction and associated impact on construction costs and scope. Identify the requirements for temporary buildings to serve as swing space. In addition, identify actions that reduce or interrupt service to an existing, occupied area. Identify potential temporary connections, extensions of service that increase system demand, locations of new connections, or other measures necessary to sustain service for engineering systems within the existing building.

C-5.4 20 Percent Submittal Design Drawings.

The following are minimum 20 percent submittal drawings depicting proposed architectural and engineering aspects of the project.

C-5.4.1 Civil Drawings.

Show building locations, future expansion, existing and proposed structures, topography, final master plan of the site, utilities (include point of origin), utility modifications, pedestrian paths, roads, parking (surface and structured), ATFP, and easements.

C-5.4.2 Architectural Drawings.

Provide floor plans for each floor showing all programmed spaces and corridors; key building dimensions; structural grid system (including columns and type of system proposed) and key building dimensions; electrical and mechanical equipment rooms; stairs, elevators, and escalators; transportation equipment for movement of material and supplies; and specific locations of vertical and horizontal transportation systems, for example, pneumatic tubes, dumb waiters, automated guidance systems. All spaces identified in the PFD must be labeled with the Room Name and Room Code, in addition to the programmed and designed net areas. Also, addition/alteration projects must include preliminary demolition drawings with photographs depicting existing conditions. Provide preliminary exterior elevations with proposed finishes, floor to floor heights and overall dimensions.

Utility Services Distribution / Physical Space Requirements for Equipment and Distribution Systems. Provide conceptual interdisciplinary cross section drawings of the most congested utility areas (for example near vertical chases, elevators, mechanical rooms, communications rooms, etc.) to demonstrate that the floor to floor heights, above ceiling space, crawl spaces and chase areas are sufficient for utility installation as well as future operations and maintenance activities. Designate installation zones for each utility. Include all technical systems in the congested areas (for example HVAC main ducts, heating and cooling mains, plumbing mains, fire sprinkler pipe, electrical cables and lighting, communications cable trays, pneumatic tube systems, seismic restraints and supports etc.). Include piping slope considerations where that may require additional clearances. Base HVAC utility sizing on block heating and cooling load estimates and zoning concept. Label each utility and show required clearances with measurements. Base cable tray dimensions on industry standard sizes per fill rate estimates.

C-5.4.3 Interstitial Building System (IBS).

If applicable, a preliminary IBS design must be developed. Establish the floor to ceiling heights for the IBS supported by the most stringent preliminary equipment, utility dimensions and crossings. Demonstrate that adequate space is provided for maintenance access and compliance with NFPA 101 Means of Egress requirements.

C-5.4.4 HVAC.

Establish the minimum size and number of mechanical rooms, utility tunnels, and utility pathways based on estimates of building demands and equipment capacities, zoning,

equipment redundancies, considering required components and clearances. Provide plans showing single line drawings of the HVAC distribution systems to the areas served. Establish minimum vertical space requirements clearances for any above ceiling space, crawl space or IBS based on required HVAC distribution system sizes, piping slopes etc., coordination with other discipline utilities. Provide conceptual AHU sizes and utility requirements based on the block load calculations.

C-5.4.5 Plumbing and Medical Gas.

Establish the minimum size of mechanical rooms based on estimates of demands, anticipated water treatment requirements, equipment capacities and considering mandatory components, redundancies, and clearances. Provide plans showing single line drawings of the plumbing distribution systems to the areas served. Demonstrate space provisions for all medical gas producers, bottle manifolds and storage locations as well as main distribution lines.

C-5.4.6 Electrical.

Submit drawings that are compliant with paragraph 3-3 of UFC 3-501-01. Submit the following drawings, at a minimum: 1) site plan showing existing utility primary power and preliminary locations of new exterior normal and essential / standby electrical equipment; 2) building floor plans for Power and Lighting showing size and location of electrical rooms; and 3) Single Line Diagram(s).

C-5.4.7 Communications.

Establish the minimum size and number of Telecommunications Rooms and Server rooms based on estimates of building demands and equipment capacities. Provide plans showing riser drawings of the distribution systems from Telecommunications Rooms to the areas served. Submit drawings utilizing diamond analysis assuming 180 ft sides for layout of information and communication technology (ICT) spaces. Identify aligned TR stacks within the facility free of any fixed adjacencies in Chapter 12. Provided initial estimate of total rack units per TR and total rack requirement for sizing efforts under the engineered solution. Identify location of entrance facility. Provide two EFs with greatest separation practical for NFPA 99 Category 1 and 2 facilities. Identify outside plant pathways to two separate installation/provider nodes for NFPA 99 Category 1 and 2 facilities. Submit drawings of initial fiber backbone riser indenting physically independent pathways for Category 1.

C-5.4.8 Food Service.

If applicable, provide plans showing an initial layout of food service areas. Show circulation paths from servers to seating, loading dock to storage, kitchen to inpatient units, general material movement, principal dimensions, and dining seating counts. Optimize movement of food products and minimize personnel cross-traffic, backtracking, and queuing conditions. Reference Appendix F for additional requirements.

C-5.4.9 Construction Phasing.

When required by the Design and Construction Agent, provide a graphic "Node" diagram of major elements and areas showing proposed sequential and parallel phased work. Indicate interim swing space, temporary facilities, and locations of existing and relocated functions with time duration for any Government moves.

C-5.4.10 Rehabilitation Work.

For projects involving rehabilitation work including addition/alteration projects, update and continue to differentiate where existing conditions end and new conditions begin. Define extent and scope of rehabilitation. Provide documentation of existing conditions.

a. Existing building as-builts.

b. Statement of conditions.

c. Existing/Prior hazardous material abatement reports and studies.

C-5.5 20 Percent Submittal Calculations.

C-5.5.1 A/E Calculations.

All calculations that support A/E features within the design must be provided including but not limited to those required in the Design Analysis. Supporting documentation must include life cycle cost analysis (LCCA) per UFC 1-200-02, to include energy systems, renewable systems, lighting, solar hot water use, and utility demand. Documentation should also include validation of the parking requirements.

C-5.5.2 Gross, Departmental & Net Area Tabulations.

Gross, departmental, and net area tabulations for all floors must be submitted with a small-scale, single-line, dimensioned key plan, and must be provided to reflect the total space required per Chapter 3. Provide a departmental area summary tabulation to include: net areas, net to gross area and factor, and net area difference. Functional areas and or rooms must address room quantity, net area, and total area comparing the net as-designed area against the PFD values. Comparison must include: net areas, departmental gross areas, minimum grossing ratios, and building gross area. Provide justification if deviation between as-designed and PFD values is greater than +/- 10 percent, except for rooms programmed for 50 SF or less.

C-5.5.3 20 Percent Submittal Cost Estimates.

Provide schematic cost estimates reflecting all design features and elements. Update all project costs based on refined project design details. Provide an updated DD Form 1391. Show Post Construction Award Services (PCAS) and "Other" special cost as separate line items.

C-6 35 PERCENT SUBMITTAL.

This submittal is a minimum 35 percent of the total design across all disciplines and incorporates response to all review comments. This is considered the “technical submission” in which all major architectural and engineering systems and A/E design decisions are finalized into the project scope and costs. Load demand, equipment sizing, energy consumption, LCC, NFPA 101 compliance, and other calculations for all building systems and features defined herein must be provided and reflected in the cost estimate. A formal 35 percent design presentation to the DoD Project Sponsor may be required. Final changes to the project’s enacted DD Form 1391 description, justification, and execution timelines are made at this submittal level.

C-6.1 35 Percent Submittal Design Analysis.

Concept design narratives and related technical calculations further refining the 20 percent design requirements to a 35 percent design effort must be provided as noted here:

C-6.1.1 World-Class Checklist.

Update the draft World-Class Checklist.

C-6.1.2 Civil.

Include the site investigation, geotechnical investigation, and utilities reports. Summarize the civil design parameters, parking requirements in accordance with Appendix G, and major features of the design.

C-6.1.3 Architectural.

Address the overall architectural concept including interior design (in accordance with Appendix B) and exterior finish materials, wall systems, roofing systems, acoustics (exterior and interior), base architectural plan, floor-to-floor heights, and contingency and mobilization features. Shielding requirements based on a health physicist report for all radiation areas. Provide a final functional narrative that describes alignment of the design with the Functional Program developed for the project. Demonstrate through the required Dew Point Analysis (per UFC 3-410-01) how the proposed exterior building envelope systems are coordinated with space temperature and humidity requirements to prevent condensation and mold growth. Describe how proposed material selections and finishes promote aseptic environments and infection control and patient/staff safety.

C-6.1.4 Interstitial Building System (IBS).

If applicable, update the design parameters and major features, including interstitial space considerations.

C-6.1.5 Structural.

Address the selected structural foundation and framing systems considered and provide an economic basis for system selection. Summarize the structural design parameters and major features of the design.

C-6.1.6 Seismic.

Summarize the seismic design considerations including “S” values and the level of protection required. Discuss post-earthquake operation requirements. For projects involving rehabilitation work, complete the Facility Upgrade Report.

C-6.1.7 HVAC.

Provide a summary of the primary and secondary HVAC systems considered and the economic basis for system selection. Summarize the proposed control systems, building pressure control scheme, humidification features, and the energy conservation features being considered. Provide room-by-room and zone heating and cooling load calculations, AHU sizing and utility requirements. Interior equipment loads must be identified on a space by space basis. Provide a fully developed room-by-room Air Balance Summary including each room name, number, room code, number of people, summer/winter design temperatures and relative humidity, minimum outdoor air changes, minimum total air changes, space pressurization minimum load driven air flows, design supply/return/exhaust/transfer/exfiltration air flows and primary outdoor air fraction at design condition. Provide calculations for minimum outdoor air at each AHU in accordance with Chapter 10. Provide duct pressure drop calculations. Provide piping thermal expansion calculations (thermal stress and flexibility analysis) for all systems identified in UFC 3-410-01 plus all heating hot water and chilled water systems larger than 4 in. (100 mm) to support the proposed piping layout, supports and thermal expansion features. Provide catalog information for equipment used as the basis of design. Provide report on the detailed air intake and exhaust analysis including any resultant recommendations on building siting, orientation, intake or exhaust configurations, or special filtration.

C-6.1.8 Plumbing and Medical Gas.

Describe the plumbing systems to include domestic hot, cold, recirculating, high purity water, fuel gas, sanitary waste and vent, and storm drains. Summarize the water supply, quality, water treatment, required storage, distribution systems and all waterborne pathogen prevention features. Provide a water chemistry analysis IAW Chapter 9. Describe the water treatment requirements and arrangement (for example centralized, decentralized, redundancies etc.) necessary to meet the domestic water requirements as well as specialized medical equipment requirements (for example sterilizers, washer/disinfectors etc.). Discuss hot water generation, storage, temperatures, distribution systems. Provide the ASHRAE 188 Water Management Program and it’s required analyses. Provide the supplemental disinfection analysis to support the selection of waterborne pathogen control treatment system. Provide sizing

calculations for all plumbing systems including sizing of piping, booster pumps, treatment systems, storage etc. Provide catalog information for equipment used as the basis of design.

Identify the System Category of each medical gas system in accordance with the Risk Assessment. Identify all locations where medical gas is utilized and how it is to be served (and stored) whether provided centralized with on-site producers, bottle manifolds or with portable bottles, as coordinated with the DoD Project Sponsor. Provide source sizing calculations and node to node pipe sizing calculations for all medical gas systems. Provide historical use data where relevant to sizing. Provide catalog information for equipment used as the basis of design.

C-6.1.9 Electrical.

The Design Analysis must illustrate the further development of the design from the Concept Design phase, as required by UFC 3-501-01, paragraph 3-2. Include complete descriptions of required coordination with the utility, connection to primary power source, establishment of utilization voltage, routing of exterior power, and connections to the service equipment and all downstream distribution, and the essential (Type 1 or 2) or standby (Emergency, Legally-Required, Non-Essential / Optional) electrical system. Update the load analysis and all calculations as required by UFC 3-501-01, paragraph 3-2. Include NFPA 99 risk analysis for wet procedure locations in accordance with Chapter 11. Provide cut sheets for all electrical equipment.

C-6.1.10 Communications.

Summarize all communication system design parameters and major features. Provide cut sheets for all communication equipment. Discuss the general framework of the networking design or diagram including MEDCOI and traditional IT systems. Determine which systems require interconnectivity and identify if connection is physical or logical. Discuss location of installation nodes for end point destination and note how physical independent pathways will be ensured for NFPA 99 Category 1 and 2 systems.

C-6.1.11 Fire Protection and Life Safety.

Address and evaluate the fire protection and life safety design parameters and major features to include (but not limited to): fire detection, fire alarm, fire extinguishment, and fire suppression systems. Summarize the life safety considerations, design parameters, and major features. Address type of construction, height and area limitations, building separation, fire rating of materials, life safety features, and occupancy classification. For projects involving rehabilitation work, provide a summary of the analysis of the FSES Study and latest LSA Report. Include related design considerations and criteria that have been coordinated among all the affected disciplines.

Evaluate the fire protection and life safety features in accordance with UFC 3-600-01 in terms of what is required and what will be provided to accommodate the scope of the work for this project along with a drawing, or set of drawings, to support this analysis (in

the form of a narrative). Utilize the following requirements to further clarify the preparation of the fire protection and life safety design narrative (or FPLSDN).

a. Provide a description of the use(s) proposed in each facility, including all functions, operations, and procedures, to support the designer's determination of the occupancy classification(s) in accordance with NFPA 101 and the use and group classification(s) in accordance with IBC for all fire areas and smoke compartments of the proposed facility. Also, address the use of the IBS, high-rise provisions and any other features impacting the fire safety/protection design (as applicable).

b. Prepare a tabular summary to represent each proposed subdivision of building space [for each floor in multi-story facilities] to clearly identify all fire separations and smoke compartments required by either the IBC or NFPA 101.

c. Address interior wall and ceiling finish and interior floor finish identifying classification and flame spread ratings and smoke-developed indices and extent of plastics to be provided as finish materials.

d. Describe protection of all vertical openings, including enclosure requirements for stairs, elevators, escalators, conveyors, dumbwaiters, chutes, atriums, malls, and light wells (as applicable).

e. Describe provisions for life safety, especially in terms of the means of egress. Identify types and numbers of exits; capacity and arrangement of the means of egress; performance parameters of the means of egress, namely common path of travel, dead-end corridor, and total travel distance; discharge from exits; exit marking and illumination of means of egress; emergency lighting; opening protectives; and special security features.

f. Identify FAFDMN and voice communication requirements for field devices. Indicate facility operations that impact selection of FAFDMN with consideration given to type of evacuation, patient and staff evacuation procedures, and layout of fire separations and smoke compartments. Include functional description for alarm initiation, alarm indication and emergency notification; signaling circuits and appliances, sequences of operations, annunciation of alarm, trouble and supervisory signals, and interface with other building systems as well as other fire protection features (or systems). Indicate system configuration (for example conventional hardwired, addressable, multiplex, or intelligent) and type of signal communication (for example digital or analog). Indicate FAFDMN requirements as they relate to other building systems, for example, HVAC.

g. Describe the fire (or emergency) reporting system(s) in service at the Installation, for example, central station fire alarm reporting system.

h. Document the current conditions of the available water supply in terms of volumetric waterflow rates (in gallons per minute) and waterflow pressures

(in pounds per square inch), including a copy of the most current fire hydrant flow test report. This flow report shall be inserted as an attachment to the FPLSDN. If there is on-site water storage, identify its components and the available volumetric capacity. Provide a description for types and locations of system equipment and existing facility fire flow demands.

i. If fire hydrant water flow test results support the necessity to install a fire pump or a tank for water storage or both, indicate design criteria (for example NFPA 20 or NFPA 22), equipment type, arrangement, and capacity and pump ratings. Include pump equipment power, alarm and supervision requirements, automatic and manual fire pump control requirements, and FAFDMN interface and supervision requirements.

j. Identify objective and scope for smoke control or smoke management in the project, particularly the relevant performance criteria that the QFPE intends to meet. Indicate the type(s) of smoke control and management proposed to meet criteria. Identify building systems that must be interfaced to provide smoke management. Summarize design considerations, control parameters and operational features.

k. Identify layout and distribution parameters for fire extinguisher cabinets.

l. Elaborate upon facility features for emergency power distribution, including control and switching requirements for life safety, critical and equipment loads with load shedding and restoration features (as applicable).

m. Consider each of following special hazards and features, which may impact the overall level of fire protection being provided.

(1) Security (for example electric door releases, door hardware, and locking arrangements)

(2) Malls/atriums

(3) Automatic data processing and electronic facilities

(4) Elevator control/FAFDMN interface

(5) Emergency power

(6) Emergency vehicle easements

(7) Explosion prevention

(8) Flammable and combustible liquids handling and storage

(9) High-frequency electrical equipment

(10) Radio Frequency Interference (RFI) shielding

(11) Underground structures/areas, including crawlspace(s)

(12) Waste handling (medical and hazardous)

(13) Limited-access structures or areas

(14) Special storage arrangements and configurations

C-6.1.12 Physical Security.

Summarize the security system design parameters and major features.

C-6.1.13 Antiterrorism/Force Protection (AT/FP).

Summarize the AT/FP system design parameters and major features.

C-6.1.14 Sustainability and Energy Performance/Conservation Compliance.

Discuss status toward meeting the requirements of UFC 1-200-02; update sustainable rating system points; refine energy consumption status relative to achieving the required 30% (minimum) energy reduction as compared to the ANSI/ASHRAE 90.1 baseline; and update status of additional sustainability goals for the project. Discuss all energy conservation design features considered and those incorporated.

C-6.1.15 Commissioning.

Summarize the Commissioning Plan and process to achieve the required commissioning of all commissioned systems. Include the final Commissioning Plan incorporating comments received. Further clarify the process by which commissioning must be performed.

C-6.1.16 Transportation and Logistics.

Summarize the recommendations and analyses (pros and cons), rational, and scope and cost impacts of the overall Transportation and Logistics Study to include all sub-studies, for example, Elevator Traffic Study and Analysis, Life-Cycle Cost Analysis for automatic and manual material handling systems, a Waste Management Study, and a Food Service Study (include all food serve areas). The MTLC must also present at the 35 percent design meetings describing how the facility design addresses the transportation, logistics, and waste management requirements of the facility. The Transportation and Logistics Analysis (TLA) must be developed enough to finalize and address any functional requirements of the facility layout required at the 35 percent submission.

C-6.1.17 Interior/Exterior Signage and Wayfinding.

Summarize the Interior/Exterior Signage and wayfinding master plan recommendations, solutions, and tools for patients, staff, and visitors to navigate in and around a facility. Identify any scope and cost impacts to proposed recommendations, solutions, and tools. Summarize the types of functions and activities a person may perform in a medical facility.

C-6.1.18 Food Service.

If applicable, summarize the food service design. Discuss its parameters and major features to include optimal movement of food products to all designated locations; minimal cross-traffic, backtracking, and queuing conditions; and separation of personnel traffic.

C-6.1.19 Equipment Specifications.

Equipment List. The A/E must further refine the initial for-record equipment list into a viable medical facility room contents list or room-by-room contents listing. Coordinate all categories of equipment for each room identified on the list as well as substitutions or changes with the DoD Project Sponsor. The type, quantity, and location of biological, radioisotope, fume, canopy, and laminar air hoods must also be indicated in the equipment list. Provide appropriate equipment data and catalog cut sheet(s) for all items of equipment having unique utility requirements, heat loads, structural support, or space requirements.

Develop requirements for all equipment that does not have current information, as directed by the Design and Construction Agent.

C-6.1.20 Specifications.

Provide outline specifications.

C-6.1.21 Construction Phasing.

A written narrative must be provided, developed, and documented by the A/E that shows one overall workable phasing plan. This phasing plan must indicate proposed construction duration and describe major elements of the work and any impacts on or by the Government. The phasing plan must include the scope and timing sequence of each identifiable phase or major activity with required precedents, procurement, Government move durations, commissioning, and outfitting. Each phase must be described in terms of the work involved and what work has to come before and after the phase. Phasing elements affecting the Government but not the contractor, such as Government only actions, should be determined and documented.

C-6.1.22 Rehabilitation Work.

For projects involving rehabilitation work including addition/alteration projects, further identify work activities in a phasing plan that would impact any requirements for continued operation of a facility, including temporary utilities, swing space, implementation of hygienic barriers, and temporary access routing.

C-6.2 35 Percent Submittal Design Drawings.

C-6.2.1 Civil (Site).

Show building location, future expansion, existing and proposed structures, topography, final master plan of the site, utilities (include point of origin), utility modifications, roads, pedestrian paths, parking (surface and structured), and landscaping.

C-6.2.2 Architectural.

C-6.2.2.1 Floor.

For each floor, show floor elevation; all programmed spaces; corridors; structural grid systems (including columns); electrical/communications/mechanical equipment rooms; all vertical and horizontal transportation, for example, stairs, elevators, escalators, pneumatic tubes, dumbwaiters; and AGV to meet functional requirements and CONOPS for the building. All spaces identified in the PFD must be labeled with the Room Name and Room Code. Provide programmed and designed net area tabulations. Provide key building dimensions. Identify accessible maneuvering clearances (for example turning radius and door/fixture clearances, etc.) for all applicable spaces and components. Plans must be coordinated with the life safety-building code composite plans.

C-6.2.2.2 Reflected Ceiling.

Show ceiling grid and light fixture placement.

C-6.2.2.3 Exterior Elevations and Major Building and Wall Sections.

Include all exterior views and multiple cross sections through all unique building areas. Provide floor to floor, as well as roof and parapet heights. Wall sections must show and describe building envelope materials.

C-6.2.2.4 Utility Services Distribution / Physical Space Requirements for Equipment and Distribution Systems.

Provide interdisciplinary cross section drawings of the most congested utility areas (for example near vertical chases, elevators, mechanical rooms, communications rooms, etc.) to demonstrate that the floor to floor heights, above ceiling space, crawl spaces and chase areas are sufficient for utility installation as well as future operations and maintenance activities. Designate installation zones for each utility. Include all technical systems in the selected areas (for example HVAC main ducts, heating and cooling mains, plumbing mains, fire sprinkler pipe, electrical, telecommunications cable trays, pneumatic tube systems, seismic restraints and supports etc.). Include piping slope considerations where that may require additional clearances. Base HVAC utility sizing on room-by-room heating and cooling load calculations and the zoning concept. Label each utility and show required clearances with measurements.

C-6.2.3 Interstitial Building System (IBS).

If applicable, a conceptual IBS design must be developed, for example, plans and sections delineating interdisciplinary cross-sections at critical locations. Validate floor-to-ceiling heights for the IBS supported by the most stringent equipment and utility dimensions. Show defined maintenance access and Means of Egress in compliance with NFPA 101. Develop interdisciplinary crossings at congested areas to demonstrate sufficiency of space.

C-6.2.4 Structural.

Provide drawings of the selected structural system adequately developed so no additional major engineering decisions are required.

C-6.2.5 HVAC.

Provide equipment room drawings in plan and elevation showing major equipment of all disciplines including architectural and structural elements, and depict the required access, maintenance, and code clearances. Footprints of air handling and other major equipment must be established from catalog dimensional data of three manufacturers and demonstrate that all required AHU elements have been included. Include clearance space for component cleaning, removal, and maintenance. Provide AHU equipment schedules, AHU configuration plans and sections, control schematics and sequence of operations. Show coordinated distribution mains (dimensioned) on the floor plans. If integral sound attenuating devices are required in VAV/CAV terminal units, indicate these on the plans for the respective terminal unit(s). Design all aspects of the piping systems to control thermal expansion and distribution as supported by piping stress calculations. In the design drawings, show all control features such as pipe guides, anchors, expansion joints, expansion ells, offsets, flexible couplings, and other piping features that may affect expansion forces in the piping. For steam and condensate piping, show the required direction, degree of line slope, details of drip traps, and other drainage features.

Identify all HVAC control zones and the type of zone control devices to be used (VAV, CAV etc.). Provide air handling unit zoning diagrams identifying which areas are served by each AHU. Provide space pressurization and airflow diagrams. Provide single line dimensioned distribution drawings for all ductwork, and for the main heating, chilled water, and steam services, throughout the facility. Provide schematic diagrams for all piping systems; identify locations of all outdoor air intakes and exhaust air discharge points.

C-6.2.6 Plumbing and Medical Gas.

Provide plumbing and medical gas system plans, including central equipment, and main distribution lines. Show layout of the technical rooms in plan and elevation for plumbing and medical gas systems including architectural and structural elements and major equipment of all coordinating disciplines. Equipment dimensions must be based on the

catalog dimensional data of three manufacturers. Include clearance space for component cleaning, removal, and maintenance. Water supply and gravity drainage mains must be dimensioned. For sanitary piping and vacuum piping, show the required slope and cleanouts including access clearances. Provide schematic diagrams and riser diagrams for all plumbing and medical gas systems including all functional components and pipe sizes.

C-6.2.7 Electrical.

Show placement and location of electrical room layouts, light fixtures, receptacles, motor controls, panelboards, and distribution equipment. Provide single line diagrams of the normal/essential electrical systems, emergency power, and uninterruptable power supply (UPS). Include the grounding system design and initial testing requirements in the project design documents.

C-6.2.8 Communications.

Provide site utility plans for voice, data, security, and television (TV) systems indicating all communications ductwork, manholes, hand-holes, and cable routing required to tie the new facility into the existing installation-wide networks/systems. Indicate all existing communications cables on, or adjacent to, the immediate project site.

C-6.2.8.1 Facility Communications.

Show layout of communication equipment, devices, and closets. Develop, in detail, a nurse call Zone Light Activation Matrix (including identification numbers) must be detailed on the telecommunication systems project design documents. A matrix must be developed for each patient care unit served.

Provide enlarged communication room elevations to include equipment racks, wall mounted equipment and devices. Verify all drawings identify port locations to match project PRC. Provide heat maps for wireless access points. Provide heat maps for IRES emergency management radios if included or to verify not needed (facilities smaller than 50,000 sf (4650 sm) with signal strength of 80 dB).

Provide, for each communications system, riser diagrams; identification and associated proposed location for each major item of equipment; and identification of cable sizes and types and termination equipment. Provide initial rack layout based on standard medical device sizing such as switches and vendor equipment both contractor provided or government provided (estimated).

C-6.2.9 Physical Security.

If ESSs are included in the project design, these systems must be detailed in the project design documents. Include information such as sensor locations, floor plans, riser diagrams, security equipment schedules, monitoring and control equipment, alarm control panels, switches, and access control devices.

C-6.2.10 Fire Protection and Life Safety.

Coordinate all design features with applicable criteria and all architecture and engineering disciplines. At a minimum, the plans to graphically represent fire protection and life safety features shall identify the following. As appropriate, indicate both the minimum requirement and the actual provision being incorporated into the project.

a. Prepare life safety-building code composite plans at a minimum scale of 1/8” = 1’-0” (1:100) utilizing a set of architectural floor plans with room names and numbers, clearly identifying horizontal and vertical means of egress, any vertical openings, such as elevators and other shafts, utility rooms, and structural support elements. The following shall be indicated: occupancy classification and sub-classification per NFPA 101 and Use-Group Classification per IBC of all fire areas; delineation of smoke compartments (or barriers); location of all fire-rated separations, including fire-rated door assemblies and dampers with specific fire-resistance ratings identified; fire pumps; fire extinguishing cabinets; and number and locations of all required exits, exit capacities (number of people per exit), means of egress and travel distances of all fire areas and smoke compartments. Identify performance parameters of the means of egress, including proposed measurements and maximum limitations of travel distance, common path of travel, and dead-end corridor, on each floor and compartment, as well as the specific location where each measurement was taken. It is noted that any travel distance measurements shall be taken both to an exit and to a smoke barrier (where smoke compartments are required) in compliance with NFPA 101. Utilize egress tags at each interior exit to a vertical component of egress, like a stair, and at each exterior exit from the facility, which shall each identify the following four parameters: (1) minimum clear width required, (2) actual clear width proposed, (3) calculated maximum number of occupants that the particular component is capable of serving, and (4) estimated number of occupants anticipated to use that particular component based upon a reasonable distribution of occupants performed by the QFPE.

b. The following is the minimum information that shall be either graphically represented in the drawings or detailed in the specifications prepared for the performance-based fire suppression design in this project: fire hydrant waterflow data; location of area(s) to be protected by sprinklers or standpipes; identification of sprinkler system type, sprinkler hazard classification(s), and respective sprinkler design density, design area, hose stream demand (including location of the hose stream demand), duration of water supply, and sprinkler spacing and area of coverage, for each system proposed. The QFPE shall review the technical notes in UFGS 21 13 13 and incorporate those that apply as the specification section for automatic sprinkler protection is being developed. The zoning of automatic sprinkler protection shall be coordinated with the building smoke compartments, where applicable, and shall indicate locations of

other areas protected by other automatic extinguishing and suppression systems.

c. The following is the minimum information that shall be graphically represented in the drawings prepared for the performance-based fire suppression design in this project:

(1) Layout and distribution of all piping and equipment from the point of connection to the water supply to the sprinkler cross mains.

(2) Locations of service mains, interior feed mains, control valves, sprinkler risers, drain lines and discharge points, sectional valves, and inspector's test valves.

(3) Location of the backflow preventer (including provisions for draining and access for maintenance) where the potable water supply system is at risk of contamination from any fire suppression system.

(4) Details of pipe restraints for underground piping, for example, pipe clamps, tie rods, mechanical retainer glands, and thrust blocks. If required, identify size of wall or floor sleeve(s) to meet earthquake requirements.

(5) All concealed spaces requiring sprinkler protection, such as spaces above suspended ceilings, that are built of combustible material or that can contain combustible materials, such as storage and communication cabling without a fire rating.

d. Prepare fire alarm/fire detection/mass notification plans to graphically represent locations of all FAFDMN control and annunciation panels; all connections for notification, monitoring and control; all FAFDMN initiating and indicating circuits and locations of connected devices, including control of respective HVAC units for either smoke control (see NFPA 90A) or smoke management or both; and all interfaces with other building systems.

C-6.2.11 Interior/Exterior Signage and Wayfinding.

Graphically indicate specific interior/exterior signage and wayfinding locations, proposed solutions, and tools that relates to the facility.

C-6.2.12 Food Service.

Food service equipment items must be identified in detail in the project design documents and represent the latest available technology. Specific equipment locations, utility requirements including ventilation, and equipment installation must also be shown. Include mounting heights for all wall-hung equipment items.

C-6.2.13 Equipment (to include FFE).

Show all Categories of equipment. Show all equipment (to include FFE) on the equipment drawings and floor plans at a minimum scale of 1/4" = 1'-0" (1:50). Clearly identify and differentiate between RPIE and PP equipment. Provide plans showing Log Cat A and B items with heavy, solid lines and showing Log Cat C, D and R items with dashed lines. Provide JSNs as indicated in the PRC on floor plans, on all Interior Design FF&E sheets, and in tabular format for all applicable logistical categories. Provide separate Architectural equipment plans and Interior Design FF&E plans. Indicate and properly detail the type, quantity, and location of biological, radioisotope, fume, canopy, and laminar air hoods on the drawings. Coordinate all equipment locations and details to ensure adequate utility requirements, structural support, or space requirements are provided.

C-6.2.14 Structural Interior Design (SID).

Provide a 35 percent SID package. The SID package must be fully coordinated with all interior and exterior finishes, colors, and materials. Key the room finishes schedule to the plans by room number, room code, and room name, for each room labeled in the PFD. Include proposed SID color scheme/selections. Provide color boards (or binders) with samples of finishes or pictures - scanned pictures are not permitted. An aseptic environment ICRA must be coordinated with the SID package to define infection control risks associated within each project. Reference paragraph 6-5.1 for additional details. The wayfinding plan must also be an integral part of the facility's SID package and enhance the design features. The ICRA and the wayfinding plan are critical to begin early in the design process. See Glossary for expanded definitions of the SID.

C-6.2.15 Comprehensive Interior Design (CID).

Provide a 35 percent CID package for furniture and accessory selection. The CID package must be fully coordinated with all finishes, colors, and materials included in the SID package. Provide CID floor plans, table of all JSNs, and binders with samples of finishes - scanned pictures are not permitted. Provide description and cut sheets for all CID items. Include specific artwork selections. Reference paragraph 6-5.2 for additional details. See Glossary for expanded definitions of the CID.

C-6.2.16 Construction Phasing.

Provide a graphic "node" diagram (not a bar chart or time-scaled bar chart) to show the relationships established in the phasing narrative. The graphic representation of the phasing plan in the contract documents should not indicate durations (numerical or graphical) except for the contractually established durations such as Owner moves. Individual phase durations should be considered only in developing the Government's proposed overall contract duration. This phasing plan should not be confused with the requirement to determine the overall constructability and construction timeline that may involve a more detailed milestone chart. The phasing should be coordinated and documented in the design drawings either as a segregated set with all engineering

disciplines addressed or have associated drawings within each discipline. A separate overall phasing plan must be developed for the Government's use only to inform, educate, and track Government actions. It should include interaction of Government activities such as move times, swing space durations, and Government outfitting and training activities. This plan must further delineate the coordination of required actions of the Government that are not a part of the contractor's responsibility or contract.

C-6.2.17 Rehabilitation Work.

For projects involving rehabilitation work including addition/alteration projects, provide 35 percent demolition drawings indicating removal of structural, architectural, MEP, communications systems, and asbestos and other hazardous materials.

C-6.3 35 Percent Submittal Calculations.

C-6.3.1 Calculations.

Provide conceptual level calculations for all engineering systems being proposed as identified in the Design Analysis requirements and as required here.

C-6.3.2 Gross and Net Area Tabulations.

Update all gross and net area tabulations based on refined floor plans.

C-6.3.3 Health Physicist Report.

Provide a Health Physicist Report and coordinate with related design drawings and specifications. Refer to Chapter 15 and Appendix D.

C-6.3.4 Sustainability and Energy Performance/Conservation Compliance.

Discuss status toward meeting the requirements of UFC 1-200-02; update sustainable rating system points; refine energy consumption status relative to achieving the required 30% (minimum) energy reduction as compared to the ANSI/ASHRAE 90.1 baseline; and update status of additional sustainability goals for the project.

C-6.3.5 35 Percent Submittal Cost Estimates.

C-6.3.5.1 Cost Estimate.

Update all project costs. Align all revised costs in accordance with the DD Form 1391 format. Provide any changes to the project's DD Form 1391 description, justification, and execution timelines.

C-6.4 35 Percent Design Drawing Record Copy.

The record copy of the 35% design drawing submittal must be provided to the Design and Construction Agent documenting the outcome of the 35 percent meeting and must be submitted in accordance with the directives established above.

C-7 65 PERCENT DESIGN SUBMITTAL.

The Design and Construction Agent must develop the specific submittal requirements to define this level of effort. The project design documents must reflect a 65 percent level of coordination across all architecture, interior design, equipment, and engineering disciplines. Specifications should include a preliminary Division 01.

C-8 100 PERCENT AND FINAL DESIGN SUBMITTAL.

The Design and Construction Agent must develop the specific submittal requirements to define this level of effort. When the design is complete, the Design and Construction Agent must submit a complete copy of the final submittal documents, for example, drawings, specifications, equipment SID & CID packages, cost estimate, instructions to bidders. These documents must be fully coordinated across all architecture and engineering disciplines within 30 days of completing the 100 percent design documents.

C-9 REQUEST FOR PROPOSAL (RFP) FOR DESIGN-BUILD (DB) PROJECTS.

The RFP for Design/Build (DB) acquisition projects must clearly define all the requirements and background information that a DB contractor must have to estimate, bid, design, and construct the project. These requirements must be included in the RFP as appropriate to the project:

a. Project Technical Requirements

b. Updated DD Form 1391

c. Program for Design (PFD)

d. Medical Concept of Operations (CONOPS) for the facility

e. Project Room Contents (PRC)

f. Requirements for:

(1) Comprehensive Interior Design (CID)

(2) Structural Interior Design (SID)

(3) Additional requirements as determined by the Design and Construction Agent to facilitate fast track construction.

(4) User needs specific to the design of the facility

(5) Installation approved site location Base Commander signed document.

C-10 RFP DEVELOPMENT SUBMITTALS.

These submittals are required during the RFP development:

a. 5 Percent Level Design Report.

b. Draft RFP (RFP Development). If 20 percent design is provided, include all required submittal items in Section C-5.

c. Final RFP (RFP Development). If 35 percent design is provided, include all required submittal items in Section C-6.

C-11 AFTER CONTRACT AWARD.

Following the successful selection of a DB contractor and award of a DB contract, the DB contractor must provide these comprehensive submittals to include, but not limited to, the following as previously defined:

a. Final 35 Percent Design Submittal.

b. 65 Percent Design Submittal.

c. 100 Percent Design Submittal.

d. 100% Corrected Final.

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APPENDIX D UNIVERSAL X-RAY ROOM

D-1 GENERAL.

This appendix contains mandatory criteria for Universal X-ray Room design and construction. The Universal X-ray Room is capable of accepting radiographic and fluoroscopic equipment, regardless of manufacturer, with minimal facility modification.

D-1.1 Applications.

The Universal X-ray Room applies to Room Codes XDR01 and XDRF1 (see Appendix B). The DoR selects an X-ray system for a basis of design based on the JSN provided in the PRC. The DoR designs this room to accommodate the selected system, the criteria listed here, NCRP Report No. 147 Structural Shielding for Medical X-Ray Imaging Facilities, and using MilDep specific criteria (TB Med 521, AFI 48-148, etc.).

D-2 SPECIFIC REQUIREMENTS.

D-2.1 Electrical Raceway System.

The Electrical Raceway System includes a floor trench, wall ducts, and ceiling cable trays that meet the criteria listed here, and additional requirements of the X-ray system selected as a basis of design for installation (reference Figures D-1, D-2, and D-3). All raceways and cable trays must be UL-listed (CE for Europe) for enclosure of wiring to all X-ray system components and concealed in floors, walls or above the ceiling.

D-2.2 Floor Trench.

Floor trench is a bottom-type trench duct, with nominal 3.5 in. (89 mm) by 12 in. (300 mm) duct and a 12 in. (300 mm) wide by 1/4 in. (6 mm) thick steel cover plate. Cover plate is installed flush with the floor with the same finish insert as the floor. Provide a gasket on the cover plate to maintain water tightness. Location of floor trench to the radiology table is determined based on the X-ray system selected for the basis of design.

D-2.3 Core Drilling.

Provide oversized conduits below the floor deck in lieu of floor trench when the Universal X-Ray Room is located on a floor other than ground level.

D-2.4 Wall Ducts.

Wall ducts are nominal 3.5 in. (89 mm) by 10. in (250 mm) with 12 in. (300 mm) wide flush-mounted cover plates finished to match the walls. Transition wall ducts to the floor trench or the conduit below the floor deck.

D-2.4.1 Ceiling Cable Trays.

Ceiling cable trays are nominal 3.5 in. (89 mm) by 12 in. (300) with 3 in. (76 mm) load depth National Electrical Manufacturers Association (NEMA) Class 12A ladder type installed above the finished ceiling.

D-2.4.2 Partition Separation.

Provide partitions to separate high- and low-voltage cables in all trenches, ducts, and cable trays.

D-2.5 Electrical Service Requirements.

Provide copper feeder conductors and adequate power service to each Universal X-Ray Room to ensure the X-ray system can be installed without additional facility-related electrical work.

D-2.5.1 Power Quality.

Provide the specified nominal voltage (480 V) +/-5 percent to each Universal X-ray Room. Provide special power conditioning equipment, where required with the X-ray system installation.

D-2.5.2 X-Ray Equipment Service.

Provide 150 ampere, 480Y/277 V, 3 phase (5 wire, neutral, and ground) service to the room. Provide an adjustable trip, 150 ampere, 3 pole, shunt trip circuit breaker in a NEMA 1, flush-mounted enclosure.

D-2.5.3 Emergency Shutdown.

Provide a large, clearly identified push button to actuate the shunt trip circuit breaker to disconnect all power to the X-ray system.

D-2.5.4 Auxiliary Panelboard.

Provide a 120/208 V, single phase, 100 A panelboard with a 50 A shunt trip main breaker to support the single phase loads in each room. Provide a 20 pole space panelboard with at least two 20 A, 2 pole circuit breakers, and five 20 A, 1 pole circuit breakers. This panelboard may be served from the nearest general-purpose 120/208 V transformer, or a dedicated step-down transformer fed from the 480 V service to the room. Calculations are based on 180 A maximum demand if fed from the 480 V service to the room.

D-2.5.5 Voltage Drop and Regulation.

Ensure total voltage drop in a branch circuit and feeder conductors does not exceed 2 percent from the facility distribution transformer to the Universal X ray Room. Total

voltage regulation of the distribution transformer, feeder, and branch circuit conductors will not exceed 5 percent. For circuits that serve only one room, this calculation is based on the maximum demand current of the single X-ray generator. For circuits that serve more than one room, this calculation is based on the maximum demand current of the two largest rooms. Calculations are based on 180 A minimum demand. Size wiring for a maximum of 1 percent impedance.

D-2.5.6 Distribution Transformers.

Distribution transformers are not dedicated solely to the X-ray system. Voltage regulation is better when an X-ray system is connected to a transformer that is partially loaded with other equipment. Connect X ray systems line to line, never line to neutral.

D-2.5.7 Essential Power.

Provide essential power for X-ray systems, illumination, and duplex receptacles in accordance with the using MilDep guidance documents.

D-3 WARNING LIGHTS.

Provide “X-ray In-Use” warning light outside and above patient entry door. The “X-ray In-Use” light is controlled by applying power to the X-ray system control console. Provide conduit and wiring from the “X-ray in Use” light to the X-ray unit control console.

D-4 OTHER REQUIREMENTS.

D-4.1 Walls.

Provide studs on either side of the vertical electrical raceways. Design walls to support 220 pounds vertical to horizontal pull. Provide double walls between adjacent X-ray rooms. Full height partitions with wall backing and support are required for wall bucky units and control panels, or any wall that supports radiographic and/or fluoroscopic equipment.

D-4.2 Ceiling Support System.

Provide an overhead tube mount support system with a load-bearing capacity of 1000 pounds vertical point load and 50 pounds per square foot uniformly distributed load. Ceiling support system to cover the complete ceiling area of the room. Spanning members are mounted perpendicular to the centerline of the X-ray table and positioned at 25 5/8 in. (67 mm) on center to provide 2 ft (610 mm) of clearance between members. Suspend acoustical ceiling from the spanning members. Bottom of spanning members are flush with the finished ceiling.

D-4.3 Floors.

When a floor trench is utilized, provide appropriately thickened slab to accommodate the floor trench.

D-4.4 Radiology Shielding.

Lead shielding will at a minimum meet the following requirements:

a. The design is certified by the DoR's health physicist to ensure that the required degree of protection is achieved in compliance with NCRP Report No. 147. Certify in accordance with NCRP Report No. 102 and the using MilDep qualified expert guidance. Lead shielding design and certification report is the responsibility of the DoR.

b. Provide Lead shielding of 1/16 in. (1.6 mm) lead or lead equivalent up to 7 ft (2.14 m) above the finished floor. Avoid penetrations through the shielding or mitigate penetrations when necessary.

c. Apply lead shielding to the Universal X-ray Room side of the wall partitions and laminated behind gypsum board for protection. The construction Contractor is responsible for the shielding installation in accordance with the approved plans and specifications and to provide the shielding integrity certification.

D-4.4.1 Additional Requirements.

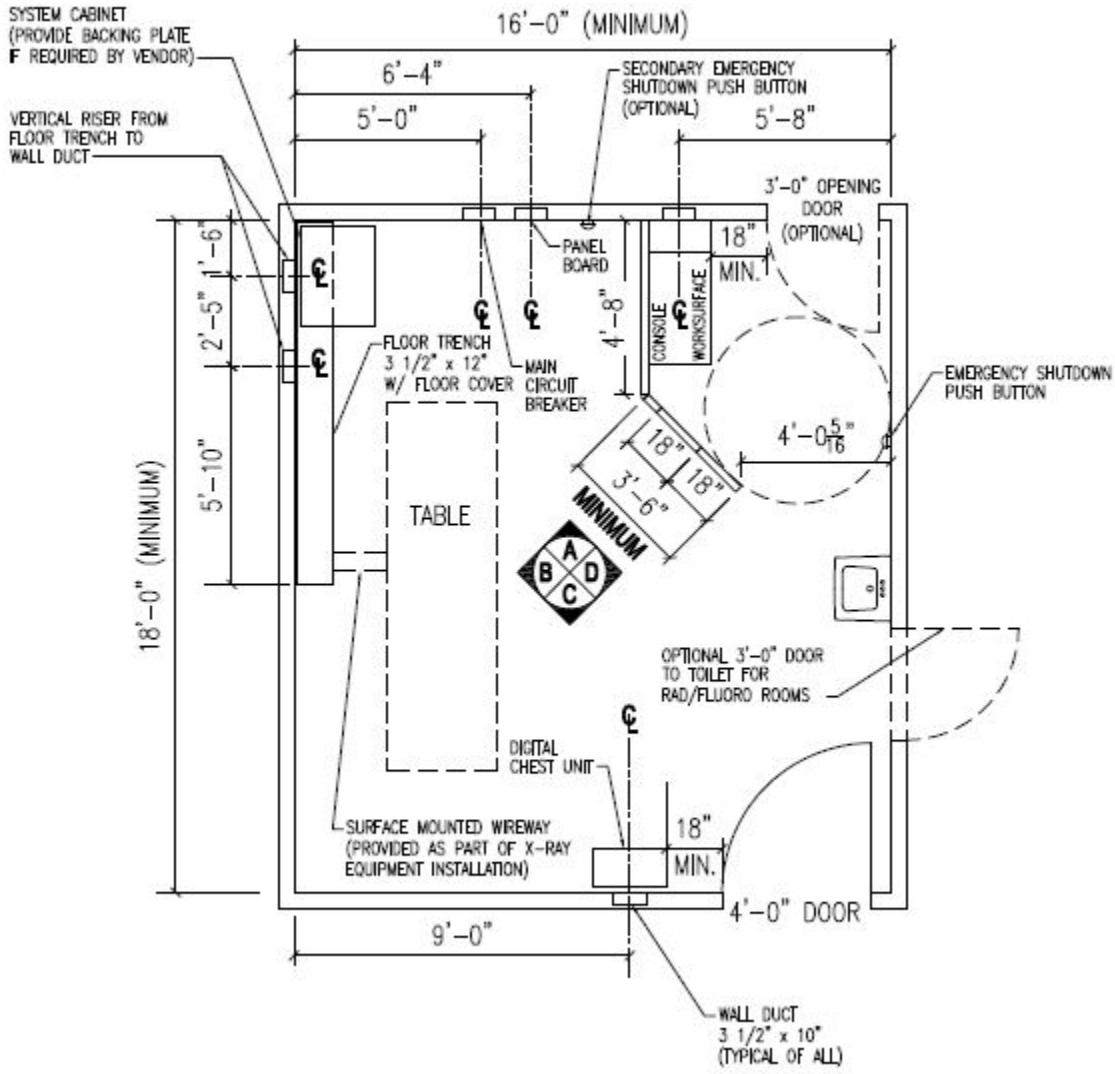
Use built-in or modular shielding for the control booth. Maximize viewing pane(s) where practical so that the operator has an unrestricted view of the patient, wall bucky and x-ray table during all x-ray exposures in the room.

Locate all ductwork, grilles, registers, and diffusers above or flush with the ceiling to avoid conflict with overhead equipment rail travel and shielding. Route thermostat transmission lines to avoid penetration of shielding.

D-4.5 Fire Protection.

Ensure all automatic sprinkler heads are recessed.

Figure D-1 Universal X-ray Room Floor Plan



Note: 1' = 304.5 mm

Figure D-2 Universal X-ray Room Above Ceiling Plan

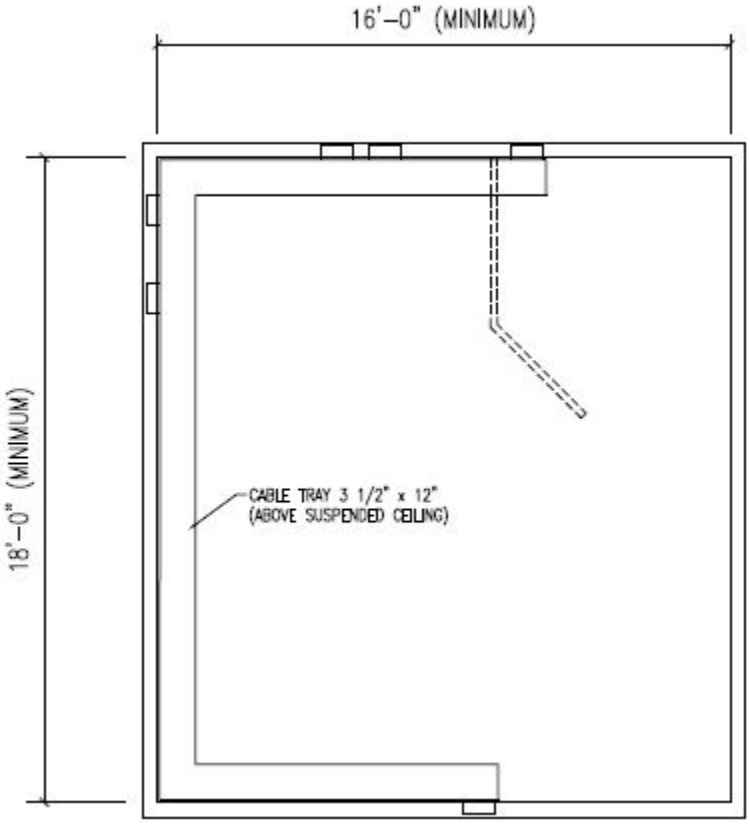
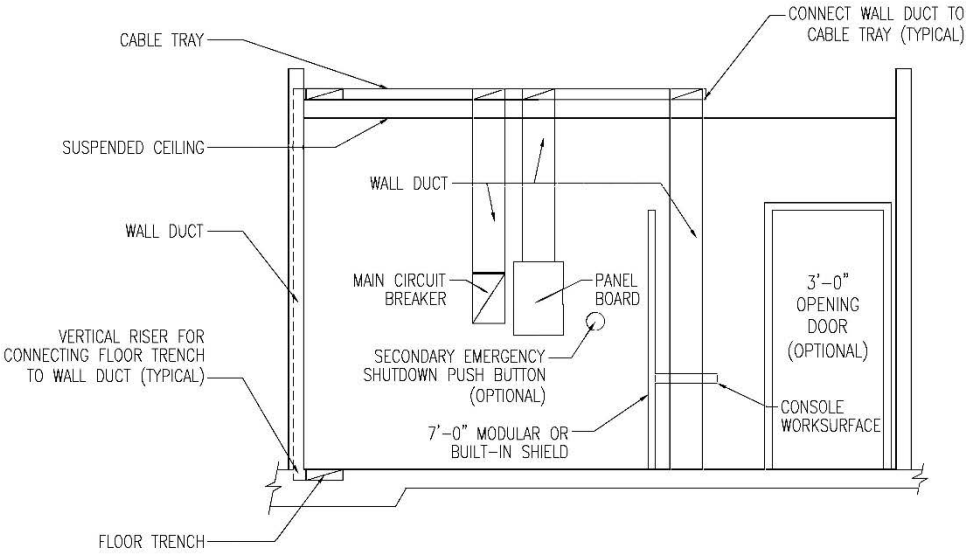
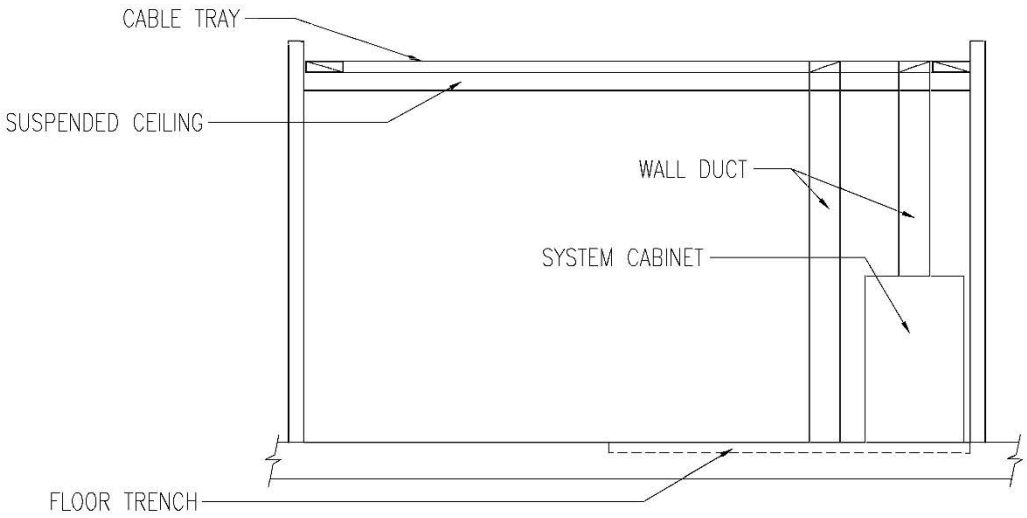


Figure D-3 Universal X-ray Room Elevations



ELEVATION "A"



ELEVATION "B"

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APPENDIX E INTERSTITIAL BUILDING SYSTEM (IBS)

E-1 GENERAL.

This appendix provides mandatory criteria for the use and application of IBS concepts, including interstitial utility spaces.

E-2 IBS DESIGN CONCEPT.

The primary concept of interstitial spaces located between functional floor spaces is a non-traditional design feature that permits locating the majority of facility utility distribution and terminal equipment within the interstitial space, and not within functional spaces. This IBS concept offers the DoD several advantages over standard building design in providing convenient installation, maximizing utility access and maintainability, providing for future building flexibility, while minimizing disruption to medical or laboratory services.

E-2.1 DoD Systems Module Concept.

The fundamental approach to interstitial building design in DoD is the DoD Systems Module. The DoD Systems Module organizes building areas into discrete modules, normally defined by major medical department or occupancy boundary, and limited to the size of the relevant smoke compartment as permitted by NFPA 101. Each module is served by equipment, for example, mechanical, electrical, and piping, located in a dedicated utility pod, from which the services are distributed within the confines of the module boundaries via a dedicated distribution zone (interstitial space) and connection zone (above-ceiling space) to the occupied zone (functional space) associated with the respective module. (Refer to Figure E-1.) Having dedicated services for each module, the user has full knowledge of the areas affected by O&M services and by future system modifications. The DoD Systems Module concept also results in greater standardization of major MEP equipment (such as AHUs), reducing the storage of spare parts, and increasing the overall dependability of the systems.

E-2.2 Alternate Non-Modular Concept.

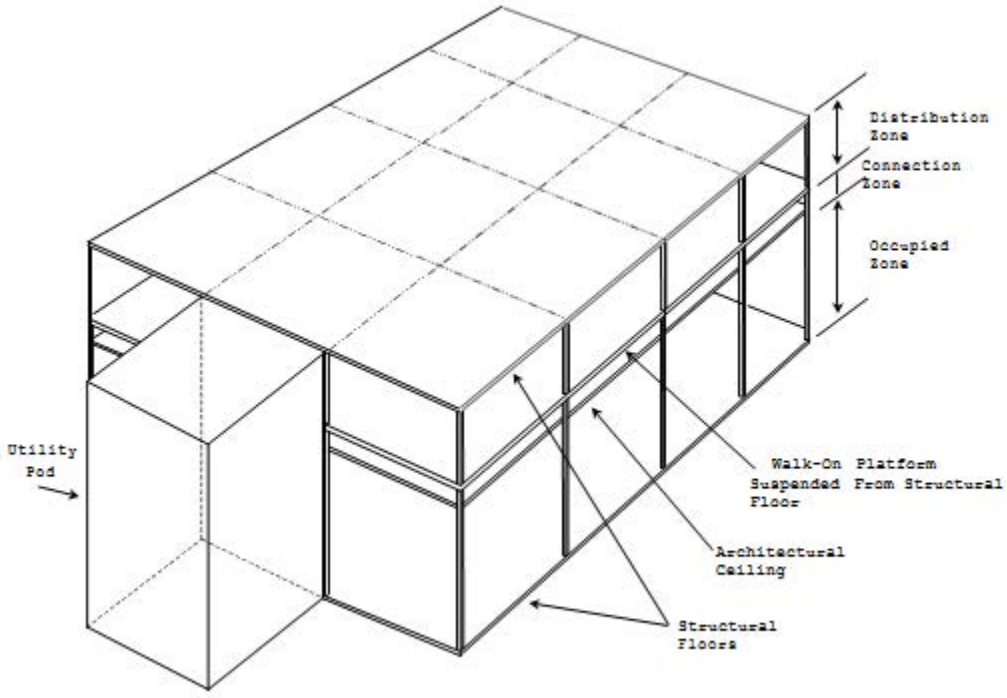
An alternative, non-modular approach, also with interstitial floors for utility distribution, may in some cases be utilized for some types of DoD facilities. In some instances, the DoD Systems Module design concept can be less economical than a non-modular approach, and is not ideally suited for all building types, for example, laboratories, in all locations. The non-modular designs typically differ from the DoD Systems Module in permitting equipment, such as AHUs, to serve different (multiple) functional areas, occupancies, or compartments. This can involve horizontal service distribution to differing parts of the building.

E-2.3 IBS Design Concept Approval.

For any IBS design, incorporate requirements in this appendix including those for construction of the interstitial floor (walk-on platform), utility penetrations, and the

organization of the distribution zone for accessibility and fire safety. Evaluate the decision as to whether an IBS building will follow the DoD Systems Module concept or an alternate non-modular design. Evaluation to occur following the 5 percent design submission and completed by the 20 percent submission. Include an economic comparison with alternatives considered with the 20 percent submission. Also include all costs associated with acquisition, operation, maintenance, and alteration for the designated service life of the proposed facility. Reference Appendix C for submission requirements. Approval of the IBS is documented on the DD Form 1391 as constructible building scope IAW Chapter 3.

Figure E-1 DoD IBS Systems Module (Typical)



E-3 IBS DESIGN.

E-3.1 DoD Systems Module Design.

The DoD Systems Module, a designated unit of space one story in height, is the basic building block of a DoD Systems Module facility, in other words the facility is composed of separately identifiable DoD Systems Modules each consisting of a utility pod, a distribution zone, a connection zone, and an occupied zone. Each DoD Systems Module is served by its own utility distribution systems. The relationship of the various zones is illustrated in Figures E-1 and E-2. Limit DoD Systems Modules to the size permitted by NFPA 101 for the smoke compartment associated with the relevant IBS system module, exclusive of the utility pod. Although there is a spatial discipline

associated with the DoD Systems Module, the overall organization and massing of a facility can be varied according to specific project requirements.

E-3.1.1 Utility Pod.

The utility pod contains AHUs and associated risers, fans, pumps, and other related equipment; electrical and heat exchange equipment; and associated risers serving the DoD Systems Module. Fresh air and exhaust openings are generally part of the utility pod enclosure. The utility pod is the space between two adjacent structural floors or between the highest structural floor and the roof. In multi-story buildings, stack utility pods from floor to floor so that plumbing and electrical risers can be efficiently and economically accommodated.

E-3.1.2 Distribution Zone.

The distribution zone is the space between the walk-on platform and the structural floor or roof above. The maximum height of the distribution zone measured from top of walk-on platform to underside of floor slab above is 9 ft (2.74 m). The distribution zone accommodates the horizontal distribution of main utility systems and provides convenient access to these systems by means of a walk-on platform. Central equipment for mechanical, electrical, plumbing, and communications systems, as well as motorized equipment, is not permitted in the distribution zone. Utility distribution systems enter and leave the utility pod through the distribution zone. Arrange the utilities (piping, ducts, VAV boxes, raceways, conduits, and cable trays) to minimize future modifications of the mains and to accommodate future modifications of branches and laterals. Except for gravity piping services, most systems in the distribution zone down-feed to the connection zone below. Finish the walk-on platform surface, or provide the capability of receiving finish materials, with sufficient bond strength and resistance to abrasion and impact to permit maintenance personnel to walk on the surface without affecting the structural integrity of the platform and without generating a dust problem. Seal all painted concrete surfaces.

E-3.1.3 Connection Zone.

The connection zone is the space between the walk-on platform and the architectural ceiling of the occupied zone below. The connection zone accommodates recessed lighting fixtures, sprinkler piping, and air diffusers and their supports, as well as the horizontal distribution of utilities to individual rooms or spaces. Provide access the connection zone from the occupied zone, usually through the architectural ceiling.

E-3.1.4 Occupied Zone.

The occupied zone is the space of functional activity. The occupied zone is defined by the structural floor and the architectural ceiling above.

E-3.2 Alternate (Non-DoD) IBS Design.

E-3.2.1 Use of Mechanical Rooms or Penthouse.

When utility pods are not provided, AHUs are typically located on the roof (in an enclosed, conditioned penthouse) or on another floor level in a mechanical equipment room. Remotely locating AHUs from the serviced area, compartment, occupancy, or smoke compartment boundary can require vertical distribution of ductwork passing through multiple floors. Also, to reach the intended serviced location, HVAC ductwork may be run horizontally through more than one smoke zone.

E-3.2.2 AHU Serving More Than One Area, Occupancy, or Smoke Zone.

Where air handling systems are designed to serve multiple areas, occupancies, or compartments, design the primary supply and return ductwork to enter each individual smoke zone boundary at a single point. Provide isolation smoke dampers to allow modifications in that smoke compartment to occur without impact on adjacent compartments. Provide smoke dampers, similar to a non-IBS facility, when crossing smoke compartment separation barriers.

E-3.2.3 Duct Smoke Dampers.

Provide smoke dampers in ducts in the distribution zone where a duct serves more than one smoke compartment. Where required, locate the smoke damper in the duct at the approximate location where the smoke barrier is located below in the occupied zone.

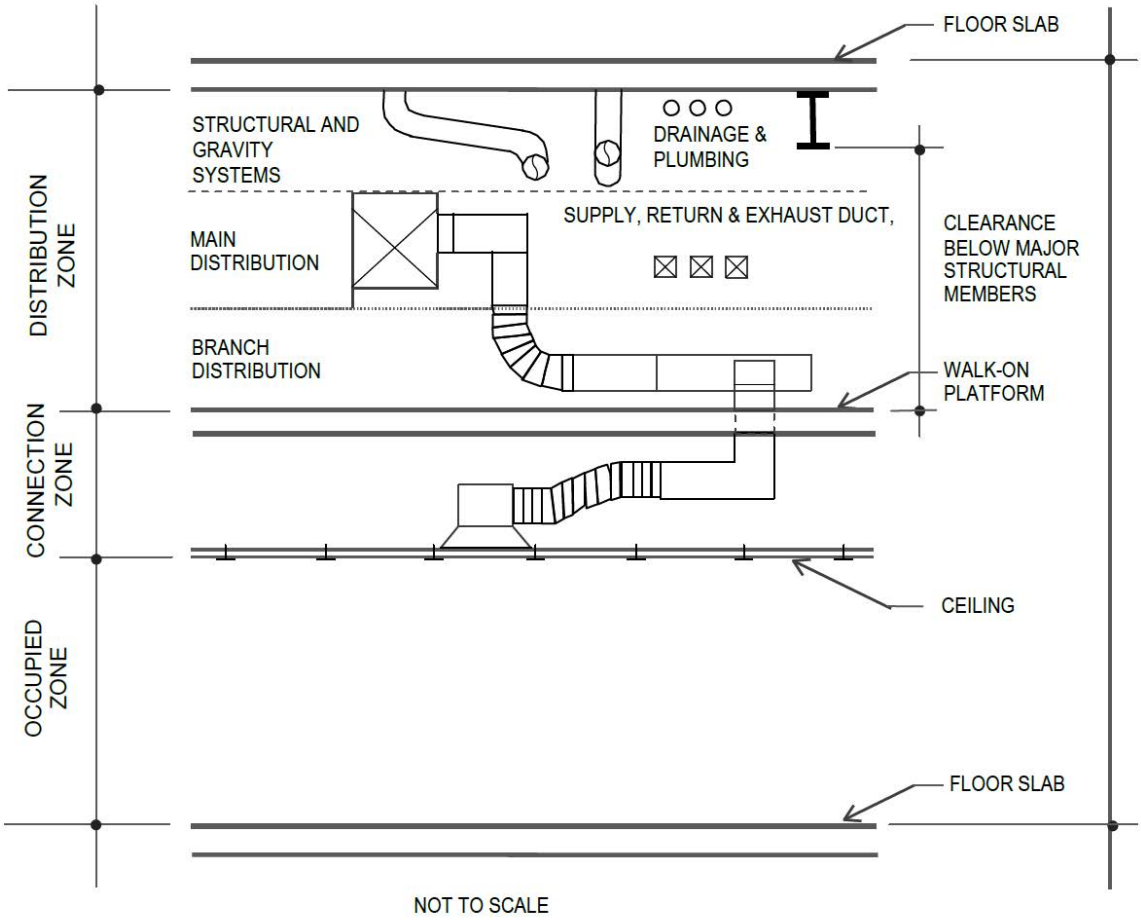
E-3.2.4 Boundary Partitions.

To manage systems distribution, partitions relative to the boundary of the predominant occupancy are required in the same locations of the distribution zone as located below in the occupied zone. This non-rated partition extends from the surface of the walk-on platform to the underside of the occupied zone above. This partition is required to maintain the separation of the support area relative to the boundaries of only the predominant occupancies, rather than every possible occupancy separation. In addition to utility management, another benefit is the added perimeter wall space for locating additional means of egress paths for the distribution zone.

E-3.3 General IBS Design Requirements.

Design requirements for the distribution zone, connection zone, and occupied zone are the same as defined and described for DoD Systems Module designs. Arrangement of IBS elements must be in accordance with Figure E-2.

Figure E-2 Interstitial Design Elements



E-3.3.1 Exceptions.

As early as possible in the design process, but no later than the 20 percent design submittal, identify any spaces or uses within a facility's proposed design that would either prevent, or otherwise negatively impact, the use of walk-on platforms. Spaces to consider include (but are not limited to) sloped floor areas; high-ceiling spaces, for example, auditoriums, high-pile storage, and atria; and MRI suites where equipment weight or unusual structural requirements may be applicable.

E-3.3.2 Number of Stories.

The walk-on platform constitutes the floor of the distribution zone. A walk-on platform does not constitute an independent story. Each occupied zone and the corresponding distribution zone are counted together as an independent floor (for the purpose of determining the number of stories).

E-3.3.3 Facility Expansion.

In DoD Systems Module buildings, place utility pods so not to encumber vertical or horizontal facility expansion.

E-3.3.4 Existing Facilities.

When an IBS facility is to be connected to an existing conventional facility, design concerns may arise. Existing floor-to-floor heights are typically less than the heights required for IBS construction. Therefore, alignment of new floors with existing floors is required. Continuity with existing facilities cannot be hastily assumed to preclude application of the IBS design concepts.

E-3.3.5 System and Equipment Capacity Increases.

Oversize utility systems to accommodate future changes. Design AHUs and ducts to have their capacities increased for future demand growth by a minimum of 15 percent. Design the distribution systems to accommodate a degree of capacity increase. During initial design, the Design and Construction Agent and the DoD Project Sponsor are to jointly determine the extent of system and equipment capacity increases required.

E-3.3.6 Distribution Zone Accessibility.

Provide means of egress paths on the walk-on platform throughout the distribution zone. All means of egress paths accommodate ease of access for maintenance and provide a defined means of egress. Provide available vertical space clearances within the distribution zone to permit the organization of the utility distribution systems for ease of accessibility. (Refer to Figure E-3.) It may not be practical to arrange the distribution zone for complete accessibility to every component. However, it is important to examine the various accessibility requirements to best locate means of egress paths to reach all main systems, feeders, connections, and maintainable equipment. Provide paths unobstructed by utility lines or other equipment. Provide sufficient clearance within the means of egress paths for a worker to stand, exclusive of major structural members. Additionally, clearly mark walking surfaces for means of egress paths which are to be clear from dust and debris. Access to the distribution zone is to be from adjacent stairs and, in multi-story facilities, from key-operated service elevators designed to stop at the walk-on platform levels. No access to the distribution zone will be permitted through access panels from the connection zone.

E-3.4 General IBS Mechanical and Plumbing Requirements.

E-3.4.1 Riser Locations.

In DoD Systems Module designs, risers and vertical circulation elements not located in the utility pods must be located at the boundaries of the DoD Systems Modules adjacent to permanent structural elements, stairs, or elevators.

Figure E-3 Interstitial Access-Egress (Typical)



E-3.4.2 Valves.

Locate control valves, except those required to be in the occupied zone such as medical gas control valves, in utility pods or equipment rooms to permit centralized control. Tag and identify shut-off and balancing valves located in the distribution zone and identify on a valve list that shows their distribution zone locations and the areas or equipment served in the occupied zone. Do not locate valves in the connection zone for any utility system unless specifically permitted by the DoD Project Sponsor.

E-3.4.3 Systems Expandability.

Select prime moving equipment, for example, pumps and fans, for operation at the midpoint of their operating characteristic curves. Size ducts and piping to permit future flow increases. Provide stubs, valves, and caps in plumbing risers and in horizontal branch terminations for future service extensions.

E-3.4.4 Air Handling System Selection.

Base system selection on functional needs, LCCA, energy efficiency, and ease of maintenance and repair. To enhance maintainability, it is normally desirable to "standardize" the size of AHUs when practical from a performance standpoint. For example, several AHUs of the same unit size and motor horsepower allow economy in the stocking of spare parts. Select "Off-the-shelf" packaged AHUs in lieu of custom manufactured units to ensure parts availability and ease of future modification.

E-3.4.5 Ventilation of Distribution Zone.

Under normal conditions, fresh air is not required in the distribution zone. However, if determined by the designers, ventilation may be required for moisture or temperature control in distribution zones exposed to roofs.

E-3.4.6 Gravity Systems in IBS Facilities.

Design the location and elevation of sloped gravity piping to maximize the access around the piping. Do not block designated access pathways.

E-3.5 General IBS Electrical and Communications Equipment.

E-3.5.1 Distribution Systems.

Base the distribution system routing (horizontal and vertical) and the quantity and location of unit substations on the size of the facility, LCCA, overall flexibility, and long-term system reliability. Compare the benefits of underground (or crawlspace) utility service distribution to the utility pods with service distribution through the distribution zones considering flexibility, reliability, system maintainability, and safety.

E-3.5.2 Electrical Room Locations.

In all IBS designs, stack electrical rooms to the extent feasible. In DoD Systems Module design facilities, locate electrical rooms in the utility pods and stack vertically from floor to floor. Provide provisions for easily running vertical cabling from floor to floor, for example separate/independent conduit risers with pull boxes at each distribution zone. (Refer to Chapter 11.) Size cabling and wiring for allowable voltage drop at full design load.

Evaluate the need for additional electrical rooms, located at opposite ends of the DoD Systems Modules from the utility pods, for maintenance of acceptable voltage drops, reasonable lengths of secondary cable runs, and numbers of devices per circuit. Locate additional rooms in the occupied zones adjacent to permanent structural elements, stairs, or elevators, and stack vertically from floor to floor.

E-3.5.3 Capacities for Flexibility.

Base capacities of major electrical components, such as main distribution panels and transformers, on the areas served, rather than specific use, to allow for flexibility.

E-3.5.4 Electrical Secondary Distribution.

Route branch circuiting through the distribution zone to allow for modification with minimal disruption of the occupied zone. Distribute electrical systems wiring through totally enclosed cable trays. Provide ground continuity throughout the cable tray system. Design cable trays with space dedicated in the distribution zone for future cable trays.

E-3.5.5 Communications Systems Distribution.

Use cable trays to distribute communications systems wiring. Provide ground continuity throughout the cable tray system.

E-3.5.6 Identification.

Provide coded identification of electrical raceway and junction boxes by voltage and function at 40 ft (12 m) intervals and on junction boxes. Provide circuit identification for electrical wiring and system identification for communications wiring.

E-3.5.7 Lighting.

Provide 50 lux of lighting throughout the distribution zone. Provide one hundred 50 lux over access-egress pathways and at distribution zone elevator lobbies using damage-resistant lighting fixtures. Additionally, provide egress lighting and exit signs over access-egress paths and at distribution zone exits as indicated in “Means of Egress Paths” of this appendix. Provide switches at each distribution zone entry and exit.

E-3.5.8 Power.

Provide specification-grade, heavy-duty, ground fault-protected electrical outlets in the distribution zone for use with portable tools and located to accommodate maximum 50-foot extension cords.

E-3.6 General IBS Fire Protection Design.

Design the fire protection and life safety features for facilities using IBS with the same codes and standards applicable to any non-interstitial facility. The IBS criteria noted here are based upon two special studies conducted by the National Institute of Standards and Technology (NIST)—one in May 1985 (NBSIR 85-3158) and the other in February 1995 (NISTIR 5560). The criteria herein have been coordinated with the requirements of the referenced codes and standards to accommodate the non-traditional characteristics of the interstitial building approach. Proposed designs that vary from the special studies will require a new fire test in accordance with NFPA 251.

Note that the use of engineering evaluation in lieu of fire tests is not permitted. Where variations between this standard and other applicable codes and standards occur, the fire safety design requirements for interstitial facilities indicated herein must govern; however, do not apply this document in such a manner as to exempt NFPA 101 or other applicable code requirements.

E-3.6.1 Occupancy.

The distribution zone is a “normally unoccupied building service equipment support area” (NUBSESA) as defined by NFPA 101. All IBS distribution zones and interstitial spaces are NUBSESA and compliance with NFPA 101 is required as modified in this appendix.

E-3.6.2 Smoke Compartmentation.

In all IBS building designs, provide smoke barrier separation for smoke compartmentation for occupied and connection zones. Smoke compartmentation is not required for the distribution zone in an interstitial floor.

In DoD Systems Module designs, the integration of facility building modules with NFPA smoke compartmentation requirements is a basic fire protection/life safety principle of this non-traditional building concept. When applying NFPA 101, the modular configuration of the DoD Systems Module approach becomes a significant benefit because compartmentation is a natural byproduct.

E-3.6.3 Floor-to-Floor Fire Separation.

A two-hour fire separation is required between each functional floor level for IBS facilities. The functional floors are separated by a fire-resistive “floor/ceiling” assembly. The limits of each floor/ceiling assembly are defined by the bottom of the walk-on platform and the top of the structural floor above. In the DoD Systems Module concept, the fire resistance rating runs in a horizontal plane along the utility pod floor, then vertically along the wall separating the utility pod from the occupied zone and connection zone. The fire resistance rating then continues along the walk-on platform to the outside wall. The walk-on platform of the distribution zone must be designed in accordance with NBSIR 85-3158. Figure E-4 illustrates fire protection for the DoD Systems Module concept. The same figure is applicable to alternative non-modular designs, except the Utility Pods are not utilized.

E-3.6.3.1 Occupied Zone.

Provide smoke barriers requirement of NFPA 101 for the occupied zone.

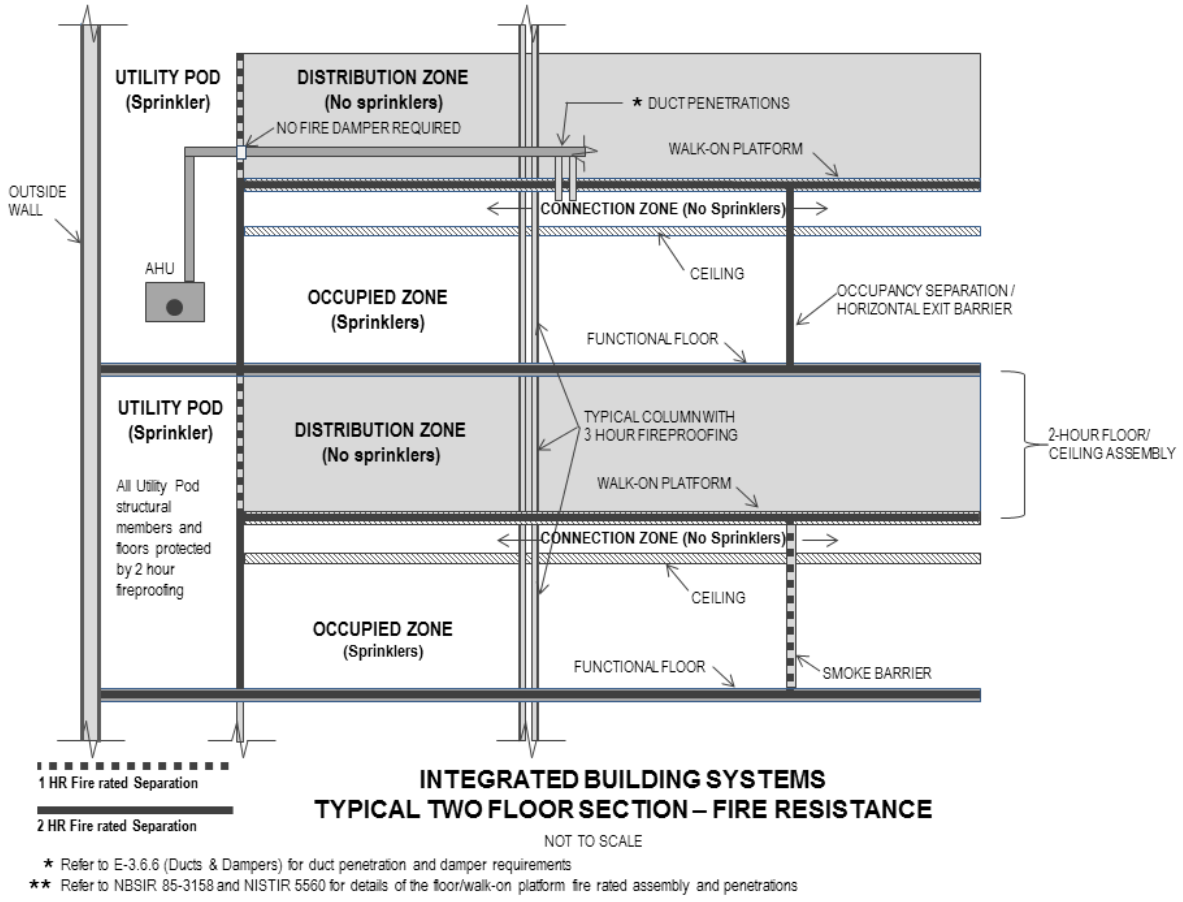
Extend all barriers and partitions with fire-resistive ratings of two hours or less to the bottom of the walk-on platform.

E-3.6.3.2 Distribution Zone.

Dividing the distribution zone into smoke compartments with smoke barriers is not required.

In DoD Systems Module design facilities, horizontal exit, occupancy separation, or smoke barrier walls located in the occupied/connection zone need not be extended up into the distribution zone.

Figure E-4 DoD Systems Module Typical Two Floor Section – Fire Protection



E-3.6.3.3 DoD Systems Module Utility Pods.

Separate utility pods from the distribution zones by one-hour fire-rated construction and from the occupied and connection zones by two-hour fire-resistive construction. **\1\ /1/** Provide a two-hour fire resistive rating for the structural members in the utility pod.

Clearly identify the limits of the connection zone, occupied zone, and the distribution zone from the utility pod, particularly with respect to delineation of one- and two-hour fire-rated assemblies.

E-3.6.4 Structural Members Fire Protection.

Results of NBSIR 85-3158 determined that all structural steel within the interstitial space (distribution zone), except the columns, is adequately protected from the effects of fire for a minimum duration of two hours by the walk-on platform/interstitial space arrangement without any fireproofing directly applied to the structural steel within the tested interstitial space. Structural steel within the distribution zone (interstitial space) includes structural members supporting the walk-on platform. **\1\ /1/** Provide all columns with three-hour fire-resistive rating within all zones.

Provide a two-hour fire-resistive rating or protect in accordance with the fire resistance requirements of IBC for all primary structural members (supporting more than one floor) located within the distribution zone, such as girders and trusses. Do not fireproof secondary structural members (supporting only one floor) within the distribution zone. Lateral and seismic bracing within the distribution zone need not be fireproofed provided these members do not carry vertical loads (live or dead).

E-3.6.5 Openings.

To prevent fire and smoke migration into the distribution zone, protect openings through the walk-on platform as noted here: **\1**

E-3.6.5.1 Firestop.

/1/ Firestop all penetrations, for example, ducts, pipe, cables, and conduit, at the walk-on platform with approved material in accordance with NBSIR 85-3158 or with an approved through-penetration protection system. Incorporate all proposed designs with utility penetrations of the walk-on platform by one of the following methods of firestopping:

a. Approved firestopping material using materials from the NBSIR 85-3158.

b. A listed through penetration assembly for the proposed walk-on platform design.

c. A tested system that complies with ASTM E814 or ANSI/UL 1479 for the proposed walk-on platform. **\1**

E-3.6.6 Shafts.

/1/ Enclose shafts in properly rated construction and tightly seal the full perimeter of the penetration at the walk-on platform in accordance with NBSIR 85-3158 or with an approved through-penetration protection system.

E-3.6.7 Ducts and Dampers.

E-3.6.7.1 One-hour Rated Partitions.

Fire dampers are not required where ducts penetrate the one-hour fire-rated partition between the utility pod and the distribution zone.

E-3.6.7.2 Two-hour Rated Partitions.

Fire dampers are required where ducts penetrate two-hour fire-rated partitions between the utility pod and the occupied and connection zones.

E-3.6.7.3 Walk-on Platform Limitations on Unprotected Penetrations.

Do not exceed .98 percent for the total cumulative open space created by unprotected duct penetrations in the walk-on platform above any single smoke compartment or room in the occupied zone. NOTE: this includes annular space between duct and the inside edge of the walk on platform opening. This limit is provided as a design control feature to prevent over penetrating a given area of walk-on platform with un-dampered duct penetrations. The 0.98 percent value is based upon the percentage used in NBSIR 85-3158 and has been coordinated with TJC. Comply with the following paragraph for Individual duct penetrations.

E-3.6.7.4 Walk-on Platform Duct Openings.

Provide fire dampers for duct penetrations greater than 225 in^2 (0.14 m^2) in the walk-on platform. Fire dampers are not required in ducts for openings in the walk-on platform less than or equal to 225 square in^2 (0.14 m^2). This includes supply ducts from the distribution zone to the occupied zone, exhaust ducts, and return ducts from the occupied zone to the distribution zone. Flexible, round duct work (UL 181, Class I) is permitted in interstitial space for connections less than 5 ft (1.52 m) long, but not larger than 12 in. (305 mm) in diameter.

E-3.6.8 Automatic Sprinkler Protection.

Provide an approved automatic supervised sprinkler protection as defined by NFPA 101, throughout the occupied zone and, in DoD Systems Module facilities, in the utility pod. Sprinkler protection is not required throughout the distribution zone or connection zone unless otherwise required by UFC 3-600-01. However, sprinkler protection is required in rooms being used for electrical, communications, and elevator machine equipment, as well as over automatic box conveyor rails and tracks for electric track vehicle systems when located within the distribution zone.

E-3.6.9 Standpipe Protection.

Provide standpipe protection in accordance with UFC 3-600-01. In addition, provide hose outlets at each entrance to the distribution zone exit/access door.

E-3.6.10 Management of Smoke.

Evaluate each facility on an individual basis for the requirements for a smoke management system. Provide a means for purging the distribution zone of smoke and other products of combustion for post-fire operations.

E-3.6.11 Fire Alarm, Fire Detection, and Mass Notification.

Provide fire alarm, fire detection, and mass notification in accordance with Chapter 14. In addition, align system supervision and alarm zoning with the fire and smoke compartments associated with the IBS design. Identify the fire alarm and fire detection devices located in the distribution zone as a subset of the fire alarm evacuation system.

E-3.6.11.1 Manual Alarm Initiation.

Provide a manual pull station provided in the distribution zone at each exit/access door. Coordinate zoning for annunciation with the exit enclosure serving the occupied zone exit/access.

E-3.6.11.2 Occupant Notification.

Provide alarm notification appliances (speakers) utilizing voice evacuation for occupant notification throughout the distribution zone. Activate the alarm notification appliances within the corresponding distribution zone, upon any alarm initiating signal. Provide supplemental visual notification (signaling) in accordance with NFPA 72 along the means of egress paths.

E-3.6.11.3 Smoke Detection.

Provide smoke detection at each elevator access landing in the distribution zone. Connect the smoke detector(s) to the elevator controls and provide elevator response per NFPA 101.

E-3.6.12 Distribution Zone.

Storage is not permitted in the distribution zone.

E-3.6.12.1 Exit/Access.

Exiting from the distribution zone is provided by a side-hinged swinging door assembly located in each exit stairway enclosure. The exit/access door is the primary means of egress for distribution zone occupants and compliance with the exit and ease of operability requirements of NFPA 80 and 101 is required. Provide a door assembly with a minimum width of 36 in. (915 mm) and height of 80 in. (2030 mm). Provide a door which is lockable, self-closing, positive latching, and accessible only by key. Provide a sign on each access door stating: “Storage in This Area is Prohibited by Order of the Fire Marshall.” Provide a similar sign inside the distribution zone.

E-3.6.12.2 Means of Egress Paths.

Provide a designated means of egress path throughout the distribution zone space in accordance with NFPA 101. Any means of egress path connecting the exit/access doors are required at the perimeter of the distribution zone. Provide egress travel along means of egress paths not to exceed 100 ft (30 m) before two separate and distinct means of egress paths of travel to two remote exits are available. Additionally, provide means of egress paths within 25 ft (7.6 m) of any portion of the distribution zone where the only available access requires crossing over or under obstructions or distribution equipment. The minimum clear width for all paths is 36 in. (915 mm), except paths of existing distribution zones which maintain a minimum clear width of 28 in. (710 mm). Provide paths which are nominally level with thresholds and elevation changes in accordance with NFPA 101.

Delineate paths for the full 36 in. (915 mm) width on the surface of the walk-on platform from the most remote point to the exit/access door. Paint paths yellow with direction arrows or cross-hatching indicating direction to each exit/access door. Treat paths with a surface sealant prior to painting. **\1\ /1/** Illuminate exit signs and locate at each exit/access door. Provide an exit sign adjacent to the doorway within 36 in. (915 mm) of the walk-on platform. Locate exit signs along the pathways to provide clear direction toward exits. Provide exit signs in accordance with NFPA 101 for size and illumination requirements.

E-3.6.12.3 IBS Headroom Clearance.

Provide a designated means of egress path with a minimum headroom clearance of 80 in. (2032 mm) and maintained along the entire designated pathway, exclusive of interferences from major structural members. Headroom clearance may be reduced to 72 in. (1828 mm) for no more than 36 in. (915 mm) along any given path. The minimum spacing between each location with limited headroom clearances must be 36 in. (915 mm).

E-3.6.12.4 Exit Signage and Egress Lighting.

Provide exit signage and egress lighting on the life safety circuits and provide with standby or emergency power. Since the distribution zone space is normally unoccupied, separate keyed-alike key-operated light switches (for normal lighting, egress lighting, and exit sign lighting) located at each access doorway activates normal lighting, egress illumination, and exit sign illumination within the module in accordance with NFPA 70 switch requirements for control of emergency lighting circuits to minimize electrical usage and replacement of lamps in the distribution zone.

E-3.6.13 Variations.

In the event a variation from applicable IBS criteria herein is considered, provide documentation to justify the need and identify alternate solutions. Solutions may include equivalent concepts. Support all documentation with sound engineering

principles that are economically feasible and practical to apply. Address and obtain approval of all variations with the Design and Construction Agent prior to incorporation into the design. Interstitial floor construction characteristics, including the features, properties, and attachment methods of structural support members, walk-on deck materials and properties, and limitations and characterization of allowable deck penetrations, to be in accordance with the referenced NIST-tested assemblies. Where the proposed interstitial design does not replicate NIST tested assemblies, demonstrate structural and thermodynamic equivalency by full-scale testing in accordance with NFPA 251.

E-3.7 Documentation and Construction Considerations.

E-3.7.1 Construction Documentation.

Provide drawings for IBS facilities to include plans and sections delineating zones reserved for utility distribution, branches, and laterals. Drawing information must indicate location of all utility system walk-on platform penetrations and include installation details for each type of utility system penetration. Coordinate drawings with all disciplines. Provide interdisciplinary cross-sections at critical locations, for example, above ORs, equipment rooms, and corridors. Include requirements for coordination of all disciplines prior to construction in all pertinent specification sections.

E-3.7.2 Pre-Bid Conferences.

To ensure that construction contractors take the IBS DoD Systems Module design concepts into account when preparing bids, recommend presentations of these concepts for pre-bid conferences conducted by the Design and Construction Agent.

E-3.7.3 Pre-Construction Consideration.

For a DoD Systems Module construction project, construct a mock-up distribution zone at least 1000 feet^2 (93 m^2) in area at the project site, at the discretion of the Design and Construction Agent. Include a complete walk-on platform assembly with suspension members for the mock-up. Within the sample, include elements of the utility systems within the distribution zone. Complete construction of the mock-up in advance of facility construction to allow time for necessary testing and approval. Address and finalize various construction details within the mock-up, such as temporary protection of the walk-on platform during construction, proper support and sealing of ducts and fire dampers at walk-on platform penetrations, and permanent fire sealing of the walk-on platform to abutting walls and other permanent structural elements.

E-3.7.4 Coordination Drawings.

Provide coordination drawings prior to construction that show all utilities and penetrations. Include this information in the record drawings indicating the as-built conditions.

APPENDIX F FOOD SERVICE

F-1 GENERAL.

This appendix provides criteria and guidance for the design and development of food service systems in new and existing applicable facilities. The appendix includes lessons learned from using MilDep consultants and Post-Occupancy Evaluations for the purpose of minimizing errors on all future projects.

F-2 CONSULTING SERVICES.

The A/E of record shall provide the services of a qualified hospital food service consultant at project initiation, who provides design function, flow and equipment input throughout the design process. The consultant also provides input on equipment specifications and cost estimates of the equipment. A qualified food service consultant is one who has been in business solely as a food facilities design professional for a period of not less than five years and is a member of the Food Service Consultants Society International (FCSI) or equal. The consultant shall not be involved in the sale, installation, distribution, manufacture, or representation of food service equipment. Furthermore, the consultant should have experience with similar projects scope, size, and location for the specific project.

F-3 FOOD SERVICE DESIGN OBJECTIVES.

F-3.1 Environment.

Provide a functional, efficient, and aesthetically pleasing food and nutrition environment for patients, service members, staff, and guests, within staffing, budgetary guidelines, and space requirements. This includes a functional, efficient patient tray assembly area designed to provide room service style patient feeding.

F-3.2 Design Elements.

Design nutrition services (or patient and staff feeding) facilities that optimize the performance of existing personnel, the facility, and the equipment, while producing high-quality nutrition care services and products. The design shall incorporate evidence based design (EBD) elements, such as access to outdoor dining, access to natural views, a variety of spaces for social, dining, and collaborative engagement among patients, family, and staff, and providing positive distractions in all public spaces. Design patient tray assembly area to efficiently support room service style patient feeding, please refer to F-4.5. Give highest priority to colocation of all food service spaces and functions on one level. Requirements for food preparation spaces include proper temperature control, ventilation, and to the extent possible, minimizing the distance required to transport food products and finished food items from the point of preparation and cooking to the point of service.

Collocate and make accessible the pot and pan room and dishroom to the patient tray service and dining facility preparation areas.

F-3.3 Design Flexibility.

Design a food service system with the ability to adapt readily to changing missions, requirements, food preparation processes, labor conditions, and equipment technology.

This objective requires forethought from the DoD Project Sponsor, end user, and food service consultant. Recommended methods to build flexibility into the design include planning multiple sources of power with additional electrical capacity incorporating dual use equipment, and integrating information technology effectively. Design the dining area to maximize the projected seating capacity without sharing with non-food service departments, allow for flexibility to accommodate various sized groups as needed within the dining area, and provide a clear flow of traffic into and out of the dining area. Design the servery, dining area, cash registers and condiments bar as securable, discrete areas during non-operational hours.

F-3.4 Equipment.

Provide high-quality food service equipment that is manufactured in the United States (or as designated by regional requirements in OCONUS locations) and sized to accommodate the maximum capacity of the expected growth of the facility at the time of design. Provide dual functional equipment when possible, for example, a serving line capable of being self-serve or full service; a serving line with the capability to hold hot or cold food for service. Select and incorporate equipment into the design to create an efficient flow of materials and personnel. Custom-fabricated equipment is permitted in the servery, walk-in refrigeration and freezers, and space-restricted equipment; specified modular equipment must be easily disassembled and reassembled by the end user and must be off of the floor and or on wheels or coasters for ease of movement for cleaning and reconfiguration. Equipment must also be designed and built for ease of sanitation and food safety measures. Large equipment installed, custom fabricated or not, must be designed such that it can be removed and replaced at the end of its life cycle without having to execute major facility construction to widen doorways, open walls, or move other installed equipment during the removal/replacement process [or] all equipment included in the design must have the ability to be disassembled with minimal effort for removal through existing doorways, elevators, etc.

F-3.5 Energy Efficiency and Sustainability.

Consider energy efficiency and sustainability in the design. Incorporate sustainable design features and requirements including day-lighting, energy and water conservation measures, the use of nontoxic materials and finishes, and sustainable O&M practices. Incorporate space and equipment to maximize waste reduction, reuse, recycling, and composting in accordance with UFC 1-200-01 and local installation requirements. Prior to design, the contractor must verify that the community can support the recommended sustainability practices. Incorporate a blend of reusable dishware and other food service-related disposables.

F-3.6 Food Service Systems.

The basis of physical planning constitutes three food service system: ready prepared, cook/serve, and Grab and Go or a mix thereof. Most facilities have a mix of food systems utilizing a conventional flow of food. See the Functional Diagrams depicting flows for the various food service systems in the DoD Space Planning Criteria Chapter 510 Food Service.

F-4 DESIGN CRITERIA.

F-4.1 Design.

In food service design: (1) provide movement of food products to ensure effective monitoring and control of food temperatures through conventional flow while minimizing personnel cross-traffic, backtracking, and queuing conditions; (2) incorporate the Food and Drug Administration (FDA) Hazard Analysis and Critical Control Points (HACCP) system, and the Tri-Service Food Code (TSFC) to ensure food safety. The DoR and food service design consultant, at the 35 percent submittal, provide schematic plans; circulation paths from servery to seating, loading dock to storage, and kitchen to inpatient units; general material movement; principal dimensions; and dining seating counts in accordance with current DoD Space Planning Criteria Chapter 510 Food Service.

F-4.2 Configuration.

Use a rectangular general configuration of the food service operation to optimize use of space. Provide capacity to close off and secure the food storage areas, food service preparation, servery area, cash registers and cash control room from the public area after normal operational serving times. The food storage areas should have limited access to required personnel. Individual controlled access (card readers) is required on all walk-in refrigerators and freezers in addition to all storage rooms. Configuration provides an efficient flow of products from storage to preparation, to service in the servery and the patient tray assembly areas. The servery accommodates large numbers of customers in short periods of time and be configured to support prominent display of healthy/nutrient dense food and beverage options and less prominent display of less healthy/low nutrient density foods. Utilize a scatter, hollow square, or scramble servery design. Supply beverage stands with water sources and piggyback soda fountain conduit. Serving stations must require extensive planning based on input from the DoD Nutrition Committee, and the local end user, as well as coordination with the DOD Space Planning Criteria Chapter 510 Food Service, and Chapter 13.

F-4.3 Staging.

Collocate food service storage areas with the food service operation. Provide a dedicated food service dock that distinctly separates “dirty” and “clean” receiving. For the receiving area, provide adequate space and associated utility connections for a large, digital read out platform scale. The food service operations and receiving areas

must fully comply with HACCP principles and the TSFC. With respect to food safety, consider staging refrigerators and freezers near the loading dock to minimize elevation in food temperature. Provide a transportation and handling study during the planning stage that addresses the transportation of foods, food products, and food material throughout the medical facility to include recycling and holding, trash compaction, paths of travel, efficiencies in operations and locations, and waste management associated with food service. Refer to Chapter 17 for coordinated information related to transportation and waste management requirements. All supply areas where pallet jacks are used must have corridors that are a minimum width of 6 ft (1.83 m), and door design must accommodate pallet jacks. Food storage areas must be limited to authorized personnel for food security, safety, and accountability purposes. Designs must not have open access to all nutrition staff members.

F-4.4 Refrigerator and Freezer.

Connect all refrigerators and freezers to a single control panel with corresponding temperature readouts. Fit all refrigerators with a visual and audio alarm that annunciates in the Food Service Department and in the Facility Management Control Room and off duty personnel. Equip all refrigerator systems with temperature gauges located outside the entrance of the walk-in unit. Design must accommodate walk-in access to freezers directly via a walk-in refrigerator for optimal temperature control, and door design must accommodate pallet jacks. Locate compressors in close proximity to the refrigeration system, in a ventilated room with a floor drain and hose bibb. Refer to Chapter 10 for ventilation criteria. Label compressors with the refrigeration unit(s) they service. When using chilled water backup, include, a redundant pump to avoid refrigeration and freezer compressor damage and food product loss. All refrigeration and freezer units must be placed on an equipment EPS to provide department functionality during periods of crisis. Refer to Chapter 11 and Appendix B for emergency power requirements.

F-4.5 Patient Tray Assembly.

Patient Tray Assembly area must be designed to support Patient Room Service. Patient Room Service allows patients to call a dedicated call center that receives patient meal orders. Patients may order meals anytime between established hours (typically between 0600-1800). Meals are prepared and delivered on-demand within a specified time after the patient calls (typically 40 minutes). The Room Service call center must be adjacent to the Patient Tray Assembly area. The Patient Tray Assembly area must be separate from the dining room food preparation area and must be designed with a separate but collocated cold preparation area, hot cooking area to include hooded ventilation, tray assembly area and cart staging area. Appropriately scale the hot cooking area equipment to support the patient feeding workload, using relevant historical, current, and projected patient workload information to ensure sufficient capacity, such as a grill and stove top. Design all areas to include adequate adjoining work space collocated with equipment; for example: space to land hot pans, and adequate power, grates, drains, hood systems and exhaust systems. Additionally,

provide appropriate space and connectivity (IT and power) for printers that print patient meal tickets throughout the meal period.

A directly accessible route from tray assembly to service corridors or elevators to patient care areas is required. Provide dedicated elevators to food service in large medical centers. For cart routes, prevent dirty carts from crossing food preparation areas. Include flexible energy distribution systems in patient tray assembly area. Design warmers and refrigeration to ease bulk movement. Plan beverage islands and include a water source, ample electricity for expansion, under-floor installation of a 4 in. (100 mm) (minimum size) PVC conduit for “piggy-back” soda fountain conduit and juice machines, steam, and adequate drainage. If beverage dispensers have an ice machine affixed to the top, plan and provide a minimum ceiling height of 9 ft 0 in. (2.74 m) (reference Appendix B). Design a flexible tray line to decrease or increase the number of trays without changes in infrastructure requirements. Electrical outlet drops from the ceiling must be available to ensure versatility of tray line reconfiguration. Adequate space is required for cart staging, loading, storage, and cleaning, which includes consideration for life-safety requirements for egress and two way traffic, as well as increasing space requirements to avoid life-safety parameters around and near electrical boxes, control boxes, fire extinguishers, eye-washes, and other like items.

F-4.6 Dishwashing and Ware Washing.

Design dishwashing and ware washing (pot washing) to prevent crossing workflows between soiled and clean wares, and the food preparation and service areas. Locate dishwashing and pot washing adjacent to each other to share labor and equipment. Locate pot and Pan washing area in proximity to the main food preparation area. Sufficient dirty pot and pan landing space adjacent to a three compartment sink must be considered. Design dishwashing space to provide ample space as dirty dishes arrive on a conveyor system, followed by a disposal system, then a spray mechanism prior to dishes being loaded in the dishwasher. This space must accommodate patient tray carts to include the offloading of the cart, scraping of trays and allocation of various tray items into the appropriate containers for further cleaning. Plan out space to accommodate separate clean dish air drying and storage, dish racks, pots, plate warmers/low-raiders, inpatient tray racks, and tray delivery carts. Locate the tray drop-off and dishwashing areas as close to the dining area exit as possible to permit patron self-bussing. Design workflow to prevent garbage and dirty dishes from crossing into clean areas. Design must include or plan for installation of automated washing, disinfecting, and sanitizing chemical dispensing systems that are easily accessible to staff and have sufficient space for storage and cleaning.

F-4.6.1 Additional Requirements.

For manual ware-washing operations, water temperatures for sanitization must comply with the TSFC requirements. Allocate sufficient space to land large items that require cleaning and a garbage disposal/rinsing component. In accordance with the TSFC, manual washing must have sufficient space to accommodate air-drying of dish racks, pots, utensils, mobile plate warmers/low-raiders, inpatient tray racks, and tray delivery

carts (see DoD Space Planning Criteria Chapter 510 Food Service). Additionally, after manual cleaning and sanitizing, equipment and utensils must be air-dried or used after adequate draining as specified in 40 CFR 180.940. Design must include or plan for installation of automated washing, disinfecting, and sanitizing chemical dispensing systems that are easily accessible to staff and have sufficient space for storage and cleaning.

Install all mechanical ware washers and pot and pan washers with a steam reclaimer designed to remove hot, moisture-laden air as described in TSFC. For mechanical ware-washing equipment and sanitizing units, the wash solution temperature must comply with the TSFC requirements. Provide booster heaters as needed to meet TSFC temperature requirement. If low temperature ware-washers are used, they must be designed to dispense approved chemical sanitation agents in accordance with Federal, state, and local requirements. Include in the design floor drains in the ware washer center where equipment cleaning actually occurs. Special consideration must be given to the coordination of appropriate drain types, and their locations, and elevation such that the floor slopes toward the drain(s). Minimize the runs of piping from equipment to drains.

F-4.7 Communications.

Coordinate communications requirements with the DoD Project Sponsor and Chapter 12. Coordinate wiring, conduit, routing devices, and equipment with the DHA-FE and Food Service Consultants. Telephone and data lines are required in all offices, the Room Service call center, the tray assembly area, serving lines, storage, receiving, and food preparation areas. Provide connectivity to a wireless network or the internet throughout the kitchen to accommodate capabilities for patient tray ticket transfer and printing, temperature monitoring systems, inventory systems, and communications among staff. Prewiring is required for computerized communication at the cashier stations for electronic payment options and at serving stations for electronic menu boards. Design cashier stations to have a separate internet line to process credit card transactions that does not interface with the main server/system at the facility due to cyber security concerns. The dining area requires a base or post telephone capability for medical staff responses. Security systems (Service component coordination) intercom system, and TV in dining room require prewiring. The video surveillance system, at a minimum, must include cameras in the cash control room, at cash registers and in storage and supply areas, and per the requirements of the project specific CONOPS.

F-4.8 Waste Handling.

Dietary trash and waste handling requirements must be considered in conjunction with the total health facility waste handling requirements to minimize duplication of facilities. (Refer to Chapter 17.) Design dining, food preparation, servery, and processing areas to avoid transporting trash through food-handling or preparation areas for disposal. Provide waste pulping disposing systems to minimize the volume of solid waste products. Current disposal methods for the pulping residue must be accommodated in

the design as required per local contract agreement. Provide recycling areas and equipment in the Food Service Department for separating and recycling of cardboard, plastics, and other recyclable materials as required per local contract agreement. Handling of waste must be in compliance with local installation requirements. Further, separate spaces for storing clean (empty) and dirty (full) waste and recycling bins must be incorporated into nutrition services space and at external delivery pick up locations according to evidenced based / regulatory waste handling procedures that include prevention pest mitigation considerations and life-safety concerns. Also design a dedicated space to use for regularly cleaning waste and recycling bins (this may be interior or exterior near the waste disposal area).

F-4.9 Emergency Power.

Evaluate food service equipment for inclusion on the EPS to ensure impact to dining facility and patient tray food service operations is minimized by loss of power, giving special consideration to inclusion of walk-in refrigerators and freezer. The cash register electrical power system, at a minimum, must be on UPS; however, evaluation of the cash register system must be part of the overall evaluation of kitchen equipment and may be deemed appropriate for inclusion on the EPS by the DoD Project Sponsor. Refer to Chapter 11 and Appendix B for emergency power source requirements. Consideration must also be given to distributing electrical requirements between separate major junctions to create redundancies that maintain power to certain equipment while others may be down unexpectedly or for preventive maintenance requirements.

F-4.10 Steam.

Steam in direct contact with food must be "clean", containing no amines, oxygen scavengers, or other potentially harmful treatment chemicals. Where treated steam is available, it may be used for the indirect generation of clean steam for cooking. All equipment used in the generation and distribution of clean steam must be constructed of stainless steel in accordance with Chapter 10. Consideration must also be given to have multiple steam access and shut off points such that redundancies exist that maintain at least moderate steam flow to equipment when valves or steams systems go down unexpectedly or are taken out of operation for preventive maintenance requirements.

F-4.11 Shelving

Equip all storage areas (dry, non-food, refrigeration and frozen) with shelving systems that maximize space utilization and are appropriate to their specific applications. Use high density or track shelving where feasible to expand storage capabilities and maximize available storage areas. Shelving must be finished with galvanized steel, zinc-coated carbon steel, chrome-plated carbon steel, or extruded aluminum. To comply with Joint Commission, the bottom shelf must be solid. Louvered and open-wire shelving is recommended to encourage air movement. The Chemical Storage Room is

best located near the dishwashing and pot-washing area in accordance with applicable safety and environmental requirements.

F-4.12 Plumbing.

F-4.12.1 Hand washing.

All hand-washing sinks must be stainless steel and have “hands free” operation (wrist-, elbow-, or knee-operated). Install in accordance with the manufacturer’s instructions. Ensure compliance with the requirements of the TSFC for water temperature, valves, and water flow.

F-4.12.2 Floor Drains and Sinks.

Provide floor drains or floor sinks at all "wet" equipment (including ice machines) and as required for wet cleaning of floors. Coordinate location of floor drains and floor sinks with equipment to avoid conditions that prohibit removal of drain/floor sink covers (for example ensure drain/sink covers can be removed for cleaning). Drains must be properly leveled on the floors to ease cleaning.

F-4.12.3 Trough Drains.

Provide a floor trough at steam-jacketed kettles and tilt frying pans to facilitate cleaning of food service equipment. Construct fiberglass or heavy gauge stainless steel trough grates. Where pallet jacks are utilized, do not provide troughs in front of walk-in refrigerators and freezers. Grade floors throughout the storage (to include refrigerators and freezers), food preparation, food service, and sanitation areas to eliminate water accumulation.

F-4.12.4 Eyewash Stations.

Provide eyewash stations in janitor closets and all other areas where chemicals are utilized.

F-4.13 Compliance Standards.

Design food services to comply with TJC standards of care of patients, the NSF standards, the TFSC, and the HACCP Food service equipment must be manufactured or fabricated in accordance with industry standards governing safety such as the NSF, UL, the American Gas Association (AGA), the ASME, and the EPA ENERGY STAR program.

F-4.14 Exhaust Hoods.

Design all kitchen exhaust hoods to meet ASTM standard for open joints and solid welding, maximum noise thresholds (85 dBA time-weighted average is the maximum allowable exposure), and to be self-cleaning. Fire suppression system must be provided over all deep fat fryers, grills and charbroilers. Increased ventilation capability

must be considered where deep fat fryers and charbroilers are planned. Refer to Chapter 10.

F-4.15 Interior Finishes.

Interior finishes throughout food service must comply with Appendix B. Corner guards, wall guards, and steel kick plates for doors that continue up the wall partitions, toe-kicks, or cabinetry at least 4 in. (100 mm), forming a 3/8 in. (10 mm) minimum radius cove as an integral unit must be installed in applicable location per manufactures requirements. Cart wash areas and dish machine areas must be finished for wet environments to include non-slip floors. Acceptable flooring material is durable, light-colored, waterproof, grease-resistant, easily cleanable, and can withstand the load of heavy cart traffic. In areas where two contiguous Food Service functions have different flooring finishes in accordance with the Appendix B, provide the finish that is most appropriate throughout the contiguous areas/functions. Use grouting that is nonabsorbent and impregnated with epoxy, silicon, or polyurethane. Flooring must meet NSF/ANSI 52minimum standards. Acceptable wall material is durable, waterproof, grease-resistant, and easily cleanable, and can withstand high levels of moisture and the constant movement of carts that will bump and scrape against walls.

F-4.16 Data Processing Equipment and Security.

If the facility utilizes an information system or other interdepartmental system, the Food Service operation must be linked to this system (the Hospital Information Management Computer Room). Visual security monitoring systems with data recording and retrieval must be provided in the cash control room where cash counting occurs, the cashier stations, the loading dock, and the corridor utilized to move Food Service supplies into their designated storage areas. The cash control room, cash register stations, and the main foodservice supervisor office must be wired for a duress alarm. Reference paragraph 5-4.6 for further duress alarm requirements.

F-4.17 Grease Traps.

Locate grease traps outside the building. Grease traps must be accessible for cleaning in accordance with Federal, state, and local fire, safety, and environmental requirements.

F-4.18 Sealants.

Thoroughly seal all openings or penetrations of any horizontal or vertical finish surface so as not to provide access and/or hiding places for vermin or encourage the growth of bacteria. Sealant must be water- and detergent-resistant silicone.

F-4.19 Franchised/Leased Food Services.

Identification of the type of franchised or leased space for Food Services provided by entities other than DoD Food Service components must be identified during project planning and programming. To minimize unnecessary construction change orders,

careful coordination is necessary to identify room net square footages, equipment, engineering requirements, and wireless coverage for government networks to support these distinct functions. These requirements must be submitted to the Design and Construction Agent prior to the 20 percent design submittal.

F-5 SEISMIC CRITERIA.

The planning, selection, and installation of food service equipment must be carefully considered with regard to potential damage by earthquakes. Give special attention to the mounting of fixed equipment, to utility connections, and to the design features of selected equipment. The required seismic protection must depend on the seismic design level prescribed for individual projects. Indicate all bracing details for food service equipment on contract documents. Reference Chapter 7 for additional requirements.

F-6 FOOD SERVICE EQUIPMENT SPECIFICATIONS.

All contractor-provided food service equipment items identified on the contract drawing must be specific in detail. The latest technology must be specified. Commercial kitchen appliances must be either ENERGY STAR-qualified or Federal Energy Management Program (FEMP) recommended. All equipment must meet EPA standards where required, as well as NSF, UL, and AGA.

APPENDIX G PARKING REQUIREMENTS

G-1 GENERAL.

This appendix provides mandatory criteria for parking associated with applicable facilities.

G-2 PARKING AUTHORITY.

DHA-FE is the sole Approving Authority over DoD medical facility parking requirements. Inadequate parking can impede the MHS' ability to provide prompt and unhindered care to patients. It may also require ill patients to walk extended distances, and potentially increase infectious incidence on public transportation. Parking requirements within this document and shown in Table G-1 consider these issues and have been calculated and formulized by professional traffic engineers directly considering patient, staff, and visitor populations. Parking requirements at DoD Installations as stated in this document supersede all non-medical state, regional, and or local jurisdiction criteria or requirements.

G-2.1 Facilities and Location.

The parking area designer must size the required parking area based on calculation as described in this appendix. The designer must consider the minimum use of land, the economical and efficient use of existing and future utilities, ecological conditions, the impact on the environment, sustainability and conservation considerations, maintenance and operations requirements, and the potential need for future growth. Shared parking may be considered where feasible. Landscaping appropriate to the locality should be considered and utilized where applicable, affordable, and practical. Every reasonable and practical effort should be used to integrate existing trees or vegetation into the parking areas.

Parking structures or garages must be considered by the DoD Project Sponsor when the site is too small to accommodate the required parking, when the value of the land is excessive, the site is located in a harsh climate, the required amount of spaces creates extreme walking distances, or sustainability or ecological issues prevail. Parking structures must be included as a separate line item in the project Capital Investment Decision Model and later project DD Forms 1391. The DoD Project Sponsor must approve parking structures on a case-by-case basis.

G-3 PARKING CONSIDERATIONS.

G-3.1 General.

Integrate all design elements, including functional, architectural, civil engineering, electrical, emergency services access, security, and delivery services, and other features.

G-3.2 Off-Street Parking Design.

The DoR must follow the concepts from the most current Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA) Pamphlet 55-17, Section 17.2, Better Military Traffic Engineering, Off-Street Parking Facilities. Table G-1 (below) supersedes parking demand in MSDDCTEA Pamphlet 55-17, Section 17.2.1. Design parking areas for continuous traffic flow to the maximum extent possible.

G-3.3 Parking Garages.

The DoR must design each parking garage for continuous traffic flow and minimize dead-end parking spaces. The lack of continuous flow slows traffic flow and contributes to increasing vehicle accidents. Do not permit handicapped access path to traverse behind vehicles. Crossing vehicle travel aisles requires approval by Design and Construction Agent. Parking garage elevators must be included in the elevator traffic study (ETSA) and analysis in paragraph 16-2.2.

G-3.4 Parking Wayfinding.

Parking wayfinding must be included in the wayfinding plan in paragraph 6-13.

Table G-1 Required Parking Spaces for Medical Facilities

Calculating the Required Parking Spaces	
Number of Parking Spaces Required = $(0.75)(X_1) + (.40)(X_2) + (X_3) + (X_4)$	
Where:	X_1 = All personnel working in the facility on a full-time basis, plus an allowance for visitors and part-time staff. Include FTE's, contract maintenance, Red Cross volunteers, base exchange, clergy, interns, technical school trainees, Veterans Affairs and other DoD Project Sponsor liaison staff, Reserve, Guard, Professional Military Exchange (PME), and visitors. Visitors include: Installation Commander, TRICARE, RMO Security, Fire Department consultants, salespersons, and shift change overlap. (Use 10 percent if statistics are unavailable for additional visitors, shift overlap, and part-time staff.)
	X_2 = Use projected M2 (Military Medical business objects database) outpatient visits for the peak month (typically either August or September) and peak day of the week (typically a Monday). Include projected M2 pharmacy encounters: new scripts ("FCC" and "FCD") and refills except those scripts that are picked up at satellite pharmacies.
	X_3 = One space for each inpatient bed.
	X_4 = One space for each organizational Government vehicle, and facility contractor support vehicle that regularly uses the parking facilities. For those vehicles that are too large to use a standard parking space, provide an oversized space.
Notes:	
1. Additional parking spaces must be justified.	
2. "Reserved" spaces for Command, General Officers, Rewards, and Disabled are included in the above factors.	
3. Spaces for Disabled are included in the above total and must be allocated in accordance with Chapter 13 for both inpatient and outpatient requirements as applicable.	
4. Calculation adjustments may be made to the X_1 parking requirement for carpooling, public transportation (if reliable and available within reasonable walking distance) and for Quarters/Housing (if within reasonable walking distance). The adjustment must only be based on those staff that routinely avoids using the parking facilities.	
5. Parking lot segregation for staff, patients, and visitors must be addressed by the Project Sponsor during design.	

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APPENDIX H GLOSSARY

H-1 ACRONYMS.

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^{0}C	degree Celsius
^{0}F	degree Fahrenheit **/1/**
A	ampere(s)
AAMA	American Architectural Manufacturers Association
A/E	Architect/Engineer Firm
ABA	Architectural Barriers Act
AC	Alternating current
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ADT	Admissions-Discharge-Transfer
AFCEC	Air Force Civil Engineer Center
AGA	American Gas Association
AGV	Automatic guided vehicle
AHA	American Hospital Association
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
AHU	Air handling unit
AIA	American Institute of Architects
AICUZ	Air Installations Compatible Use Zones
AISI	American Iron and Steel Institute
AMR	Autonomous Mobile Robot
ANSI	American National Standards Institute
APFSS	Automatic Primary Feeder Selector Switch

APL	Approved Product List
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AT/FP	Antiterrorism/Force Protection
ATS	Automatic transfer switch
AV	Audio visual
BDF	Building distribution frame
BFE	Base Flood Elevation
BGSF	Building Gross Square Feet **\1**
BGSM	Building Gross Square Meter **/1/**
BHDG	Behavioral Health Design Guide
BH	Behavioral Health
BHMA	Builders Hardware Manufacturers Association
BHSA	Behavioral Health Staff Assist
BIM	Building Information Modeling
BP/IS	Bypass/isolation switch
BSC	Biological Safety Cabinets
Btuh	British thermal unit per hour
BUG	backlight, uplight, and glare
BUMED	U.S. Navy Bureau of Medicine and Surgery
C	Celsius
CATCODE	Category Code
CATV	Cable television

CAV	Constant Air Volume
CCT	Correlated color temperature
CCTV	Closed-circuit television
CCU	Cardiac Care Unit
CDC	Centers for Disease Control and Prevention
CEHNC-EDX	U.S. Army Corps of Engineers Medical Facilities Mandatory Center of Expertise and Standardization, Huntsville Engineering and Support Center
CFCI	Contractor furnished and contractor installed
CFM	Cubic foot per minute
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CHAPI	Chase Helicopter Approach Path Indicator
CID	Comprehensive Interior Design
CIE	Commission Internationale de l'Eclairage (International Commission on Illumination)
CIP	Capital Investment Proposal
CMS	Central Material Service
CO2	Carbon dioxide
CONOPS	Concept of Operations
CONUS	Contiguous United States
CPD	Central Processing and Distribution
CRI	Color Rendering Index **\1**
CT	Computed Tomography **/1/**
CWE	Current Working Estimate
CxC	Commissioning Specialist for the Construction Phase
CxD	Commissioning Specialist for the Design Phase

CxG	Commissioning Specialist for the Government
DA	Design Authorization, or dental compressed air
DALT	Duct Air Leak Testing
dB	Decibel **\1**
dBA	A-weighted Decibel **/1/**
DB	Design-Build, or dry bulb
DBB	Design-Bid-Build
dBmV	Decibel (referenced to millivolt)
DC	Direct current
DDA	Design Directive Amount
DDC	Direct digital control
DFE	Design Flood Elevation
DGSF	Departmental Gross Square Feet
DHA	Defense Health Agency
DHA-FE	Defense Health Agency Facilities Enterprise
DHP	Defense Health Program
DIN	Deutsche Industrie Normen
DISA	Defense Information Systems Agency
DISS	Diameter Index Safety System
DMLSS	Defense Medical Logistics Standard Support **\1**
DN	Diametre Nominal **/1/**
DoD	U.S. Department of Defense
DoDM	U.S. Department of Defense Medical
DoR	Designer of Record
DSV	Dental Surgical Vacuum

DTR	Dental Treatment Room
DUF	DTR Usage Factor
DX	Direct Expansion
EA	Economic Analysis
EBD	Evidence-Based Design
ECEv	The Environment of Care-Europe, Version V
ECG	Electrocardiogram (also EKG)
ED	Emergency Department
EEG	Electroencephalography, electroencephalogram
EENT	Eye, ear, nose, and throat
EES	Essential Electrical System
EIA	Electronic Industries Alliance
EMG	Electromyography
EMI	Electromagnetic interference
EMS	Emergency Medical Service **\1**
EMT	Electrical Metallic Tubing **/1/**
EN	European Norm
ENT	Ear, Nose, and Throat
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPS	Emergency Power System
ER	Emergency Room
ESS	Electronic Security System
ETL	Engineering Technical Letter
ETSA	Elevator Traffic Study and Analysis

EWD	Engineering Weather Data
F	Fahrenheit
FACP	Fire Alarm Control Panel
FAR	Federal Acquisition Regulation
FDA	Food and Drug Administration
FEMA	Federal Emergency Management Agency
FF&E	Fixture, Furnishings, & Equipment
FLCM	Facilities Life Cycle Management
FM	Factory Mutual
FMDF	Fiber Main Distribution Frame
FO	Fiber optic
FPT	Functional Performance Test **\1**
fpm	feet per minute
fps	feet per second **/1/**
FSES	Fire Safety Evaluation System **\1**
ft	feet
ft^2	square feet
ft-lb	foot-pounds **/1/**
FTE	Full-Time Equivalent.
FY	Fiscal year **\1**
Gal	Gallon **/1/**
GFCI	Ground-Fault Circuit Interrupter, or Government furnished, contractor installed
GFGI	Government furnished, Government installed **\1**
GPF	Gallons per Flush **/1/**
gpg	grain(s) per gallon **\1**

GPH	Gallons per hour **/1/**
GPM	Gallons per minute
GPS	Global positioning system
GSF	Gross square footage/feet **\1**
GSM	Gross square meter **/1/**
HACCP	Hazard Analysis and Critical Control Points
HAG	Historical Analysis Generator
HCRA	Healthcare Service Requirements Analysis
HDMI	High-definition multimedia interface
HDTV	High-definition television
HEPA	High-efficiency particulate air
HID	High intensity discharge
HIPAA	Health Insurance Portability and Accountability Act
HIS	Hospital Information System
hp	horsepower
HPVA	Hardwood Plywood and Veneer Association
HQ	Headquarters
HVAC	Heating, ventilation, and air conditioning
HW	Hazardous Waste
Hz	Hertz
I/O	Input and output
IA	Instrument air
IBC	International Building Code
IBS	Interstitial Building System
ICRA	Infection Control Risk Assessment

ICU	Intensive Care Unit
ID	Identification
IDS	Intrusion Detection System
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society of North America
IMD-IA	Information Management Department Information Assurance **\1**
IMO	Installation Management Organization
in.	inch
in^2	square inch **/1/**
in-Hg	inches of mercury **\1**
in-HgV	inches of mercury vacuum
in. w.g.	inches of water gauge **/1/**
IO&T	Initial Outfitting and Transition
IPC	International Plumbing Code
IRES	Internal Cellular Antenna Systems
ITV	Interactive Television
JITC	Joint Interoperability Testing Committee
JSN	Joint Schedule Number
K	Kelvin **\1**
kg	kilogram **/1/**
kHz	kilohertz
kPa	kilopascal **\1**
kPaV	kilopascal vacuum **/1/**
kV	kilovolt
kVA	kilo-volt-ampere **\1**

kW	kilowatt
L	Liter **/1/**
L&D	Labor and Delivery **\1**
L/h	liter per hour **/1/**
L/s	Liter per second
LA	Laboratory Air
LAN	Local area network **\1**
lb	pound **/1/**
LCC	Life-cycle cost
LCCA	Life-cycle cost analysis
LCD	Liquid crystal display
LDE	Laboratory dust evacuation
LDR	Labor, delivery, and recovery
LDRP	Labor, delivery, recovery, and postpartum
LED	Light-emitting diode
LOD	Level of detail/development
LPD	Lighting power density **\1**
LPF	liter per flush **/1/**
LPM	liter per minute
LS	Life Safety
LSA	Life Safety Assessment
LUF	Laboratory Usage Factor **\1**
Lux	Illuminance
m	meter
m^2	square meter

m/s	meter/second **/1/**
MA	Medical compressed air
MCWB	Mean coincident wet bulb
MDI	Medical Design Instructions
MEP	Mechanical, electrical, and plumbing
MFPO	Medical Facilities Project Office **\1**
mg/l	milligram per liter **/1/**
MHS	Military Health System
MILCON	Military Construction
MINC	Multimedia Interactive Network Center
Mips	micro inch per second **\1**
mm	millimeter **/1/**
MMA	Material Management Analysis
MRI	Magnetic resonance imaging
MRT	Modified Rhyme Test
MSA	Medical Service Account
MSF	Medical Support Facility
MTLC	Medical Transport and Logistics Consultant
MTF	Medical Treatment Facility
MV	Medical surgical vacuum or Medium Voltage
N	Nitrogen
NAVFAC	Naval Facilities Engineering Systems Command
NC	Nurse Call, or noise coefficient
NCAV	Nurse Call Audio Visual
NCPC	National Capital Planning Commission

NCR	National Capital Region
NCRP	National Council of Radiation Protection and Measurements
NCTV	Nurse Call Tone Visual
NEC	Network Enterprise Center
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NICU	Neonatal Intensive Care Unit
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology **\1**
N·m	newton meter **/1/**
NO	Nitrous Oxide **\1**
NPS	Nominal Pipe Size **/1/**
NRC	Nuclear Regulatory Commission
NSF	Net Square Feet
NTP	Normal temperature and pressure
NTS	Network Time Synchronization
O	Oxygen
O&M	Operations and Maintenance
OASD(HA)	Office of the Assistant Secretary of Defense (Health Affairs)
OCONUS	Outside the Contiguous United States
OE	Oral evacuation
OMB	Office of Management and Budget, Executive Office of the President
OPR	Owner’s Project Requirements or Office of Primary Responsibility
OR	Operating room

OSHA	Occupational Safety and Health Administration **\1**
Pa	Pascal **/1/**
PA	Process Air or Program Amount
PACU	Post-Anesthesia Care Unit
PAPD	Public address and program distribution
PBB	Primary Bonding Busbar
PC	Personal computer
P.E.	Professional Engineer
PF	Power factor
PFC	Pre-Functional Checklists
PFD	Program for Design
PoE	Power over Ethernet **\1**
ppm	parts per million **/1/**
PRC	Project Room Contents
psf	pounds per square foot
psi	pounds per square inch
psig	pound-force per square inch gauge
PT	Physical therapy
PTS	Pneumatic tube system
PTZ	Pan/tilt/zoom
PVC	Polyvinyl chloride
QA	Quality Assurance
QC	Quality Control
RA	Requirements Analysis
Rcs,h1	Chroma Shift, Hue-Bin 1

RF	Radio frequency
Rf	Fidelity Index
Rf,h1	Fidelity Index, Hue-Bin 1
RFI	Radio frequency interference
RFP	Request for Proposal
Rg	Relative Gamut Index
RH	Relative humidity
RMF	Risk Management Framework
RMS	Root mean square
RMW	Regulated Medical Waste
RP	Radio Paging
RTA	Ready to Advertise
SATV	Satellite television
SBB	Secondary Bonding Busbar
SCFM	Standard cubic feet per minute
SEPS	Space and Equipment Planning System **\1**
sf	square feet **/1/**
SID	Structural Interior Design **\1**
SLPM	Standard liter per minute
sm	square meter **/1/**
SOC	Statement of Condition
SOFA	Status of Forces Agreement
SOW	Statement of Work or Scope of Work
SPD	Spectral Power Distribution
SPL	Sound pressure level

SRA	Safety Risk Assessment
SRM	Sustainment, Restoration, and Modernization
STC	Sound Transmission Class
SUF	System Usage Factor
TAB	Test and Balance
TBCx	Total Building Commissioning
TIA	Telecommunications Industry Association
TIS	Telecommunications Infrastructure System
TJC	The Joint Commission
TLA	Transportation Logistics Analysis
TLED	Tubular Light-Emitting Diode
TR	Telecommunication Room
TSS	Telephone Switching System
TV	Television
UCS	Uniform Chromaticity Scale
UFC	Unified Facilities Criteria
UHF	Ultra-high frequency
UMCS	Utility Monitoring and Control System
UPS	Uninterruptible power supply
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USGBC	United States Green Building Council
UTP	Unshielded twisted pair
UL	Underwriter’s Laboratory
UV	Ultraviolet

V	Volt
VA	U.S. Department of Veterans Affairs
VAV	Variable air volume
VE	Value Engineering
VMC	Visual meteorological condition
VoIP	Voice over Internet Protocol
W	watt(s)
WAGD	Waste anesthesia gas disposal
VSS	Video Surveillance System
WAN	Wide Area Network
WAP	Wireless access point
WB	White Board
WMA	Waste Management Analysis

H-2 DEFINITION OF TERMS.

For additional terminology, please reference the following:

DoD 6015.1-M, *Glossary of Healthcare Terminology*, January 1999, Assistant Secretary of Defense for Health Affairs, TRICARE Management Activity.

NFPA Glossary of Terms, 2021 National Fire Protection Association, www.nfpa.org

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Air Handling Unit (AHU): An air conditioning unit consisting of fan(s), coil(s), filter(s), and other components designed and sized for supplying conditioned air to a given area or space(s).

Ambulatory: Able to walk; not confined to bed. **\1**

Ambulatory Care Center: An outpatient facility which provides a wide range of medical treatment. This facility category includes Ambulatory Care Clinics, Medical Clinics, and Dental Clinics. ***/1/***

Ambulatory Health Care Occupancies: Refer to NFPA 101 for occupancy definitions.

Ambulatory Surgery Center: An Ambulatory Care Clinic with two or more Operating Rooms.

Anesthesia: Partial or complete loss of sensation, with or without consciousness, as a result of drug, disease, or injury.

Anesthetic: Applies to any inhalation agent used to produce relative analgesia or general anesthesia.

Anesthetizing Location: Any area of the facility that has been designated to be used for the administration of any flammable or nonflammable inhalation anesthetic agents in the course of examination or treatment including the use of such agents for relative analgesia.

Antiseptic: The prevention of decay, putrefaction, or sepsis through use of an agent that must prevent or arrest the development of microorganisms.

Apparatus: Furniture, laboratory hoods, centrifuges, refrigerators, and commercial or man-made onsite equipment used in a laboratory.

Architect and Engineer (A/E) Firm: A business composed of professional architects and engineers.

Asbestos: A natural mined mineral that is a good thermal insulator, a good acoustical insulator, fire resistant, resistant to friction and wear, and a poor conductor of electricity. Known to cause lung cancer, mesothelioma, and other forms of cancer in the stomach and colon.

Aseptic Environment: An environment or area that is intended to be free from pathogenic microorganisms to prevent infection.

Automatic Box Conveyor (ABC): Also known as Electric Track Vehicle (ETV) or Powered Track Tote Box Conveyor System (PMTCS). A rail system utilizing self-contained buss bars to provide power to special carriers that contain and move small supply, demand, and other items between stations on the track network.

Automated Data Processing (ADP): Any equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data information.

Automatic Data Processing Equipment (ADPE): General purpose, commercially available automatic data processing equipment, and the systems created by them.

Autoclave: An apparatus for sterilizing utilizing steam under pressure.

Automated Guided Vehicle System (AGVS): Also known as Driverless Vehicle System (DVS). This system utilizes a battery-powered, electronically-controlled vehicle that follows a predetermined route (guide path or track that is buried in the floor or adhered to its surface) to move carts and material throughout the facility. The system utilizes the guide path network and special elevators to make the horizontal and vertical routings. Different degrees of automation and capabilities are available. The basic system components commonly found in a hospital application include: driverless vehicles, elevators, carts (modules), guide path and controls, cart wash(s), and battery charge equipment.

Average Interval, Elevator: The elapsed time in seconds between elevator departures from a terminal floor averaged over a specific time period. Average interval is a measure of the “quality” of elevator service. Average interval can be measured in existing buildings but must be calculated for new buildings. For practical purposes, it can also be viewed as the average roundtrip time of an elevator, divided by the number of elevators within the group in question. Average interval is not a direct measure of how long prospective passengers wait for service.

Average Maximum Ride Time (AMRT), Elevator: The amount of time a passenger is in an elevator from the point of origin to the destination is referred to as the “ride time.”

Average System Response Time, Elevator: The average time it takes for hall calls to be answered by an arriving elevator car. This is an estimated or simulated factor for new facilities but can be measured for existing facilities.

Average Waiting Time, Elevator: The average period that users wait for elevator service. This is an estimated or simulated factor. For example, if one person arrives at a lobby and initiates a hall call, and waits for 20 seconds for the car to arrive, while a second person arrives at the same time as the car, the average for these two persons being served is 10 seconds (20 seconds plus 0 seconds divided by 2). Tests indicate that average passenger waiting time (AWT) for service at a typical intermediate floor approximates 65–80 percent of the average interval during heavy two-way traffic periods.

Backflow Prevention: The use of a recognized device to prevent the backflow of water or other liquids, mixtures, or substances into the distributing pipes of the potable supply of water from any source such as a plumbing fixture or mechanical equipment.

Base Isolation: This is a seismic construction element to prevent ground motion from being transmitted from the building foundation into the superstructure.

Basic Life Safety (Seismic): A seismic damage risk classification category and an operational level category. Facilities in this category meet the minimum requirements and objectives of seismic building codes—to provide a collapse-resistant structure and thereby save lives. The life safety of the immediate building occupants is the sole objective of this category. Efforts to control damage due to earthquake in this category are minimum and limited primarily to the saving of human life. Reference Chapter 7.

Built-in Equipment: That equipment that is affixed to the facility and usually included in the construction contract.

Bulk Nitrous Oxide System: An assembly of equipment as described in the definition of bulk oxygen system that has a storage capacity of more than 3,200 pounds, approximately 28,000 cubic feet (normal temperature and pressure [NTP]) of nitrous oxide.

Bulk Oxygen System: An assembly of equipment such as oxygen storage containers, pressure regulators, pressure relief devices, vaporizers, manifolds, and interconnecting piping that has a storage capacity of more than 20,000 cubic feet of oxygen (normal temperature and pressure [NTP]) including unconnected reserves on-hand at the site. The bulk oxygen system terminates at the point where oxygen at service pressure first enters the supply line. The oxygen containers may be stationary or movable, and the oxygen may be stored as gas or liquid.

C-Arm: Term referring to a specific type of radiographic machine used for fluoroscopic examinations.

Cardio: Related to the heart.

Cart (also called a "Module"): A wheeled vehicle upon which material is placed to transport it throughout the facility. Many cart variations are available. The movement of carts can be accomplished by employees, or semi-automated or automated transportation systems as determined by careful analysis for each individual hospital.

Cart Lift: A small vertical lift that is dedicated to the movement of carts. Cart lifts are usually automated and provide automatic dispatch and loading and unloading of carts. "Cart lifts" that are manually dispatched and require manual loading and unloading of carts are generally called "cart dumbwaiters."

Cart Wash: The semi- or fully-automated machine that washes and rinses carts as required by the individual hospital's program. Units may provide automated or manual loading and unloading. Units may or may not provide a full drying capability. Selection of the correct unit(s) for an application should be made after a complete analysis of all requirements, to include financial (life-cycle cost [LCC]) and traffic. When the cart wash function is to be done manually, it is done by hose or steam gun in an equipment washroom or area.

Category Code (real property): A series of numerical codes used to classify and categorize real property. These code numbers are based on ten basic functional classes coded by the DoD. They are generally a five-digit code to plan, program, budget, design and construct, inventory and maintain its facilities. Some commands add digits to refine the functional description. A category code may consist of a collection of attributes that come together to form the specific category code.

Category Code (NFPA): The terms "Risk Category", "System Category" and "Space Category" are used throughout NFPA 99 and can be confusing as the definitions appear similar and all have a range of 1 to 4 with category 1 being the highest risk (or most stringent requirement) and category 4 being the lowest risk (or least stringent requirement). Space categories relate to the typical function in a given space and are defined by NFPA 99, and for the Military Health System, are provided with the room code in Appendix B. Risk categories are defined by NFPA 99 and are determined by a risk assessment IAW NFPA 99. System Categories are the resultant design criteria to be applied to a given system after considering the Risk Category and Space Category, but note that there is not always a direct correlation between these categories.

Central Material Service (CMS): The physical area and functional operation that is responsible for cleaning, sterilizing, preparing, packaging, storing, and distributing

sterile items within the facility. CMS is the primary support element for the Operating suites and Labor and Delivery Rooms.

Central Processing and Distribution (CPD): An all-inclusive term for that function in a hospital that encompasses those terms variously known as Central Supply, Central Nursing Supply, Central Sterile Supply, and Central Material Services. Generally refers to a materials handling methodology. Provides for the central management of all medical material required to support patient care activities. The heart of this concept is an automatic distribution system. CPD requires the standardization and centralization of the elements of storage and distribution.

Civilian Health and Medical Program for the Uniformed Services (CHAMPUS): An indemnity-like program called TRICARE standard that is available as on option under DoD's TRICARE program. There are deductibles and cost shares for care delivered by civilian healthcare providers to active duty family members, retirees and their family members, certain survivors of deceased members, and certain former spouses of members of the seven Uniformed Services of the United States.

Code of Federal Regulations (CFR): The CFR annual edition is the codification of the general and permanent rules published in the Federal Register by the departments and agencies of the Federal Government. It is divided into 50 titles that represent broad areas subject to Federal regulation. The 50 subject matter titles contain one or more individual volumes, which are updated once each calendar year, on a staggered basis. The annual update cycle is as follows: titles 1–16 are revised as of January 1, titles 17–27 are revised as of April 1, titles 28–41 are revised as of July 1, and titles 42–50 are revised as of October 1. Each title is divided into chapters, which usually bear the name of the issuing agency. Each chapter is further subdivided into parts that cover specific regulatory areas. Large parts may be subdivided into subparts. All parts are organized in sections, and most citations to the CFR refer to material at the section level.

Combined Elevators: Elevators intended for dual or multiple function such as combined passenger (visitors/public) and service (moving of materials or patients).

Commission of Fine Arts (CFA): A regulatory body in the U.S. National Capital Region (NCR) that helps determine applicability of all Federal Military Construction (MILCON)-funded facilities within the NCR. Reference National Capital Planning Commission [NCPC].

Compaction. A waste-handling methodology whereby the volume of waste materials is reduced for ease of disposal.

Concepts: The first phase of design that includes Block Plans (S1), Schematics (S2), Design Development (S3), and the final 35 percent submission (S4). The basis on

which a Programmed Amount (PA) can be set for the Budget Submission. Approximately 35 percent of the design effort, as opposed to the second phase of design that is called the “working drawings” phase of design.

Constructability: An analytical study that reviews the methodology, ease (or difficulty) with which a project can be administered, bid, built, enforced, understood, and phased that determines degrees of difficulty and construction time required to build a Medical Treatment Facility. Reference Chapter 3.

Construction Contract Solicitation: The point in the design-construction process when all review comments from the 100 percent design submittal have been incorporated, the CWE is within the PA, the DoD Project Sponsor has notified the Design and Construction Agent that funds are available, and the DoD Project Sponsor has notified the Design and Construction Agent to advertise the project for bids. It is generally the point in the process when the project ceases to be a design effort and becomes a “Construction Project.”

Construction Management Plan (CMP): Establishes processes and procedures for the execution of the construction contract.

Contract Documents (CDs): Design drawings and specifications that, as a unit, constitute the basis for receiving bids and awarding a contract for construction. Contract documents are the basis on which a building is constructed.

Cost-Benefit Analysis (CBA): The process of assessing all pertinent costs and benefits, usually performed in terms of an expected life-cycle of the system.

Court, Enclosed: A court bounded on all sides by the exterior walls of a building, or exterior walls and lot lines on which walls are permitted.

Criteria: Military Unified Facilities Criteria (UFCs), criteria manuals, guide specifications, definitive designs, DoD Project Sponsor guidance, standard designs, and other related guidance published to promote quality facilities’ engineering, design, construction, and maintenance.

Critical Facility: Critical Facility provides selective protection for critical healthcare mission staff and functions following catastrophic Chemical, Biological, Radiological, Nuclear, and High-Yield Explosive (CBRNE) attacks.

Critical Path: The linear path through a work schedule network determining the shortest time within which all work can be completed.

Current Working Estimate (CWE): The current cost of the project including construction cost, contingency, and supervision inspection and overhead (SIOH).

Required at certain levels of effort of design to compare against PA to determine whether the project is executable given projected funds availability.

Damage Risk Classification Categories (Seismic): Three seismic categories that attempt to relate the seriousness of the consequences of damage due to earthquake. The selection of a category may consider the density of human occupancy, the importance of the activity, or the value of the contents or structure itself. These categories are as follows: Basic Life Safety, High Risk Facility, and Essential Facility. Reference Chapter 7.

Dedicated Elevators or Lifts: A vertical transportation element that must be restricted in use to a singular predefined function. Elevators intended for patient transport from one patient care area to another patient care area, (for example ER trauma rooms, to the ORs, clean surgical material only or soiled materials only). Other functions may include the transport of surgical case carts or patient meal service. These are NOT normally shared or combined with other traffic.

Defense Health Agency - Facilities Enterprise (DHA-FE): The office of primary responsibility for all DoD MILCON funded facilities, https://home.facilities.health.mil/.

Dental Compressed Air (DCA): Compressed air system used for drying applications during dental procedures and as a power or drive source for lifts, locks, and pneumatic dental instruments and equipment. Not used for breathing or respiratory support of any kind. Reference Chapter 9.

Dental Surgical Vacuum (DSV): Dry vacuum system used to support patient care in dental treatment rooms and oral surgeries. Refer to Chapter 9.

Dental Low Vacuum for Oral Evacuation (OE): Low vacuum, high volume, wet pipe system to provide scavenging, collection, and disposal of liquids, solids, and aerosols from dental procedures. Refer to Chapter 9.

Departmental Gross Area: The functional space within a department plus intra-departmental circulation. Does not include “general” circulation.

Design and Construction Agent: The agency designated by the Secretary of Defense (SECDEF) responsible geographically (or by agreement) for the design or construction execution associated with the military construction program. Responsible for the project during design, construction, warranty period and financial closeout. Current Design and Construction Agents are:

a. The U.S. Army Corps of Engineers (USACE)

b. The Naval Facilities Engineering Systems Command (NAVFAC)

c. The Air Force Civil Engineer Center (AFCEC) in the United Kingdom

Design Authorization (DA): Notices from the DoD Project Sponsor to the Design and Construction Agents to proceed with A/E selection and award, design a project to varying levels of effort, advertise, and ultimately award a construction contract. Usually designates project, project fiscal year, project location, programmed amount (PA), scope of the project (size in square feet), which meetings the DoD Project Sponsor will attend, any deviations from the submittal requirements in this document, and whether or not the DoD Project Sponsor wishes to participate in the A/E selection process. Reference Chapter 3.

Designated Seismic Systems: The seismic force-resisting system in all structures and those architectural, electrical, and mechanical systems or their components in RC III and IV structures that require design in accordance with Chapter 13 of ASCE 7 and for which the component importance factor, Ip, is greater than 1.0. This designation applies to system that are required to be operational following the Design Earthquake for RC III and IV structures and follow the MCER for RC V structures. All system in RC V facilities designated as MC-1 must be considered part of the Designated Seismic Systems. Designated Seismic Systems will be identified in Chapter 7 of this UFC and will have an Importance Factor Ip = 1.5.

Disabled Person: An individual who has a physical or behavioral condition that, to a material degree, limits, contributes to limiting, or if not corrected will probably result in limiting the individual's performance or activities to the extent of constituting a substantial physical, behavioral, or vocational handicap.

DoD Project Sponsor: The primary DoD Project Sponsor for a particular project. For DoD MILCON, DHA-FE is most commonly the DoD Project Sponsor. Other agencies may be the DoD Project Sponsor for specific medical projects.

Drug Dispensing: The issuance of one or more doses of prescribed medication in containers that are correctly labeled to indicate the name of the patient, the contents of the container, and all other vital information needed to facilitate correct patient usage and drug administration.

Dumbwaiter: A small vertical lift that is dedicated to the movement of carts, tote boxes, and other similarly-sized items. Generally, this term implies manual loading and **unloading of the cargo.**

Economic Analysis (EA): A cost-benefit analysis done to identify the relative cost-effectiveness of delivering healthcare to a projected beneficiary population under different MTF sizing scenarios. P.L. 97-337 (15 October 1982), amended by Section

1087 of Title 10, U.S.C., requires an EA be done to determine the space to be programmed in MTFs for military retirees and their dependents.

Electrical Life Support Equipment: Electrically powered equipment whose continuous operation is necessary to maintain a patient's life.

Elevator Population: The building elevator population is the total number of riders/ vehicles that will require the use of automated vertical transport (elevators) during their stay in the building. Hence people that come, arrive, and depart from the main entrance level and that use the stairs would not be included in the elevator population. Traffic studies shall detail the calculations that arrive at the population used.

Etiologic Waste: Any viable microorganism or its toxins that causes or may cause human disease.

Evaluation: Implies an analysis to be performed by the designer (A/E) in the basic contract (as opposed to "studies" or "investigations," that are extra services to be performed to complete the contract intent and requirements).

Evidence-Based Design (EBD): The conscientious, explicit, and judicious use of current best evidence in making planning and design decisions that advance the needs of patients, staff, families, and organizations. Reference Chapter 6.

Facilities: Building(s), equipment, and supplies necessary for the implementation of services by personnel.

Facilities Sustainment: Facilities sustainment provides resources for maintenance and repair activities necessary to keep a typical inventory of facilities in good working order over the specific facility's expected service life.

Facility: A separate individual building, structure, utility system, or other item of real property improvement each item of which is subject to separate reporting and recording in accordance with DoD Instruction 4165.14, Real Property Inventory and Forecasting.

Federal Energy Management Program (FEMP): The U.S. Department of Energy (DOE) Federal Energy Management Program (FEMP) provides services, tools, and expertise to Federal agencies to help them achieve their legislated and executive-ordered energy, greenhouse gas, and water goals. These are delivered through project, technical, and program services.

Federal Information Processing (FIP): Any automatic data processing (ADP) equipment procured with Federal Government funds.

Fenestration: The arrangement of windows in a building, their size, placing, style, etc.

Fire Safety Evaluation System (FSES): In accordance with NFPA 101M.

Fixed: Fastened to walls, floors, or ceiling or to steam, gas, plumbing, electrical power, or sensor lines in a permanent manner.

Flammable Liquids Storage Cabinet: A cabinet for the storage of flammable and combustible liquids constructed in accordance with NFPA 30.

Floor Area, Gross: Gross floor area must be the total floor area within the building to include all rooms, mechanical rooms, hallways, stairs, closets, thickness of interior or exterior walls, columns, or other features. Where the term “area” is used, it must be understood to be gross area unless otherwise specified. Reference Chapter 3 and Figure 3-1 for expanded explanation.

Floor Area, Net: Net floor area must be the actual occupied area in a functional space, not including thickness of walls, chases, columns, or general circulation. Reference Chapter 3 and Figure 3-2 for expanded explanation.

Functional Program: A written narrative of the facility functional requirements. The requirements are expressed in both strategic objectives and facility area-specific operational perspectives.

Functional Requirements: Those requirements necessary to ensure a particular facility continually meets the objective of the function for which it was constructed.

Grade: The degree or inclination of slope at ground level.

Gravity Chutes: Usually used for the vertical return of trash and linen (separate chutes) to a holding and collection room at the base of each chute.

Green Board: Moisture resistant gypsum board.

Gurney: A gurney is a medical transport device designed with a variable height, adjustable headrest, leg-rest, contain accessories such as IV hook, oxygen tank holder, x-ray holder with wheeled metal frame to transport patients who require medical care, and are used by emergency medical services (EMS), hospitals and medical facilities. The minimum size is 36 inches wide x 92 inches in length.

Handling Capacity, Elevator: The “quantity” measure of elevator service is called handling capacity. Handling capacity is the number of persons and vehicles that can be transported by the elevator system in a given length of time. Average interval and handling capacity must be measured or calculated for the same designated time period to be meaningful.

Hazardous Area in Laboratories: The area inside fume hoods or enclosures where tests or procedures are being conducted.

Health: A condition in which all functions of the body and mind are “normal” and active.

Health Care Occupancies: Refer to NFPA 101 for occupancy definitions.

Hematology: The science of the blood.

High Efficiency Particulate Air (HEPA) Filter: Replaceable filters having a minimum collective efficiency of 99.97 percent for 0.3 micron particle. Reference Appendix B.

High Hazard Areas: Areas of structure, buildings, or parts thereof used for purposes that involve highly combustible, highly flammable, or explosive products or materials that are likely to burn with extreme rapidity, or that may produce poisonous fumes or gases, including highly toxic or noxious alkalis, acids, or other liquids or chemicals that involve flame, fume, explosive, poisonous, or irritant hazards; also uses that cause division of material into fine particles or dust subject to explosion or spontaneous combustion, and uses that constitute a high fire hazard because of the form, character, or volume of the material used.

High Risk Facilities (Seismic): A seismic damage risk classification category. Facilities in this category are recognized as warranting a higher level of damage risk than the average building but less than for an essential facility. Efforts to control damage due to earthquake in this category are intermediate. Reference Chapter 7.

Histology: Study of the microscopic structure of tissue. **\1**

Hospital: An inpatient facility which provides both inpatient and outpatient medical care. As a facility category this includes both Hospitals and Medical Centers.

/1/Hospital Bed: A bed for an adult or child patient. Bassinets for newborns in maternity units, beds in labor and delivery rooms, recovery rooms, and other beds used exclusively for emergency purposes are not included in this definition.

Illuminated, Externally: An illumination source contained outside the device that is to be illuminated.

Illuminated, Internally: An illumination source contained inside the device that is to be illuminated.

Incineration: In waste handling, the act of burning pathological and other designated waste/infectious waste in an incinerator in order to render the water material(s) harmless.

Inspection Certificate: An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics of the product, and the name and identification of an approved agency indicating that the product or material has been inspected and evaluated by an approved agency.

Interdepartmental Circulation: General circulation. Circulation that provides access to and from various departments; included elevators, stairs, and major corridors.

Interstitial Building System (IBS): System involving coordinated design of all elements to achieve a building of optimum functionality, appearance, maintainability, and adaptability. Reference Appendix E.

Interstitial Space: Unfinished and unoccupied space between floors used for horizontal utility distribution systems, of sufficient size to accommodate workmen, and that permit maintenance and alteration without interruption of activities on the normally occupied floors. Reference E for Interstitial Building Systems.

Intradepartmental Circulation: The area reserved for corridors and passages that are found immediately within the departmental area.

Japanese Facilities Improvement Program (JFIP): A government of Japan initiative, which started in 1979 to ease the financial burden of stationing U.S. Forces in Japan. The program reduces U.S. Government cost to improve the quality of life and military posture. Approximately 21 percent of the government of Japan host nation support provided to the U.S. Forces in Japan is allocated to JFIP.

Joint Schedule Number (JSN): The number used to identify equipment on architectural drawings and plans supporting Military Construction (MILCON) projects.

kvp: Unit used to describe the radiation quality of X-rays. X-rays generated by electrons accelerated in a potential difference of, for example, 100 kilovolts (kV), are termed 100 kvp (kV peak voltage) X-rays.

Laboratory Air (LA): Compressed air system for use in medical or dental laboratories. May be combined with a dental compressed air (DA) system. Reference Chapter 9.

Life-Cycle Cost (LCC): Reference UFC 1-200-02.

Life-Cycle Cost Analysis (LCCA): Reference UFC 1-200-02.

Local Area Network (LAN): A modular communication methodology whereby the facility is prewired during construction for current and future communications needs, such as telephone, Composite Healthcare (computer) Systems (CHCS), without having

to surface-mount additional wires or coax in the future and thereby reduce future communication installation costs.

Logistics Elevator: An elevator whose primary purpose is to transportation various supplies, such as dietary or medical/surgical supplies, devices, and equipment, as well as occasional construction materials.

Material Handling (MH): The function of moving, packaging, and storing of substances in any form. Material handling does not alter, change, enhance, or add value to a product in any way. It is a "cost" function only that should be minimized to the greatest extent possible (within given aseptic, physical, operational, and functional parameters).

Materials Handling Service Elevators: Elevators intended for use by staff for materials, supplies and equipment movement.

Materials Management (MM): Material management is a scientific technique, concerned with planning, organizing, and control of flow of materials, from their initial purchase to destination.

May: "May" is used to indicate provisions that are used at the option of the designer.

Mechanical Space: The area that houses the primary and intermediate components of the air conditioning, plumbing, communication, electrical, and ventilation systems. This area includes chases and shafts as well as mechanical and electrical equipment rooms.

Medical Compressed Air (MCA): Compressed air system used only for medical functions requiring breathable air to support respiration or for air-driven instruments that discharge into the pharynx. Reference Chapter 9.

Medical Military Construction (MILCON) Program: That portion of the President's budget devoted exclusively to the renovation, upgrade, and replacement of applicable facilities that cost more than $750,000. MILCON is not supposed to include Operations and Maintenance (O&M) or Repair and Maintenance (R&M) unless the area that could be done with O&M or R&M is affected by the larger MILCON project and must be accomplished to provide a complete and usable facility in accordance with NFPA and TJC requirements.

Medical Surgical Vacuum (MV) System: Dry vacuum system used only for medical functions involving patient care, therapy, and diagnostic functions. May be used for Dental Surgical Vacuum (DSV) requirements in dental treatment rooms and oral surgeries. Reference Chapter 9.

Medical Treatment Facility (MTF): A facility established for the purpose of furnishing medical and/or dental care to eligible individuals.

Migration, Elevator: When more than one elevator group is available in a building, a passenger's origin does not necessarily dictate which elevator group will be used. A certain percentage of the population will migrate to other areas of a building to use an elevator for reasons such as meeting a friend or dropping off something on the way to their destination. This percentage is usually estimated to be 5-10 percent of the population (or as otherwise appropriate for the facility being studied).

Military Construction (MILCON) Programming: The annual processing, review, and approval of MILCON project proposals by the Military Department Secretaries, the OSD, and the OMB for submission to Congress.

Military Department (MilDep): One of the departments within the Department of Defense created by the National Security Act of 1947, as amended. Specifically includes the Department of the Air Force, the Department of the Army, and the Department of the Navy.

Milliampere (mA): The unit of electrical current flow equal to 0.001 ampere.

Mixed Occupancies: Reference NFPA 101 for occupancy definitions.

Modernization: Alteration, repair, remodeling, replacement, and renovation of existing buildings (including initial equipment thereof) and replacement of obsolete, built-in equipment of existing buildings. Does not include replacement of a facility or a portion to a capacity greater than the capacity of the existing facility.

Modular: a. Having commensurable dimensions.
b. Capable of arrangement with exact fit in more than one sequence or direction.
c. Composed of or containing predetermined dimensional or functional units such as repetitive structural bays or service modules.

Must: Indicates a mandatory requirement, synonymous with "will."

National Capital Planning Commission (NCPC): A regulatory body in the U.S. National Capital Region (NCR) that helps determine applicability of all Federal MILCON-funded facilities within the U.S National Capital Region. (See definitions of Commission of Fine Arts and NCR.)

National Fire Codes: Codes, standards and recommended practices published by the National Fire Protection Association (NFPA).

National Stock Number (NSN): Medical equipment identification consisting of an applicable four-digit class code number plus the nine-digit national item identification number.

Noise Criteria-Level (NC-Level): Refers to a set of contours roughly corresponding to the ear's response to sound pressure level at various frequencies that define the background sound level existing within a space.

Nonflammable Anesthetizing Location: Any anesthetizing location designated for the exclusive use of nonflammable anesthetizing agents.

Nonflammable Medical Gas System: A system of piped oxygen, nitrous oxide, compressed air, or other nonflammable medical gases.

Non-Regulated Medical Waste (NRMW): Waste not classified as regulated medical waste (RMW), recyclable materials, or hazardous materials. Poses no special danger of infection or injury to personnel or the public.

Nurses' Stations: Areas intended to provide a center of nursing activity for a group of nurses serving bed patients where the patient calls are received, nurses are dispatched, nurses' notes written, inpatient charts prepared, and medications prepared for distribution to patients. Where such activities are carried on in more than one location within a nursing unit, all such separate areas are considered a part of the nurses' station.

Operational Level Category (Seismic): These categories define the post-earthquake performance requirements for various facilities with respect to operational mission, disaster preparedness, and medical post-earthquake needs.

Operationally Ready Mode: A critical facility that completed its functional checks and determined to be capable of transforming to a higher level of preparedness. Ready for the next higher Operational Mode.

Operations and Maintenance (O&M) Funds: Those funds other than MILCON used for the express purpose of upgrading and maintaining existing facilities and equipment, or for the purchase of government furnished equipment and furnishing (not built-in) to provide a complete and usable facility.

Passenger Elevator: An elevator configured to move visitors, staff, and other ambulatory passenger traffic between floors. This elevator is generally wide car configuration to facilitate the movement of passengers.

Patient Service Elevator: An elevator configured to move patients on beds, gurneys, and stretchers, as well as patient care-related equipment such as portable X-rays, inhalation equipment, empty gurneys, wheelchairs, etc. The elevation is generally narrow and deep to facilitate the loading and unloading of this traffic.

Permanent: For the purposes of Medical Military Construction (MILCON), any structure designed for a useful lifespan of 25 years or longer.

Planning and Design (P&D) Funds: Funds for costs associated with preparation of design plans and specifications (A/E and in-house design costs) and costs to develop Operation and Maintenance Support Information (OMSI) products for a specific project.

Plumbing Fixture: An installed receptacle, device, or appliance that is supplied with water or that receives liquid or liquid-borne wastes and discharges such wastes into drainage systems to which it may be directly or indirectly connected.

Pneumatic Tube System (PTS): A pneumatically-powered, small diameter (usually 4 or 6 inches) tube that moves special carriers that contain messages, small supplies, or other items that physically “fit” and can tolerate this method of transport. These systems can be point-to-point or multi-station in design.

Post-Occupancy Evaluation (POE): An evaluation of the design and construction of a facility performed after facility activation and usage to obtain lessons learned that can be applied to present and future designs and criteria.

Precious Metals Recovery Program: Promotes the economic recovery of precious metals from excess and surplus material, and the use of recovered precious metals as Government Furnished Material.

Pre-Engineered Building (PEB): For the purpose of these criteria, pre-engineered buildings are considered as those buildings in various configurations and sixes that are available from manufacturers as a standard item. This type of construction may be used for DoD medical and dental facilities where such use is indicated by life-cycle cost to be economical, where they will meet the performance and functional requirements of the project, and are architecturally compatible with the environment in which they will be erected. Because of the great variance in the quality and cost of such structures on the market, extreme care must be used in selection to ensure that the quality of the facility to be provided is commensurate with the project requirement and expected longevity of the mission to be served.

Process Air (PA): Compressed air system to support functions such as medical service columns or shop operations. Reference Chapter 9.

Program Amount (PA): The initial PA is the estimated cost of a facility based on the DoD Cost Guidance and DD Form 1391 preparation prior to any design effort that establishes a project’s viability in the budget cycle. Once Concept Design is completed, the PA may be adjusted (up or down) based on the developed and validated Current Working Estimate (CWE) from the Design and Construction Agents. This PA (new) may

be the amount sent to Congress and the basis of Final Contract Document Design phases through Construction Contract Solicitation.

Program Objective Memorandum (POM): Formal document to identify major initiatives, their resource consumption estimates, and their operational justification used to prioritize and allocate manpower and fiscal resources.

Rad/Fluoro: Radiographic/Fluoroscopic.

Radio Frequency Interference (RFI): Electromagnetic radiation that is emitted by electrical circuits carrying rapidly changing signals, as a by-product of their normal operation, and which causes unwanted signals (interference or noise) to be induced in other circuits.

Readiness, Military: The ability of forces, units, weapons systems, or equipment to perform as they were intended and to deploy and employ without unacceptable delays.

Regulated Medical Waste (RMW): Waste that poses danger of disease transmission and/or objectionable appearances to personnel and the public.

Request for Proposal (RFP): A procurement document released to commercial industries outlining a requirement for development or implementation of a system or design. Industry provides its formal response in the form of proposed solutions to the problem defined, its cost and development schedules, and other pertinent data upon which the Government selects a vendor(s) with whom to contract.

Research and Laboratory: A facility or building used directly in theoretical or applied research, development, testing, and evaluation activities for medical research. It can also be a function detached from a hospital that provides laboratory support to the hospital or other medical activities equipped to conduct scientific experiments, tests, investigations, and research. These facilities are used directly in basic or applied research in the sciences including medicine and engineering.

Respiratory Care Department/Service: An organizational unit of the hospital that is designed for the provision of ventilator support and associated services to patients.

Root Mean Squared (RMS): Also knows as Effective Value. The value of alternating current or voltage equal to 0.707 times its peak value.

Schematic Design: Room-by-room scaled drawings defining the size and arrangement of areas in a building or building configuration as a basis for design development.

Section 2807, Title 10, U.S.C: The appropriate committees of Congress must be notified of the intent to award a contract for A/E services and construction design for the proposed Military Construction (MILCON) project if the estimated cost of such services exceeds $1,000,000. This notification must include the scope of the proposed project and the estimated cost of such services and must be made not less than 14 days before the initial obligation of funds for such services.

Semi-Permanent: For the purposes of Medical Military Construction (MILCON), any structure designed to last between 5 and 25 years of useful life. An example is an overseas free-standing contingency facility off-base.

Separated Elevator: Elevators that are intentionally separated within a facility such as passenger, service (staff or patients and logistics (materials), etc. based solely on the function, operation or service provided.

Service Elevator: An elevator that is “narrow and deep” in configuration to move patients and vehicular-type traffic between floors.

Should: Indicates a recommendation or alternative that is highly advised but not absolutely required.

Simulation: The use of a computer program as a model of a real situation.

Single-Loaded Corridor: A corridor with a single entry and exit point.

Sound Transmission Class (STC): A single-number rating system that compares the sound transmission loss of a test specimen with a standard contour.

Special Use Elevator: Elevators intended for loading docks, mortuary, AGV or the transport of animals.

Standby Mode: A critical facility capable of quickly, and with minimum effort, transforming from its peacetime mode of operation to a higher level of preparedness. Ready for the next higher Operationally Ready Mode.

Statement of Work or Scope of Work (SOW): A formalized document describing the details of an effort to be accomplished through contracted resources.

State-of-the-Art: The level of development (as of a device, procedure, process, technique, or science) reached at any particular time usually as a result of modern methods.

Status of Forces Agreements (SOFA): Agreements between the U.S. Government and the government of a foreign nation (host nation) that allows U.S. Forces to engage in some activity (such as occupy, build, or otherwise have temporary rights) that

otherwise would not be possible. SOFA agreements usually stipulate governing rules, codes, and standards that must be followed in the course of construction on that nation's soil.

Stretcher: A stretcher is an apparatus used for moving patients who require emergency medical care. These are collapsible on a variable-height wheeled frame, have special wheels that makes transportation over pavement easier, integral lug to lock into the ambulance and straps to secure the patient during transport. The minimum size is 24 inches wide x 84 inches in length.

Structural Interior Design (SID): The portion of basic design services concerned with establishment of "motif," color, and finish selection usually very early in the Concept Design phase of all fixed, "structurally related" finishes (for example walls, floors, ceilings, columns, fixtures, casework, equipment, and exteriors) as opposed to Comprehensive Interior Design (CID) that is an option to design services and relates to such things as moveable, mobile, or portable equipment, fixtures, and furnishings. For unity of color selection and design, both the SID and the CID must be compatible, conform to the finish schedule, and coordinate early and throughout the design, procurement, construction, and installation processes. Reference Chapter 3 and Chapter 6.

Sustainable Design: Design, construction, operation, and reuse/removal of the built environment in an environmentally and energy-efficient manner.

Tactical (Operational) Mode: A critical facility, having completed its Operationally Ready functional checks, and activated its limited number of simple tasks during changeover, that is operating in an independent, sustained, continuous operation without resupply for a predetermined period of time. This is the highest level of preparedness or operation.

The Joint Commission (TJC): Private, not-for-profit organization composed of representatives of the American College of Surgeons, American College of Physicians, American Hospital Association, American Medical Association, and American Dental Association whose purpose is to establish standards for the operation of health facilities and services, conduct surveys, and determine accreditation status of medical treatment facilities.

Total Building Commissioning (TBCx): Commissioning is defined by the building industry as the process of verifying that all building systems perform interactively according to the design intent, and the systems meet the Owner's operational needs. Reference Chapter 19.

Total Gross Area: The total area including intra-departmental circulation, inter-departmental circulation, walls and structure, mechanical space, and total net area.

Universal X-Ray Room: The universal X-ray room must be capable of accepting all routine radiographic, fluoroscopic, and tomographic equipment up to 1200 milliamperes (mA), 150 kvp, regardless of manufacturer, during initial installation and subsequent replacement actions with little, if any, facility modification. The procedures must be performed unencumbered and without any restriction of system components, patient size, or any known procedure that any installed X-ray equipment can perform now or in the future. This definition does not apply to digital radiography, special procedure rooms, C-arms, or angiography rooms. Reference Appendix D.

Value Engineering (VE): Value engineering studies consist of analyses of certain high-cost areas of a design to determine if an alternate way exists to achieve the same or improved function at a lower life-cycle cost (LCC). The main objectives of VE studies are reduced LCC and improved quality of design. The application of value engineering must not result in a lowering of criteria, quality standards, or reduction of scope as established by the guidance in this document. Reference Chapter 3.

Vehicular Traffic, Elevator: Generally defined as that traffic that is pushed or rolled into elevators on wheels. Examples of vehicular traffic are beds and gurneys. Wheelchairs are considered vehicular traffic where they are pushed by an escort or attendant, and where the occupant is a patient. Where wheelchairs carry staff or visitors, they are generally counted in with the pedestrian population since they would utilize passenger elevators.

War Reserve Material (WRM): Material required to augment peacetime assets to completely support forces, missions, and activities reflected in DoD/Joint Chiefs of Staff war plans.

Whole Building Design Guide (WBDG): WBDG was created to assist the design community with integrating Government criteria, non-Government standards, vendor data, and expert knowledge into a 'whole building' perspective. This 'whole building' concept is an integrated design approach that employs a collaborative team process to achieve high-performance buildings.

Working Drawings: The second phase of the Design process that includes the final development of all contract documents to prepare for the bidding phase.

X-Ray Installations (Momentary Rating): A rating based on an operating interval that does not exceed 5 seconds.

Zone, Elevator: A group of floors in a building that is considered as a unit with respect to elevator service. It may consist of a physical entity – a group of upper floors above and below which are blind shafts – or it may be a product of the elevator group control system, changing with system needs.

APPENDIX I REFERENCES

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.8-13: *Standard Test Method for Determination of Resistance to Human Impact of Window Systems Intended for Use in Psychiatric Applications*

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

Manual of Recommended Practices for Industrial Ventilation

AMERICAN NATIONAL STANDARDS INSTITUTE

https://www.ansi.org/

ANSI C78.377 *American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products*

ANSI C84.1- A*merican National Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hz)*

AMERICAN NATIONAL STANDARDS INSTITUTE/ACOUSTICAL SOCIETY OF AMERICA

ANSI/ASA S3.2 *Method for Measuring the Intelligibility of Speech over Communications Systems*

AMERICAN NATIONAL STANDARDS INSTITUTE/AMERICAN SOCIETY OF SAFETY PREFESSIONALS

ANSI/ASSP Z590.3: *Prevention through Design Guidelines for Addressing Occupational Hazards and Risks in Design and Redesign Processes*

AMERICAN SOCIETY OF CIVIL ENGINEERS

https://www.asce.org/

ASCE 7, *Minimum Design Load and Associated Criteria for Buildings and Other Structures*

ASCE 24, *Flood Resistant Design and Construction*

AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIR-CONDITIONING ENGINEERS

https://www.ashrae.org/

ANSI/ASHRAE 15, *Safety Standard for Refrigeration Systems*

ANSI/ASHRAE 62.1, *Ventilation for Acceptable Indoor Air Quality*

ANSI/ASHRAE/IES 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

ANSI/ASHRAE/IES Standard 202, *Commissioning Process for Buildings and Systems*

ASHRAE Guideline 0, *The Commissioning Process*

ASHRAE Guideline 1.1, *HVAC&R Technical Requirements for The Commissioning Process*

ASHRAE Handbook *Series*

ASHRAE Handbook: *Fundamentals*

ASHRAE Handbook: *HVAC Applications*

AMERICAN SOCIETY OF MECHANICAL ENGINEERS INTERNATIONAL

ASME A112 Standard Series, Plumbing Fixtures and Appurtenances, for example, "Enameled Cast Iron Plumbing Fixtures," "Vitreous China Plumbing Fixtures," and "Porcelain Enameled Formed Steel Plumbing Fixtures"

ASME A17.1, *Safety Code for Elevators and Escalators*

ASME A17.2, *Guide for Inspection of Elevators, Escalators, and Moving Walks*

ASME A17.3, *Safety Code for Existing Elevators and Escalators (Includes Requirements for Electric and Hydraulic Elevators and Escalators)*

ASME A17.5/CSA B44.1 - 2014, *Elevator and Escalator Electrical Equipment*

AMERICAN SOCIETY OF PLUMBING ENGINEERS

https://www.aspe.org/

ASPE Data Book, Chapter 4 "Service Water Heating Systems"

ASTM INTERNATIONAL

https://www.astm.org/

ASTM C1071 - 05e1, *Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)*

ASTM D975-17, *Standard Specification for Diesel Fuel Oils*

ASTM E814, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops*

ASTM E2813, *Standard Practice for Building Enclosure Commissioning* **\1**

ASTM E2947, *Standard Guide for Building Enclosure Commissioning* **/1/**

BEHAVIORAL HEALTH FACILITY CONSULTING, LLC.

https://www.bhfcllc.com/

Behavioral Health Design Guide for the Built Environment of Behavioral Health Facilities

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION

https://buildershardware.com/

The trade association for North American manufacturers of commercial builders hardware.

CARPET AND RUG INSTITUTE (CRI)

https://carpet-rug.org/

Carpet and Rug Institute (CRI) Fact Sheet

CENTERS FOR DISEASE CONTROL AND PREVENTION

https://www.cdc.gov

Biosafety in Microbiological and Biomedical Laboratories (BMBL) 6th Edition https://www.cdc.gov/labs/BMBL.html

Guidelines for Preventing the Transmission of Mycobacterium Tuberculosis in Health-Care Facilities (the TB Guidelines), October 28, 1994, Federal Register Vol. 59, No. 208, https://www.gpo.gov/fdsys/pkg/FR-1994-10-28/html/94-26598.htm.

COMPRESSED GAS ASSOCIATION

https://www.cganet.com/

CGA Pamphlet C-9, *Standard Color-Marking of Compressed Gas Containers for Medical Use*

CGA Pamphlet P-2, *Characteristics and Safe Handling of Medical Gases*

CGA Pamphlet V-5, *Diameter-Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)*

DEFENSE HEALTH AGENCY (DHA)

https://home.facilities.health.mil/

CEHNC-EDX, *Hospital Electrical Code Study, U.S. versus German Codes, Contract W912DY-13-D-0123.*

DHA-FE World Class Facilities Toolkit

MHS Minimum BIM Requirements

DEPARTMENT OF ARMY

DA PAM 385-69, *Safety Standards for Microbiological and Biomedical Laboratories*

DEPARTMENT OF DEFENSE

https://www.esd.whs.mil/dd/

DD Form 1391, FY__ Military Construction Project Data

DoDI 6015.17, *SUBJECT: Military Health System (MHS) Facility Portfolio Management*

DoDI 6055.01, *SUBJECT: DoD Safety and Occupational Health (SOH) Program*

DoDM 6055-18-M, *Safety Standards for Microbiological and Biomedical Laboratories*

DEPARTMENT OF LABOR

OSHA - Part 1910, *Occupational Safety and Health Standards*
https://www.osha.gov/laws-regs/regulations/standardnumber/1910

ENVIRONMENTAL PROTECTION AGENCY

ENERGY STAR, U.S. Department of Energy, US EPA
https://www.energystar.gov/

Significant New Alternatives Policy (SNAP) Program
https://www.epa.gov/snap

FEDERAL AVIATION ADMINISTRATION

https://www.faa.gov/

AC150/5345-49C, *Specification L-854, Radio Control Equipment*

FOOD AND DRUG ADMINISTRATION

https://www.fda.gov/

Controlled Substance Act

Food Code

Hazard Analysis and Critical Control Points (HACCP)

ILLUMINATING ENGINEERING SOCIETY

https://www.ies.org/

IES, *Model Lighting Ordinance (MLO), a Joint Publication with International Dark Sky Association*

IES, *Lighting Handbook*

IES RP-29, *Lighting for Hospitals and Healthcare Facilities*

IES TM-30, *Method for Evaluating Light Source Color Rendition*

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

https://standards.ieee.org

IEEE C2, *National Electrical Safety Code (NESC)*

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INTERNATIONAL CODE COUNCIL

https://shop.iccsafe.org/

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

https://www.iso.org/home.html

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NFPA 45, *Standard for Fire Protection for Laboratories Using Chemicals*

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NFPA 82, *Standard on Incinerators and Waste and Linen Handling Systems and Equipment*

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https://www.usp.org/

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IAQ Guidelines for Occupied Buildings Under Construction

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TIA-329, *Minimum Standards for Communications Antennas*

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UFC 3-450-01, *Noise and Vibration Control*

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UFC 3-520-01, *Interior Electrical Systems*

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40 CFR Part 262, *Standards Applicable to Generators of Hazardous Waste*

40 CFR Part 263, *Standards Applicable to Transporters of Hazardous Waste*

40 CFR Part 264, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*

40 CFR Part 265, *Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*

47 CFR Part 15, Telecommunication, Part 15 – *Radio Frequency Devices*

47 CFR Part 76, Telecommunication, Part 76 – *Multichannel Video and Cable Television Service*

49 CFR 171, *General Information, Regulations, and Definitions*

49 CFR 172, *Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans*

49 CFR 173, *Shippers – General Requirements for Shipments and Packagings*

49 CFR 174, *Carriage by Rail*

49 CFR 175, *Carriage by Aircraft*

49 CFR 176, *Carriage by Vessel*

49 CFR 177, *Carriage by Public Highway*

49 CFR 178, *Specifications for Packagings*

49 CFR 179, *Specifications for Tank Cars*

49 CFR 180, *Continuing Qualification and Maintenance of Packagings*

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UFC 4-610-01
05 January 2021
Change 1, 30 April 2021

UNIFIED FACILITIES CRITERIA (UFC)

ADMINISTRATIVE FACILITIES

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**
1	15 April 2021	2-3.2.3 to 2.3.2.13 reordered paragraphs; 4-2.4 to 4-2.6; new planning guidance on telework and workstation sharing. Edits to Table 4-3, 4-4, 4-5, and 4-26; new Table 4-24 Focus Room; A-2.1. Tables were reordered to group similar spaces. Editorial changes throughout.

This UFC supersedes UFC 4-610-01, dated 6 May 2008, with Changes 1-2 dated 21 May 2014.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies must contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Document: UFC 4-610-01, *Administrative Facilities*

Superseding: UFC 4-610-01, *Administration Facilities,* dated 6 May 2008, with Changes 1-2, dated 21 May 2014

Description: This UFC provides planning and design criteria for Administrative Facilities. It outlines methods of space allocation and typical functional spaces to accommodate the executive and staff functions of an installation or particular organization.

Reasons for Document:

- To provide a unified approach to effectively planning, allocating space and designing, administrative facilities with updated methodologies and technologies, and incorporate the integrated design process.

Impact:

The following direct benefits will result from publication, revision and change of the UFC.

- More consistency in the design of administrative facilities with better work environments for higher productivity, efficiency and worker satisfaction.
- Lower initial cost due to better coordination and design efficiency.
- Lower Life cycle cost due to more refined definition of requirements.
- Easier, more efficient maintenance.
- Better safety and security.

Unification Issues:

- Each Service has specific planning, location and space programming requirements
- The Navy and Marine Corps have specific requirements for Austere Administrative Facilities. See Appendix B.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

An Administrative Facility is a building or portion of a building in which the administrative affairs of a military establishment are conducted. It accommodates the executive and staff functions of an installation or particular organization. The functions performed in an Administrative Facility may include logistics, personnel management, and in some cases, operational functions classified in other category codes.

1-2 PURPOSE AND SCOPE.

This UFC provides requirements for evaluating, planning, and designing basic Administrative Facilities for all new construction projects to include additions, alterations, and renovation projects in the continental United States (CONUS) and outside the continental US (OCONUS). Program and design these facilities to enhance the mission or organizational functions. In addition, design administrative spaces to be flexible, cost-effective, and create an atmosphere that increases morale, productivity, and collaboration.

1-3 APPLICABILITY.

This UFC applies to all military service elements, civilians, and contractors involved in the design and construction of Administrative Facilities, including the procurement of design-build services for the above-noted projects. For Army projects, in the event of a conflict between this UFC and an applicable Army standard design, the criteria in the Army standard design will takes precedence.

When administrative space represents a portion of a larger building, this UFC applies only if administrative functions are performed in that space and no other specific criteria addresses the function. Administrative office space provided within an operational facility, such as a warehouse or a recreational facility, is planned under the category code of the primary facility. For example, space in a general warehouse that is partitioned off and assigned to a clerk for administrative duties associated with that warehouse, is planned as warehouse space and is not governed by this UFC.

1-3.1 Users of this Document.

1-3.1.1 Planning/Programming Personnel.

Planning and programming personnel will use the UFC for pre-design planning or to assess the extent of improvements required in an existing facility in order to achieve the standard established herein.

1-3.1.2 Architects, Engineers, and Interior Designers.

Professional architects, engineers, and interior designers will provide design services under the direction of the individual design agencies and this UFC.

1-3.1.3 Service-specific Users and Distribution of Responsibilities.

When Service criteria varies from standard criteria, it is noted in the text as a “Service Exception” or a “Service-specific” criteria.

Since numerous and different program offices and functions may be housed in Administrative Facilities, refer to the appropriate overseeing program office for the specific users and distribution of responsibilities to be housed in the facility. For more general planning questions, refer to the following Service-specific governing documents:

- **Army**. AR 405-70
- **Navy and Marine Corps**. FC 2-000-05N
- **Air Force**. AFMAN 32-1084

1-4 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code.* UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-5 CYBERSECURITY.

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service Implementation Policy.

1-6 AUSTERE ADMINISTRATIVE FACILITIES (NAVY ONLY).

APPENDIX B contains requirements for Administrative Facilities that are specifically designated as “austere”. Austere construction is intended for facilities in locations determined by CNIC and approved by OPNAV to be eligible for austere construction. The austere standards are intended to be applied flexibly and in varying degrees to all facilities at locations designated as austere. Allow flexibility to ensure the criteria are appropriate for individual austere locations.

1-7 GLOSSARY.

APPENDIX C contains acronyms and abbreviations.

1-8 REFERENCES.

APPENDIX D contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

CHAPTER 2 PLANNING AND PROGRAMMING

2-1 SCOPE OF FACILITY.

This chapter establishes space planning and programming criteria and assignment guidelines for administrative facilities. These parameters assist in designing facilities to enhance the main mission or functions of an organization and increase morale, productivity, and collaboration. Additional design considerations include flexibility, initial cost, life cycle costs, and ease of maintenance.

2-2 LOCATION DETERMINANTS.

Determine facility location in accordance with the installation land use plan and/or Installation Development Plan and the following Service-specific planning documents.

- **Army**. UFC 2-100-01
- **Navy.** UFC 2-100-01
- **Air Force.** AFI 32-1015
- **Marine Corps.** MCO P11000.12C

2-3 ADMINISTRATIVE SPACE TYPES.

An Administrative Facility is planned to accommodate general administrative personnel space, support and special purpose spaces, circulation, and building core spaces. An Administrative Facility may contain more than one organization with different functional and space needs. Space requirements must be calculated for each organization and for shared spaces between the organizations.

The following space types are described functionally and may be organized or categorized differently than the Service specific planning guides. Plan and design in accordance with the following Service-specific planning criteria.

- **Army**. AR 405-70
- **Navy-Marine Corps.** FC 2-000-05N
- **Air Force.** AFMAN 32-1084

2-3.1 Administrative Personnel.

Administrative personnel require private offices, open office space, or flexible office space. Allocate space based on the personnel position and functional requirements. For example, if personnel are rarely in the office, or work remotely through a telework agreement three or more days a week, they may be located in a Flex Office or Open Office Flex Workstation. If they have a high level of interaction with others in the office, and require visual and acoustic privacy, they may be placed in a private office with conferencing space or in a private office adjacent to conferencing space. Semi-Private

Office spaces are useful for personnel whose positions do not warrant a Private Office, or may be used for a special team requiring separation from open office areas.

2-3.2 Administrative Support Spaces.

Administrative Support spaces include all office functions not included in personnel office space. Some of these spaces could be shared between multiple administrative organizations within a facility.

The design approach can consolidate some of these functions in a central area within an organization, spread them throughout the organization in a decentralized arrangement, or use some combination of these approaches. The relationship requirements of support to the administrative function must be carefully considered prior to determining the design approach. Space allocations for some of these functions are derived based on the number of staff within an organization.

2-3.2.1 Vestibule.

A building entrance vestibule both helps mitigate temperature differences between the indoor and outdoor environment and provides an area where people entering the building can wipe their feet on an appropriate surface.

2-3.2.2 Reception and Waiting Areas.

Reception and waiting areas are planned for organizations where outside visitors come to meet with personnel within the organization. The size and type of the organization and its function will determine the of reception and waiting areas requirements. The area may be staffed or just provide seating for visitors. To accommodate security concerns, the area may have intercom requirements for contact into the organization or locker requirements for cellphones or other electronic devices to be secured.

2-3.2.3 Mail Center.

This space accommodates processing and distribution of the facility’s incoming and outgoing mail and parcels. It may accommodate screening requirements. Ensure adequate storage and work area to include mail sorting stations, packaging material, postage machines, scales, storage for materials, and workspace. Mailrooms may be staffed and include workstation(s). The mailroom must be adjacent to and provide direct access to the shipping/receiving area. Consult with the appropriate Installation authority to determine how mail is delivered, inspected and sorted to determine the mailroom size, design and safety requirements

2-3.2.4 Shipping and Receiving.

This area accommodates loading and unloading of a wide variety of supplies and services necessary for the operation of the facility. Material may be stored on pallets in open areas or on pallet racks. Plan for workbenches, packaging equipment, charging stations, and pallet lifts or forklifts. It includes an exterior entrance located for easy access by delivery trucks and may include a loading dock. This entrance must not be

visible from the building's main entrance. In multistory structures, shipping/receiving must have direct access to a freight elevator. Ensure the width, depth, and height of the bays accommodate the trucks that can be reasonably anticipated for the specific location and the shipping and receiving functions within the facility.

2-3.2.5 Trash and Recycling Room.

This interior room provides a central collection point for trash and recyclable materials such as glass, plastic, aluminum, and paper. The main trash/recycling area is adjacent to the shipping/receiving area where recyclables from the floors can be consolidated and stored for pick-up. In multistory buildings, locate remote trash/recycling areas adjacent to break rooms, copy rooms, vending, and other similar areas. Locate containers such that they do not interfere with required egress widths.

2-3.2.6 Large Format Production Room.

This room provides space for large-format production equipment such as large, high capacity copiers and printers, plotters, and scanners. It includes work surfaces to handle the material and storage cabinets for associated paper, toner and other printing materials. Consider indoor air quality and HVAC requirements based on type and size of equipment.

Design the room to be conducive to computer-based design work and have space for document production and pallet-based paper storage. Incorporate double doors to accommodate movement of pallets of equipment and supplies. The room must be enclosed with partitions which extend from finished floor to the structure above. Provide acoustical treatment.

2-3.2.7 Break Rooms.

Breakrooms provide staff-only space for dining and breaks, minimal food preparation and often vending. Consider the size of the organization when planning space for refrigerators, microwaves, coffee makers, or other appliances. Ensure appropriate utilities for appliances. Some breakrooms are enclosed and require space for comfortable tables and chairs. These spaces can also be utilized as casual meeting space if necessary. Some break areas are unenclosed with fewer amenities, such as those in an open office or flex space, or within spaces designated for teleworkers who occasionally work from the office.

2-3.2.8 Nursing Mothers Room.

Nursing Mothers rooms must be in a safe area accessible to all, shielded from view, and in close proximity to the toilets in a facility. Consideration must be given to acoustics with respect to adjacent spaces. The size of the organization or facility will determine if multi-station lactation rooms are required. Reference GSA PBS-P100 and ECB 2019-4 for multi-station lactation room requirements.

2-3.2.9 Toilets.

Toilets and restrooms can be located within an organization's space with the locker room, shower room, and nursing mothers room. They can also be accessible only from within the organization's perimeter, as opposed to public restrooms being accessible as part of the building core.

2-3.2.10 Janitor's Closet.

A janitor's closet accommodates equipment and supplies, mop basin, mop rack, and shelving. This closet can be located within an organization's space with the toilets, locker room, shower room, and nursing mother's room. It can also be accessible only from within the organization's perimeter, as opposed to being publicly accessible as part of the building core.

2-3.2.11 Locker Room.

Locker rooms are provided for organizations with 24-hour/7-day operations, to support physical training requirements and security personnel. They provide storage space for personal items and change of clothes.

2-3.2.12 Shower Room.

A shower room is planned when a facility does not have access to a fitness facility or has 24-hour/7-day operations. The number of showers is determined by the number of personnel. Shower rooms are usually adjacent to locker rooms and toilets.

2-3.2.13 Fitness Room.

Small Fitness rooms can be planned for administrative facilities not located near Fitness Centers. These spaces must be in areas accessible to all and in close proximity to locker and shower facilities.

2-3.3 Assembly Spaces.

Assembly spaces include auditoriums, conference rooms, training rooms, team rooms, breakrooms, and open collaboration spaces.

2-3.3.1 Auditoriums.

Auditoriums accommodate 50 or more people for large presentations and include a tiered floor with fixed seating and a stage or raised platform. Accommodate built-in presentation equipment, a sound system, and specialized lighting. An auditorium must be enclosed with partitions that extend from the finished floor to the structure above. Include the services of specialized engineering disciplines to address issues of lighting, acoustics, audiovisual systems, and other technology requirements. Include these consultants as part of the design team when auditoriums are required in administrative office buildings.

2-3.3.2 Conference, Classrooms and Training Rooms.

Conference rooms, classrooms, and training rooms provide space for meetings, briefings and training. When planning these spaces, consider acoustic privacy, social distancing and visibility requirements, as well as audiovisual and technology requirements. These spaces may be grouped together as a centralized conference center and be isolated from quiet areas within the office space.

A classroom/training room may be planned for general training or dedicated for computer training. The classroom/training room accommodates a flexible arrangement of settings for many uses. The computer training room includes dedicated computer workstations in a more fixed arrangement. Plan for built-in projector and projector screen, or multiple monitors as indicated by the audio-visual requirements.

2-3.3.3 Team/Collaboration Areas.

Team rooms and open collaborative areas strategically placed in an office plan can be useful for casual, unscheduled impromptu meetings and collaboration. Meeting styles can range from the stand-up/touch down high-top tables and stools to low comfortable lounge seating. Include technology connectivity and acoustic design requirements in these spaces. Small team/collaboration areas can also be used for alternate work areas to support an occasional influx of teleworkers within the office environment.

2-3.4 Equipment and Storage Spaces.

2-3.4.1 General Filing and Storage Room.

This space can be open or closed space for an organization’s office supplies and equipment storage, day locker storage, conference room equipment (chairs and tables) and AV storage, lecterns, and other mobile presentation items. Group files, technical libraries, and similar materials are those not included in private offices or within workstations.

2-3.4.2 Archival Storage.

Archival storage is for retention of various types of records specific to an organization’s mission or functions performed. It may have letter or legal file cabinets, flat files, or high-density filing systems. This is a different type of space than a general filing and storage room or filing and storage incorporated into offices and workstations. Depending on the type of material and the timeframe it is to be stored, these spaces may require specialized climate control, fire protection, and ESS controls. Reference FC 4-760-10N for archival storage requirements.

2-3.4.3 Computer Room.

Plan computer rooms to accommodate an organization’s servers or LAN cabinets, and associated mechanical, electrical, and data design requirements. Coordinate the planning and design with the appropriate IT personnel.

2-3.4.4 Technical Equipment Room.

Plan this space to accommodate the organization's technical equipment requirements, including mechanical, electrical, and data. For example, it may accommodate equipment charging stations and check-in and check-out functions for government provided equipment. Plan space to be located near technology support personnel when applicable. Plan space for queuing and circulation for personnel and equipment when applicable.

2-3.5 Secure Spaces.

2-3.5.1 Controlled Entry/Quarterdeck.

A controlled entry area or quarterdeck may be required for secure facilities to allow for orderly check-in and check-out. The entry control area provides for one entry and one exit channel adjacent to one or more security watch stations. A security watch station is usually adjacent to house a security officer(s) and security system equipment.

2-3.5.2 Secure Storage.

A secure storage room provides lockable space to store sensitive or high value items. Size and furnish the room appropriately to accommodate the specific organizational requirements.

2-3.5.3 Secure Visitor Space.

A secure visitor space may be required for secure facilities where individuals must be separated from the organization awaiting an interview or an escort.

2-3.5.4 Sensitive Compartmented Information Facilities (SCIF).

A SCIF is an accredited area, room, group of rooms, buildings, or installation where sensitive compartmentalized information is stored, used, discussed, and/or electronically processed.

2-3.5.5 Vault Room.

A secure storage and workspace for classified materials may include storage and file cabinets, worktables, and workstations for staff. This space will likely have secure networks, hardware and construction requirements specific to the organization's function or mission; however, it may not be accredited.

Depending on the level of classification, refer to requirements for classified facilities requiring more stringent security requirements and specific design guidance such as Open Storage Secret (OSS), Sensitive Compartmented Information Facility (SCIF), Special Access Program Facilities (SAPF), and Top Secret/Sensitive Compartmented Information (TS/SCI).

2-4 SPACE PLANNING PROGRAM.

A space planning program can be calculated in general terms based on the number of occupants or based on a detailed accounting of each type of personnel space and support space. Space planning programs should take into account job-sharing programs, office/workstation sharing, and out-of-office remote working through telework agreements when approved by the Command. The stage in the process of planning and design determines the level of detail required for calculating the space program. Refer to the following for Service-specific criteria.

- **Air Force**, AFMAN 32-1084
- **Army**, AR 405-70
- **Navy and Marine Corps**, FC 2-000-05N

A space program can be developed through use of an interactive spreadsheet to serve as a baseline for the planning team. This spreadsheet is available as a downloadable Microsoft® Excel file from the Whole Building Design Guide (WBDG) website: https://www.wbdg.org/ffc/dod/unified-facilities-space-program-sustainability-spreadsheets.

2-4.1 Circulation.

Building design must allocate for primary circulation space in the building core and secondary circulation space as determined by the interior configuration of personnel and support /special spaces. Plan for secondary circulation in and around the private offices, open office space, flex space, and the administrative support and special spaces. A higher secondary circulation factor is required when there is more open office space and less private office or enclosed space. The General Services Administration (GSA) has conducted studies to determine the circulation required when utilizing open office design versus private office configurations. Refer to Appendix A for examples for planning circulation based on building layout and configuration.

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CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 BUILDING CONFIGURATION AND LAYOUT.

Building size, shape, and area-to-perimeter ratio have a direct impact on the cost and efficient space utilization of the facility, and these aspects must be considered during planning and design. A simple shape with an efficient structural layout and a high area-to-perimeter ratio yields the most economical and flexible facility.

Limit permanent interior partitions to those required for building core elements, private offices and special purpose spaces to allow flexibility in reconfiguration. Critical elements of an efficient layout include the design of the building core, the dimensions of floor depth and bay spacing, and the workstation design and layout.

3-1.1 Building Core.

The building core may include the following elements: vestibules; lobbies; passenger and freight elevators; primary corridors; stairs; toilets and restrooms; telephone, telecom, and electrical rooms; custodial closets; vending rooms; and mechanical rooms. Typically, these spaces are centralized and/or stacked in a building to provide greater efficiency in floor-plan layout, design, and utility distribution.

3-1.2 Floor Depth.

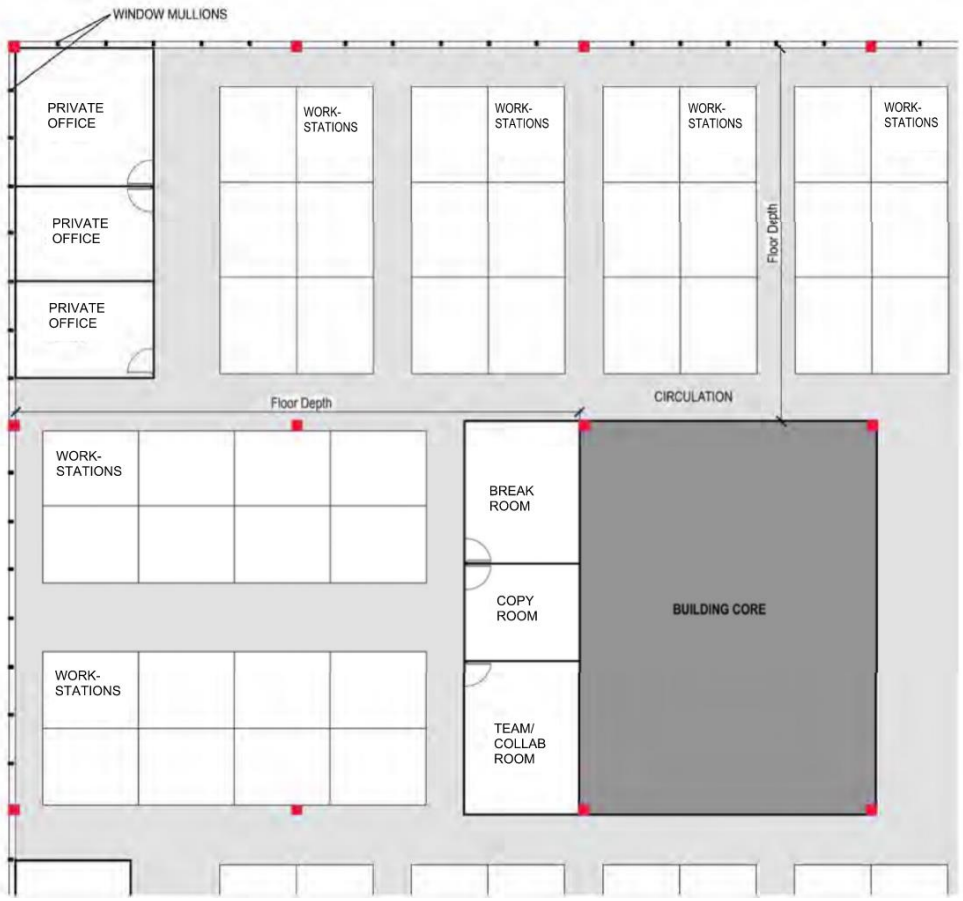
The floor depth is defined as the distance from inside face of the exterior wall to outside face of the building core. Floor depth affects the office and workstation sizing and configuration, and must be carefully coordinated with private office furniture and the open office furniture systems. In addition to its effect on workstation and office sizing, floor depth affects the admission of natural light. Too great a floor depth will preclude access to daylight by building occupants near the building core. Locate spaces not regularly occupied with personnel near the core of the building. Refer to Figure 3-1 for an illustration of the use and effects of working with a building’s floor depth.

3-1.3 Structural Bay Spacing.

The structural bay spacing plays a critical role in workspace layout efficiency as well as building primary circulation. The open area between structural columns is commonly referred to as a structural bay. The size and shape of the structural bays will directly affect the number of offices and workstations of a particular size that can be accommodated. Refer to Figure 3-1 for an illustration of the use and effects of working with a building’s structural bay spacing.

In this example, private offices are sized to align with the window mullions as well as having at least one dimension in common allowing for efficient construction and space utilization. The workstations are sized and aligned with the structural grid to accommodate the maximum number for this footprint. (structural columns are indicated as a red rectangle). This sample layout is an efficient use of space and adequate amount of secondary circulation.

Figure 3-1 Sample Building Layout



3-2 ARCHITECTURE AND INTERIOR DESIGN.

3-2.1 Exterior Design.

Exterior design must comply with the individual installation's architectural and design standards and the installation's development plans. This involves material and color selection for exterior walls, doors, and window elements, glazing, and roofing, as well as placement of mechanical units and landscaping.

3-2.2 Entrance.

Provide a main entrance with a clearly identifiable point of reference or landmark that serves as a welcome and a transition. Provide a canopy (or a recess) at required egress doors to ensure that doors can open completely without obstruction.

3-2.3 Windows and Natural Lighting.

Provide for the admission of natural light in the design of the window systems and in the design of the overall footprint and floor depth. Locate spaces not regularly occupied, such as Mail Centers and Large Format Production rooms, at the core of the building. Incorporate light-transmitting building elements to allow light to penetrate the space. Coordinate the selection of furniture systems that maximize the admission of natural light into the facility.

3-2.4 Raised Access Floor Systems.

A raised floor system is recommended, as it allows for easy access to utilities and flexibility in reconfiguration of the entire space. This system is particularly useful in spaces with high levels of data systems and power requirements. If such a system is used, mechanical air distribution may be incorporated into the floor cavity. Floor-supplied HVAC provides greater occupant comfort, which can lead to increased productivity.

3-2.5 Demountable and Operable Partitions.

Consider using demountable partitions and/or movable walls when reconfigurations are expected. Systems that are independent of the floor finish and ceiling grid will reduce configuration cost. If office or conference modules are repetitive, consistent sizes of panels allow for the maximum re-use of panels. These partitions and walls give facility managers flexibility to rearrange offices without the disruption or expense of construction. They have a higher initial cost than typical gypsum wallboard and steel stud partitions, but may be life-cycle-cost effective where reconfigurations are expected.

Dual-purpose features of some demountable and/or movable partitions include glazing for daylighting transfer, marker board and tack board surfaces, acoustical surfaces and slotted standards to receive systems furniture components. Multiple doors or telescoping sliding panels can open to adjacent spaces for alternate functions. Power and data can be managed easily with removable access panels.

3-2.6 Interior Signage.

Interior signage identifies spaces, organizations, and persons, as well as providing wayfinding and directories. Signage must comply with UFC 3-120-01 and Installation requirements. Sign placement and type are site-specific, but signs must be strategically located, adequately lit, and of sufficient size and contrast to permit proper viewing.

3-2.7 Interior Design and Finishes.

In addition to planning and designing for an organization’s space needs and functionality, provide interior construction elements such as casework, column enclosures, floor and wall accents, soffits, and ceiling features. Design interior finishes to support a professional image and incorporate the organization’s theme or mission. Coordinate interior finishes with the Functional Data Sheet Tables in Chapter 4. Provide

easily cleanable, maintainable, and durable finishes with material characteristics to support sustainability requirements and infectious disease control.

3-2.8 Acoustics.

Design facilities with acoustical treatments to provide a comfortable acoustical environment. Design acoustical control within the office environment to address sound isolation, transmission, and sound absorption appropriate for each type of space. Each of these characteristics are emphasized differently, depending on the use of the space, whether it is a private office or conference room, or a large open office setting. Consult with acoustical engineers and/or industry representatives to evaluate effective acoustical solutions for noise control. With space being a premium, workplaces are very densely populated and consequently require noise control.

3-2.8.1 Open Offices.

Use materials on ceilings, partitions, and floors that absorb sound and reduce noise reflection. These materials have a high Noise Reduction Coefficient (NRC) and are manufactured specifically for open office environments. Consider the acoustics when selecting a location for and designing the finishes adjacent to office equipment, such as copiers, printers, scanners, shredders, and facsimile machines.

The use of sound masking systems generates background noise to disguise speech. These are applied with noise generators strategically placed within the space. Consult with an acoustical engineer before designing an open office environment where a sound masking system will be used.

3-2.8.2 Multi-Purpose Spaces.

Design acoustical treatments in multipurpose spaces that have different acoustical needs depending on the configuration in use. For example, a conference room adjacent to a break room will need acoustic isolation from the break room. If the partition between the rooms is operable, and the rooms are opened to each other for a larger event, the acoustic treatment or design needs to accommodate the dual use.

3-2.9 Technology and Connectivity.

Technology and connectivity are some of the most frustrating and most important issues in the design and subsequent use of a facility. Identify telecommunications requirements early in the design process. Determine if an organization has special requirements, involve the appropriate IT personnel early on and engage them on lessons learned and challenges to overcome. Design building spaces and furniture selection to accommodate telecommunications distribution and access.

Plan assembly spaces of all types and sizes for power and data capabilities that can accommodate various uses such as presentations, instruction, or collaboration. Include technology and connectivity in collaboration spaces to increase multipurpose use and add productivity.

3-2.10 Ergonomics.

Provide an ergonomic work environment. Design features for an ergonomic environment include correct lighting for the space, comfortable noise levels, and adequate climate control and ventilation. Incorporate furniture design solutions with adjustable height worksurfaces with independently adjustable keyboard platforms and computer monitor mounting components. Ensure task seating includes a high level of adjustability to meet personnel requirements, including worker sizes and physical disabilities or characteristics.

Design facilities to reduce or eliminate work-related musculoskeletal (WMSD) injuries and risk factors or stressors due to processes, job tasks, and materials utilized in the workplace. Refer to the following for service-specific guidance:

- **Air Force**, *Air Force Interior Design Guide*, (update pending)
- **Army**, EP 385-1-96
- **Navy and Marine Corps**, OPNAVINST 5100.23G

3-3 TELECOMMUNICATIONS.

Coordinate the distribution of voice and data lines with the workstation and office layout and with installation communications personnel. Determine if accommodating a wireless network for data transfer is a requirement. All networks must meet the applicable Department of Defense and Service component information assurance certification and accreditation processes.

3-4 ELECTRONIC SECURITY SYSTEMS (ESS).

Determine electronic security systems requirements for providing ESS for access control, intrusion detection, and closed-circuit television (CCTV). If required, these systems protect personnel, equipment, and other assets. Provisions for alarm systems and access control features must be justified during the planning/programming process and included in project costs.

3-5 ALTERATIONS TO EXISTING FACILITIES.

Special attention must be given to selecting suitable existing facilities for adaptation to administrative functions. In retrofit projects, the column spacing, floor depth, and building configuration is already established. If the selected building or space has inefficient key elements such as floor depth and bay spacing, fewer workstations and office layouts can be accommodated than were planned for based solely on the gross area. In other words, inefficiency in building configuration and layout increases the circulation and net-to-gross multipliers so that fewer personnel can occupy the same gross building area when compared to efficiently designed facilities. The layout and capacity of existing electrical, communications, and other building distribution systems may also limit the feasibility and flexibility of the layout. Alteration and renovation projects must update existing facilities to meet the guidance and criteria in this UFC.

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CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-1 DESIGN AND SPACE PLANNING.

The following are design parameters to incorporate in determining space calculations and program requirements for administrative facilities.

4-1.1 Recognizing and Planning for Different Work Modes.

Workplace design has evolved from static spaces to dynamic, interconnected spaces comprised of a variety of work modes. The designer must acknowledge and identify the various work modes within an organization: Focused, Learning, Collaborative and Social. All of these are present whether private offices or open office spaces are planned.

4-1.1.1 Focused Work Mode.

Focused spaces are enclosed offices or open office workstations that provide visual or auditory privacy from other workstations. Personnel are usually doing heads-down work and require few distractions to be productive. These need to be located away from the busy circulation areas and meeting spaces.

4-1.1.2 Learning Work Mode.

Learning spaces are conference rooms, training rooms or classrooms where a group of people gather for information sharing or instruction. These spaces must have limited distractions and are usually enclosed. Glazed walls are beneficial for daylighting, however not ideal for projection, video display and distractions.

4-1.1.3 Collaborative Work Mode.

Collaborative spaces, enclosed or not, are where a group of people can interact on the task. These gathering spaces can range from being as structured as a conference room, to a collaborative area of the offices that has low or no barriers between workstations, to as simple as an impromptu gathering around a central files counter or a lounge area for relaxing the body and mind. Consider a variety of collaborative spaces within a workplace for choices to support appropriate levels of visual and acoustic privacy and physical comfort. Consider providing communication, data, and electrical outlets for multiple users.

In some organizations, collaboration happens within the open office areas when workstations are designed for teams that regularly collaborate.

4-1.1.4 Social Work Mode.

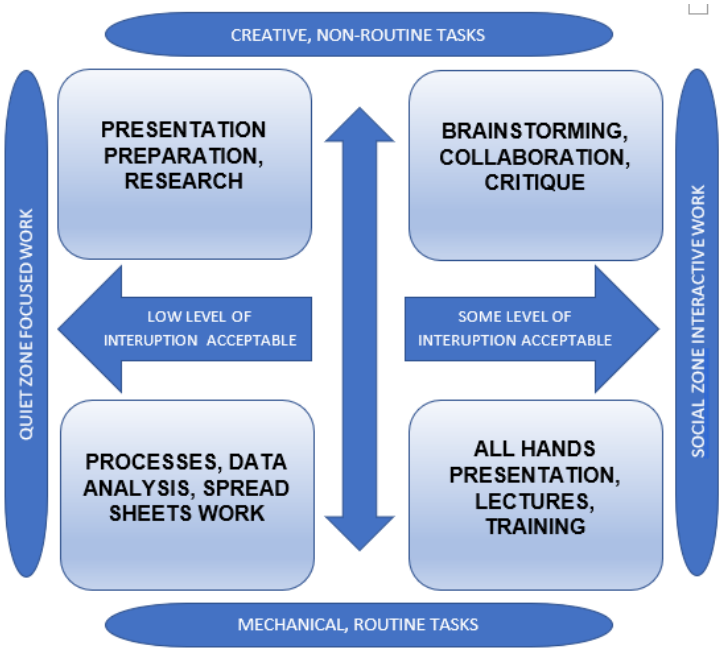
Socialization happens in variety of settings whether in breakrooms, coffee nooks or collaboration spaces. A group of people may interact on a daily basis and may require a social configuration of workspaces to facilitate communication. Social workspaces would also accommodate transactional operations within an organization. Locate

appropriately designed spaces away from focused workspaces to reduce distraction and help with worker productivity.

4-1.2 Zoning Work Activities.

In space planning for administrative facilities, proper zoning of work activities can significantly influence the quality of noise control and increase worker productivity and satisfaction. Organizational adjacency requirements may or may not be consistent with the following Figure 4-1. The design must reach a balance of interaction, separation and acoustic control.

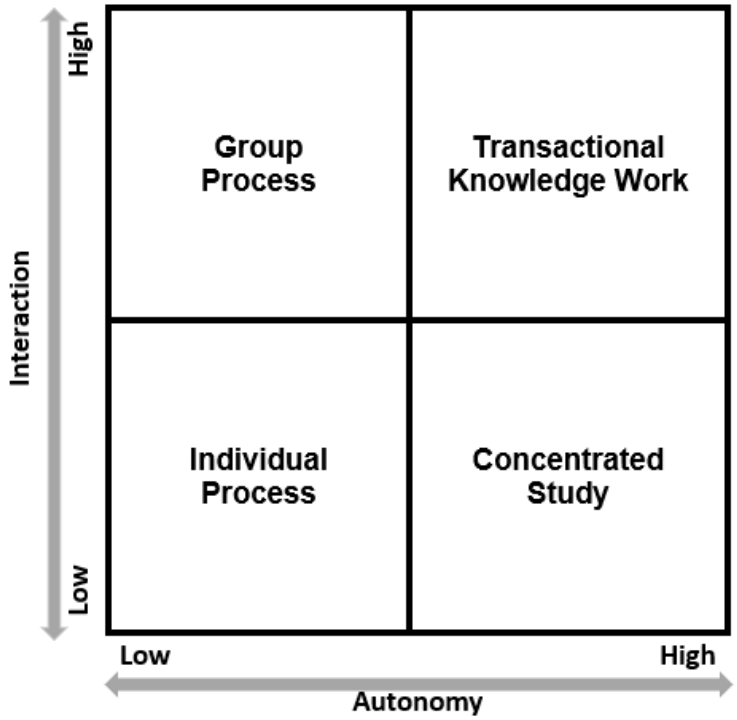
Figure 4-1 Zoning Work Activities



4-1.3 Choice of Workspace.

Plan a variety of spaces and flexible work areas where workers can move to for specific purposes or for the “change of scenery” effect. For example, Lounge spaces or alternate workstations are useful and can double as collaboration spaces. Choice of workspace also includes appropriate levels of autonomy and interaction required for work activities. Choice and flexibility can increase worker productivity and satisfaction when used properly. This also becomes part of the culture of the organization and must be managed.

Figure 4-2 Choice of Workspace



4-2 SPACE UTILIZATION AND MANAGEMENT.

4-2.1 Right-Sizing Spaces and Circulation.

Right-Sizing spaces, offices, workstations, conference and collaboration, is a method to utilizing space efficiently. For example, it is inefficient to provide a 200 square foot (18.6 square meter) private office when the only furniture required is a desk, credenza, and task and guest chairs. We are not a paperless society yet, however, filing and book storage requirements are typically less than they used to be. Space within an office or workstation previously required for paper storage has been replaced by technology requirements such as multiple computer displays. Design to the functional requirements of each worker or space and not to their position in the organization. Realistic circulation allowances also provide efficiencies in space utilization and productivity.

4-2.2 Flexibility and Modularity.

Design the interior of Administrative Facilities for flexibility of use. Maximize the use of an open floor plan and provide well-designed furniture systems that will allow adjustments to workspace to meet job functional requirements and ergonomic needs. Minimize the use of private offices and fixed partitions to the degree possible. This increases the number of personnel that can be accommodated within the space as well as allows more flexibility in reconfiguring the space. Also, minimize the number of different workstation and offices sizes. Use workstation and office sizes with a common

dimension to facilitate grouping stations and or offices of different sizes. This will ease the planning process and provide greater flexibility in the final design.

4-2.3 Multi-Purpose Uses.

Design spaces with compatible multi-functional features. Utilizing operable partitions in adjacent conference spaces and break rooms would provide rooms for small or large gatherings such as all staff meetings or events.

Conference spaces must have modular furniture reconfigurable for different types of purposes such as presentations, instruction or collaboration. Larger conference spaces and classrooms must have auxiliary storage nearby for storing folding or nesting tables and chairs, mobile screens and marker boards. **1**\

4-2.4 Teleworking, Office and Workstation Sharing.

Many organizations allow employees to work outside the office, or the position requires a certain amount of teleworking. Determine workstation or office requirements based on the amount of time these workers are physically in the office. Offices that participate in a robust teleworking program where employees routinely telework at least three scheduled days per week may consider reducing the number of individually assigned workstations and utilize shared workstations. Instead of providing one workstation for each individual, consider providing one workstation for every two regularly scheduled teleworkers. Consider technology and connectivity requirements in these spaces. Ensure that workstations or offices are designed with a high degree of adjustability to properly accommodate the different users. Consider the use of freestanding, electric, height-adjustable primary worksurfaces with or without modesty panels and attached privacy/sanitary screens to maintain the safety of nearby occupants. Secure, individually assigned lockers, file drawers, bins, mobile pedestals and other types of storage units may be required for storage of personal and work-related items used while in the office. Consider teleworking, office and workstation sharing as a space planning strategy when programming administrative facilities to minimize space requirements, construction costs and operating costs. To be effective in achieving measurable scope and cost savings, this planning strategy must be applied during the DD1391 project development process.

4-2.4.1 Situational Teleworking.

Situational telework is approved on a case-by-case basis, where the hours worked are NOT part of a previously approved, ongoing and routine telework schedule. Examples of situational telework include telework as a result of inclement weather, personal appointments, special work assignments, and is sometimes referred to as episodic, intermittent, unscheduled, or ad-hoc telework.

4-2.4.2 Routine Teleworking.

Routine telework is telework that occurs as part of an ongoing, regular schedule, occurring *up to two scheduled days per week*. The frequency of routine telework is determined by each individual Command.

4-2.4.3 Robust Teleworking.

Robust telework is a type of routine teleworking where workers regularly telework *at least three scheduled days per week*. The frequency of robust telework is determined by each individual Command. Where Commands authorize a robust teleworking program, flex workstations and office sharing may be implemented.

4-2.5 Office and Workstation Sharing.

A shared office or workstation, often referred to as a flex workstation, utilizes a "buddy system" for sharing an office or workstation between two or more persons if Command telework policy allows, and if individual work schedules can be aligned to accommodate. Shared office and workstation policy is determined by each individual Command.

4-2.6 Hoteling.

/**1**/Hoteling is an office management strategy that considers certain office resources, such as workspaces and equipment, to be shared assets, rather than assets 'owned' or dedicated to specific individuals within an organization. By sharing assets between personnel, an organization can optimize the efficiency of their offices; reduce their space requirements and operating costs by accommodating more people in the same space. Hoteling is typically characterized by reservation and check-in processes.**1**\ When planning office hoteling areas, consider the need for different Work Modes as described earlier in this chapter. /**1**/Consider hoteling as a space planning strategy when programming administrative facilities to minimize space requirements, construction costs and operating costs. To be effective in achieving measurable scope and cost savings, this planning strategy must be applied during the DD1391 project development process.

4-2.7 Command Suite.

The command suite is an office area that houses a Commanding Officer of an installation or activity or a Grade O7 or equivalent with command authority. It is typically an enclosed suite consisting of private offices, administrative support, special purpose spaces, and a secure entry point. The command suite typically includes the following spaces, but other spaces may be provided based on specific tenant needs (actual spaces to be provided and position titles vary by Service and mission):

- Commanding Officer's (CO) office,
- Deputy Commander/Executive Officer's office,
- Chief of Staff's office,
- Command Noncommissioned Officer's office,
- Visitor's office,
- Reception/waiting area,
- Aides' offices,
- Administrative support,
- Coffee Nook or Kitchenette and
- Conference room.

For details on the individual spaces, see the appropriate FDS Tables in Chapter 4. In general, finishes will be of a higher quality and tailored to meet the level of importance or rank of the suite's occupants.

4-3 FUNCTIONAL DATA SHEETS.

The Functional Data Sheets provide the minimum requirements for the respective rooms and spaces for the designer, planner, or RFP preparer. These minimum requirements apply in addition to the requirements of this criteria document and the referenced documents. This chapter identifies minimum and specific design requirements for the most common functional areas associated with Administrative Facilities. Not all of these spaces may be required in an administrative facility. Conversely, additional spaces with specialized functions may be required, depending on the organization's function and mission requirements.

4-3.1 Interior Construction/Built-in Equipment.

The Interior Construction/Built-in Equipment category includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window shades or blinds, and recessed projection screens.

4-3.2 Furnishings and Equipment.

The Furnishings and Equipment category includes loose or moveable items that have no permanent connection to the structure of a building, or utilities such as desks, chairs and tables, and cabinets.

4-3.3 Table Format and Usage.

The following tables provide this data in a standard Functional Data Sheet. Items enclosed in brackets [xx] are potential anticipated requirements. On design-build projects, the RFP preparer must either select from these bracketed items or include other specific requirements in the RFP. Where the requirements in a design-build RFP differ from this UFC, the RFP content takes precedence. "As required" designates there are no additional specific requirements other than the requirements in UFC 1-200-01 and the core UFCs.

Table 4-1 Private Office

Description/ Usage	Provide enclosed space for one person with visual and/or acoustic privacy based on assignment or functional requirements.
Ceiling Height	9 ft. (2.7 m) minimum.

Windows	Provide daylighting.
Doors	Door with minimum 35 STC rating or as required. Privacy lock or passage set.
Interior Construction / Built-in Equipment	Provide markerboard, changeable room signage acoustical treatment [demountable partitions].
Finishes	**Walls** Painted gypsum wallboard or demountable partitions extended from finished floor to suspended ceiling; for higher privacy requirements, extend partitions to structure. Minimum 40 STC.
	Floor Carpet tile with attached cushion, low maintenance, rated for heavy traffic.
	Base Rubber wall base [Wood base].
	Ceiling SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide two quad electrical receptacles on separate walls or as needed to support the required equipment.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data Provide a minimum of two lines/outlets or more to support the required equipment.
	CATV As required by organization function or mission.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide a minimum 40-45 STC depending on occupant privacy requirements.
Furnishings and Equipment	Office desk/workstation, ergonomic task chair, filing and book storage, task lighting, [wardrobe], two guest chairs. Consider the use of freestanding, electric, height-adjustable primary worksurface with attached modesty panel.
Special Requirements	As required by organization function or mission. May be an executive private office as part of a command suite and require upgraded finishes.

Adjacencies / Location within Facility	As required by organization function or mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table 4-2 Semi-Private Office

Description/ Usage	Provide enclosed space for two or more persons with visual and/or acoustic privacy based on assignment or functional requirements
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	Provide daylighting.
Doors	Door with minimum 35 STC rating or as required. Privacy lock or passage set. Lock if required.
Interior Construction / Built-in Equipment	Provide marker board, changeable room signage, demountable partitions.
Finishes	**Walls** Painted gypsum wallboard or demountable partitions, extended from finished floor to suspended ceiling. Minimum 40 STC.
	Floor Carpet tile with attached cushion; low maintenance, rated for heavy traffic.
	Base Rubber wall base.
	Ceiling SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide a quad electrical receptacle per person or as needed to support the required equipment.
Lighting	Provide general and task lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication per person.
	Data As required.
	CATV As required by organization function or mission.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide a minimum of 40 STC.
Furnishings and Equipment	Office desks or workstations, ergonomic task chairs, filing and book storage, task lighting, [wardrobes], one guest chair per person or as required. [Collaboration table/space]. Consider the use of freestanding, electric, height-adjustable primary worksurface with attached modesty panel.
Special Requirements	As required by organization function or mission.
Adjacencies / Location within Facility	As required by organization function or mission. Command Suites require upgraded finishes and appurtenances.

	For Use during project execution by appropriate Service
Occupancy	Staff
	Other
Min. net Ft^2 (m^2)	

Table 4-3 Open Office – Full Time Staff

Description/ Usage	Open office space for full-time staff includes systems furniture workstation clusters, filing and storage, and informal meeting spaces. \1\ For Navy and Marine Corps projects, this space usage corresponds with Workstation Type 1 (WST1) in UFC 2-000-09N, Series 600, Table 61010-5.1 /1/
Ceiling Height	10 ft. (3.0 m) minimum.
Windows	Provide daylighting.
Doors	Provide doors at the perimeter walls of the open office space.
Interior Construction / Built-in Equipment	Interior wayfinding and workstation signage, marker boards, tack boards, bulletin display cases, casework, [acoustic treatment to aid in noise control] [demountable partitions].
Finishes	**Walls** Painted gypsum wallboard or demountable partitions of varying materials for various levels of visual and acoustical privacy.
	Floor Carpet tile with attached cushion for noise reduction; low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC with high Articulation Class (AC) and Noise Reduction Coefficient (NRC) ratings.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide multiple circuits to the space to connect systems furniture workstations to building power. Exposed wiring is [and power poles are] not allowed. Plan power capacity for a minimum of four receptacles per person per workstation, or as required.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication per person. Coordinate communication distribution through the systems furniture and as required.
	Data Provide one outlet per staff unless multiple systems are required. Provide additional outlets for each printer, copier, scanner, shredder, and other similar equipment. Coordinate data distribution through the systems furniture and as required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV As required by organization function or mission.
Acoustics	Provide acoustical treatment in accordance with ASTM E1130-16 for open office spaces.

Furnishings and Equipment	Provide workstations sized for staff assignments and functionality; ergonomic task seating, guest seating, task lighting, lateral file cabinets, counter-height work/storage/meeting islands for files and supplies. Provide worksurfaces for printers, scanners, and other equipment as required to be used in the open office area. Consider the use of freestanding, electric, height-adjustable primary worksurface with attached modesty panel.
Special Requirements	Coordinate telecom and data distribution, equipment, and connection points requirements with workstation configurations and open office layouts.
Adjacencies / Location within Facility	As required by organization function or mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table 4-4 Private Flex Office

Description/ Usage	Private office space set aside for intermittent use by transient or teleworking staff or visiting dignitaries occasionally needing space in the office.**1**\ Offices may be shared by two or more persons depending on individual work schedules and demand./**1**/
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	Provide daylighting.
Doors	Door with minimum 35 STC rating or as required. Privacy lock or passage set.
Interior Construction / Built-in Equipment	Provide markerboard, changeable room signage [demountable partitions].
Finishes	**Walls** Painted gypsum wallboard or demountable partitions, with varying materials for various visual and auditory privacy. Extend from finished floor to suspended ceiling. Minimum 40 STC.
	Floor Carpet tile with attached cushion, low maintenance, rated for heavy traffic.
	Base Rubber wall base.
	Ceiling SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide two quad electrical receptacles on separate walls or as needed to support the required equipment.
Lighting	Provide general and task lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data Provide a minimum of two lines/outlets or more to support the required equipment.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide a minimum of 40 STC.
Furnishings and Equipment	Office desk, ergonomic task chair, filing and book storage, task lighting, [wardrobe], two guest chairs, [small meeting table]. Consider the use of freestanding, electric, height-adjustable primary worksurface with attached modesty panel. **1**\ Provide individual, lockable storage units for daily storage of personal items. /**1**/
Special Requirements	As required by organization function or mission. If located in a Command Suite, provide upgraded finishes and appurtenances.

Adjacencies / Location within Facility	As required by organization function or mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table 4-5 Open Office – Flex Staff

Description/ Usage	Open office space set aside for intermittent use by transient or teleworking staff occasionally in the office. Includes systems furniture workstation clusters, informal meeting spaces. **\1** For Navy and Marine Corps projects, this space usage corresponds with Workstation Type 2 (WST2) in UFC 2-000-09N, Series 600, Table 61010-5.1 **/1/**
Ceiling Height	10 ft. (3.0 m) minimum.
Windows	Provide daylighting.
Doors	Provide doors at the perimeter walls of the open office space.
Interior Construction / Built-in Equipment	Wayfinding and workstation signage, marker boards, tack boards, bulletin display cases [demountable partitions].
Finishes	**Walls** Painted gypsum wallboard; demountable partitions of varying materials for various levels of visual and acoustical privacy.
	Floor Carpet tile with attached cushion for noise reduction; low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC with high Articulation Class (AC) and Noise Reduction Coefficient (NRC) ratings.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide multiple circuits to the space to connect systems furniture workstations to building power. Exposed wiring is [and power poles are] not allowed. Plan power capacity for a minimum of four receptacles per flex workstation or as required.
Lighting	Provide general and task lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication per person.
	Data Provide one outlet per staff unless multiple systems are required. Provide additional outlets for each printer, copier, scanner, shredder, and other similar equipment.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide acoustical treatment in accordance with ASTM E1130-16 for open office spaces.
Furnishings and Equipment	Provide desks or workstations, sized for staff assignments and functionality; ergonomic task seating, guest seating, lateral file cabinets, counter-height work/storage/meeting islands for files and

	supplies. Consider the use of freestanding, electric, height-adjustable primary worksurface with attached modesty panel. **\1** Provide individual, lockable storage units for storage of personal items for day use. **/1/** Provide worksurfaces for printers, scanners, and other equipment as required to be used in the open office area.
Special Requirements	Coordinate telecom and data distribution, equipment, and connection points requirements with workstation configurations and open office layouts.
Adjacencies / Location within Facility	As required by organization function or mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table 4-6 Vestibule

Description/ Usage	Airlock enclosure at the entrance to a building. Building security may be performed in this space.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	As required.
Doors	Exterior and interior double doors.
Interior Construction / Built-in Equipment	Recessed entrance mat, soil collection; interior signage, [wall protection].
Finishes	**Walls** Durable, easily maintained walls of [painted gypsum wallboard,] [split faced CMU], [clay masonry], [porcelain tile].
	Floor Durable, weather-resistant material, such as ceramic tile or vinyl tile, rated for severe traffic.
	Base: Resilient or tile to match floor material.
	Ceiling Durable, humidity-resistant material ,such as acoustic tile or painted gypsum wallboard.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide a minimum of one outlet, additional as required.
Lighting	Provide general lighting.
Telecommunications	**Telephone** As required if building security to be managed in this space.
	Data As required if building security to be managed in this space.
	CATV None required.
Security	**IDS** As required.
	ACS As required.
	CCTV As required.
Acoustics	As Required.
Furnishings and Equipment	None required.
Special Requirements	None required.
Adjacencies / Location within Facility	Where applicable, locate controlled entry, quarterdeck, watch, reception, waiting room, or secure visitor spaces near the entrance vestibule.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table 4-7 Reception and Waiting

Description/ Usage	Space or Room at organization entrance to receive visitors, usually staffed. Building security may be performed at reception via a check point. May include a seating area for visitors. May be an entry into a Command Suite.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	As required.
Doors	As required.
Interior Construction / Built-in Equipment	[Built-in reception desk], [organization directory], [command board,] [enclosed bulletin board,] interior signage [demountable partitions].
Finishes	**Walls** Painted Gypsum wallboard or demountable partitions, accent/feature wall.
	Floor Carpet [tile,] [, broadloom,] [porcelain tile,] or luxury/solid vinyl tile; low maintenance, rated for severe traffic.
	Base Rubber wall base {Wood base] or base to match/coordinate with flooring.
	Ceiling SAPC, [mid-quality], [high quality], [decorative] ceiling.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	As required. Provide a minimum of one quad outlet at reception desk.
Lighting	Provide general, decorative and task lighting.
Telecommunications	**Telephone** Provide a minimum of one line with internal two-way communication.
	Data Provide an outlet at reception desk, [electronic directory] [flat screen monitor] or as required.
	CATV As required.
Security	**IDS** As required.
	ACS As required.
	CCTV As required.
Acoustics	As required.
Furnishings and Equipment	As required by organization function or mission. [Reception desk, ergonomic task seating, guest seating, display units for literature, memorabilia, artwork, lamps, flags].
Special Requirements	As required by organization function or mission. May require electronic storage lockers for cell phones. Command Suites require upgraded finishes and appurtenances.

Adjacencies / Location within Facility	Vestibule, entrance, main corridor, waiting.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table 4-8 Mail Center

Description/ Usage	Room for processing and distribution of the facility's incoming and outgoing mail and parcels.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	As required.
Interior Construction / Built-in Equipment	Built-in solid surface counters and plastic laminate wall and base cabinets (if not freestanding mailroom products) for equipment and supplies, marker boards, interior signage, mailboxes.
Finishes	**Walls** Painted gypsum wallboard.
	Floor Luxury/solid vinyl tile or rubber tile; low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general and dedicated outlets as needed for the required equipment.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data As required to support equipment and staff.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide a minimum STC of 40.
Furnishings and Equipment	As required by Installation authority for mail delivery, sorting, packaging, and distribution. Provide counters and cabinets for equipment and work area and storage for supplies. [Provide workstation, ergonomic task chair, personal storage.]
Special Requirements	May accommodate screening requirements.
Adjacencies / Location within Facility	Direct access to Shipping and Receiving or as required by organization function and mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table 4-9 Shipping and Receiving

Description/ Usage	Accommodates loading and unloading of supplies and services necessary for the operation of the facility.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Exterior entrance not visible from the front entrance.
Interior Construction / Built-in Equipment	Interior signage, [wire cages,] [pallet/heavy duty shelving].
Finishes	**Walls** Painted Gypsum wallboard, CMU or other highly durable, impact resistant wall construction [wall protection].
	Floor Sealed concrete [resinous epoxy flooring].
	Base Rubber wall base.
	Ceiling Exposed structure, [SAPC].
Plumbing	As required. [water fountain with bottle filler], [utility sink].
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets as needed to support required equipment.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data As required to support equipment.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	As required.
Furnishings and Equipment	As required by Installation authority for delivery, staging and distribution. Provide shelving, forklifts, carts, and hand trucks as required. [Provide counters and cabinets.] [Provide workstation, ergonomic task chair, personal storage.]
Special Requirements	May accommodate screening requirements. May require loading dock, covered access, or sized to accommodate trucks inside.
Adjacencies / Location within Facility	Direct access to Mail Room and freight elevator in multi-story facilities or as required by organization function and mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other

Min. net Ft^2 (m^2)	

Table 4-10 Trash and Recycling Room

Description/ Usage	Provides a collection point for trash and recyclable materials such as glass, plastic, aluminum, and paper. Size and number of rooms based on size and configuration of facility.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	As required.
Interior Construction / Built-in Equipment	Interior signage.
Finishes	**Walls** Painted Gypsum wallboard [wall protection].
	Floor Sealed concrete, [Luxury/solid vinyl tile; low maintenance, rated for severe traffic].
	Base Rubber wall base.
	Ceiling Exposed Structure, [SAPC].
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets.
Lighting	Provide general lighting.
Telecommunications	**Telephone** None required.
	Data None required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	None required.
Furnishings and Equipment	Trash and recycling receptacles; sized and marked appropriately for central and/or remote location within the facility.
Special Requirements	Coordinate with agency for trash and recycling procedures.
Adjacencies / Location within Facility	Main trash/recycling area is adjacent to the shipping/receiving area where recyclables from the floors can be consolidated and stored for pick-up. In multistory buildings, locate remote trash/recycling areas adjacent to break rooms, copy rooms, vending, and other similar areas.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other

Min. net Ft^2 (m^2)	

Table 4-11 Large Format Production Room

Description/ Usage	Provides space for a large, production-quality copy machine and/or for staff to design and assemble reports, brochures, and informational pamphlets. It must be conducive to computer-based design work and have space for document production and pallet-based paper storage
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Door(s) with a minimum 35 STC rating.
Interior Construction / Built-in Equipment	Built-in solid surface counters and plastic laminate wall and base cabinets for equipment and storage, marker boards, tack boards, acoustic treatment, interior signage.
Finishes	**Walls** Painted gypsum wallboard, extend partitions from finished floor to structure above.
	Floor Luxury/solid vinyl tile or rubber tile; low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC.
Plumbing	None required.
HVAC	As required to support staff and equipment.
Fire Protection and Life Safety	As required.
Power	As required to support staff and equipment.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication or additional as required.
	Data Provide outlets to support staff and equipment required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide a minimum of STC 40.
Furnishings and Equipment	Work tables, workstations for staff, ergonomic task seating, cabinets and carts for material storage and handling, storage cabinets for supplies.
Special Requirements	May have additional HVAC and power requirements due to size and function of production equipment.
Adjacencies / Location within Facility	As required by organization function and mission.
	For Use during project execution by appropriate Service

Occupancy	Staff
	Other
Min. net Ft^2 (m^2)	

Table 4-12 Break Room

Description/ Usage	Staff-only space used for breaks and lunches to accommodate storage, vending, warming, and minimal preparation of food. Provide a comfortable space with tables and chairs.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	Provide exterior views.
Doors	Door(s) with minimum 35 STC rating or as required.
Interior Construction / Built-in Equipment	Built-in plastic laminate wall and base cabinets with solid surface countertops, marker boards, tack boards, interior signage.
Finishes	**Walls** Painted gypsum wallboard, [wall protection or wainscot]. Provide cleanable wall finish above counter, such as solid surface or ceramic tile.
	Floor Luxury/solid vinyl tile or porcelain tile; low maintenance, rated for severe traffic.
	Base Rubber or tile wall base to match/coordinate with flooring.
	Ceiling SAPC with a high CAC rating.
Plumbing	Provide for sink, hot and cold water, plumbed appliances.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and as required for appliances and vending.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data As required.
	CATV As required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide a minimum STC 45.
Furnishings and Equipment	Coffee maker(s), microwave(s), undercounter or full-size refrigerator(s), café tables, chairs, trash/recycle bins.
Special Requirements	May double as a touch-down space with power/data connectivity or for informal meetings and collaboration. May include vending within break room. May require a full kitchen with stove for 24/7 operations. If located in a Command Suite, provide upgraded finishes and appurtenances.
Adjacencies / Location within Facility	As required for organization function and mission. Locate near vending and conference spaces.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table 4-13 Break Area

Description/ Usage	Staff-only space used for breaks and lunches to accommodate storage, warming and minimal preparation of food.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	None required.
Interior Construction / Built-in Equipment	Built-in plastic laminate wall and base cabinets with solid surface countertops, marker boards, tack boards, interior signage [demountable partitions].
Finishes	**Walls** Painted Gypsum wallboard or demountable partitions, [wall protection]. Provide a cleanable finish surface above counter such as solid surface or ceramic tile.
	Floor Luxury/solid vinyl tile or porcelain tile; low maintenance, rated for severe traffic.
	Base Rubber or tile wall base.
	Ceiling SAPC.
Plumbing	Provide for sink, hot and cold water, plumbed appliances.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	As required for appliances.
Lighting	Provide general lighting.
Telecommunications	**Telephone** None required.
	Data None required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	As required.
Furnishings and Equipment	Coffee maker(s), microwave(s), undercounter or full-size refrigerator(s), trash/recycling bins.
Special Requirements	If located in a Command Suite, provide upgraded finishes and appurtenances.
Adjacencies / Location within Facility	As required for organization function and mission. May be placed near large open office areas, near mail/copy rooms or near conference spaces.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other

Min. net Ft^2 (m^2)	

Table 4-14 Nursing Mothers Room

Description/ Usage	Nursing and lactation room, shielded from view and free from intrusion by others.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Door with minimum 35 STC, privacy lock.
Interior Construction / Built-in Equipment	Provide solid surface counter and plastic laminate base cabinets for minimal storage, full-length mirror, coat hooks, tack board, interior signage with occupancy indicator.
Finishes	**Walls** Painted gypsum wallboard, minimum eggshell finish.
	Floor Hard or resilient flooring such as luxury/solid vinyl tile; low maintenance, rated for severe traffic, suitable for regular mopping and sanitizing.
	Base Rubber wall base.
	Ceiling SAPC.
Plumbing	Provide a small utility type sink with hot and cold water with high neck faucet.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets for breast pump and other items, GFCI at sink.
Lighting	Provide general and decorative, dimmable lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication convenient to chair and counter.
	Data Provide one line.
	CATV As required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide minimum STC 35.
Furnishings and Equipment	Comfortable chair with worksurface for lactation equipment, trash receptacle, refrigerator with freezer section for breast milk storage, [microwave for sterilization,] clock.
Special Requirements	Reference GSA PBS-P100 and ECB 2019-4 for multi-station lactation room requirements.
Adjacencies / Location within Facility	Toilets.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table 4-15 Toilet Room

Description/ Usage	Toilet rooms are sized per code and occupancy and may be single or multiple fixture toilets. Toilets may be located within an organization's perimeter, or public toilets accessible through the building core.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Doors as required
Interior Construction / Built-in Equipment	Toilet compartment partitions and accessories, hand [and hair] dryers, built-in solid surface counters, interior signage.
Finishes	**Walls** Durable, low maintenance, water-resistant materials, such as porcelain tile.
	Floor Durable, low maintenance, water-resistant materials, such as porcelain tile, epoxy flooring.
	Base To match/coordinate with flooring.
	Ceiling Durable, humidity resistant material such as painted gypsum wallboard [or SAPC].
Plumbing	Sinks, toilets, urinals.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support required equipment such as hand dryers and hair dryers.
Lighting	Provide general and decorative lighting.
Telecommunications	**Telephone** None required.
	Data None required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	As required.
Furnishings and Equipment	Waste receptacles (if not included in construction).
Special Requirements	
Adjacencies / Location within Facility	Collocate with showers, locker rooms and fitness rooms.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table 4-16 Janitor's Closet

Description/ Usage	A janitor's closet accommodates equipment and supplies for the maintenance of the toilets and building. Usually part of the building core, it may be located within an organization's perimeter.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Doors as required.
Interior Construction / Built-in Equipment	Mop rack and shelving, interior signage.
Finishes	**Walls** Durable, low-maintenance, water-resistant materials, such as fiberglass reinforced wall panel, stainless steel, or porcelain tile.
	Floor Durable, low-maintenance, water-resistant materials, such as porcelain tile, epoxy flooring.
	Base To match/coordinate with flooring.
	Ceiling Durable, humidity-resistant material, such as painted gypsum wallboard [or SAPC].
Plumbing	Mop basin, [Utility sink].
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support required equipment.
Lighting	Provide general lighting.
Telecommunications	**Telephone** None required.
	Data None required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	As required.
Furnishings and Equipment	Waste receptacles (if not included in construction).
Special Requirements	May be incorporated inside toilets or locker rooms as required.
Adjacencies / Location within Facility	Collocate with toilets, locker rooms, shower rooms.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table 4-17 Locker Room

Description/ Usage	Space or room for staff to store and secure personal items in condensed open office areas, or for transient/teleworking staff periodically in the office. May be used in conjunction with shower rooms and fitness rooms.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	None required.
Interior Construction / Built-in Equipment	Built-in locker system, plastic laminate, phenolic, metal or composite finish, interior signage, demountable partitions.
Finishes	**Walls** Painted gypsum wallboard or demountable partitions.
	Floor Carpet tile with attached cushion, rubber or porcelain tile or luxury/solid vinyl tile; low maintenance, rated for severe traffic.
	Base Rubber or tile wall base.
	Ceiling Durable, humidity-resistant material ,such as painted gypsum wallboard [or SAPC].
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	As required.
Lighting	Provide general lighting.
Telecommunications	**Telephone** None required.
	Data None required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	As required.
Furnishings and Equipment	Provide freestanding day locker system (if not included in construction).
Special Requirements	Consider providing power ports for charging devices.
Adjacencies / Location within Facility	Locate near open office space, break rooms, fitness rooms.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table 4-18 Shower Room

Description/ Usage	Single or Multi-user shower space, if fitness or wellness areas are not nearby.
Ceiling Height	9 ft. (2.7 m) minimum
Windows	None required.
Doors	Doors as required
Interior Construction / Built-in Equipment	Shower partitions and accessories, hand and hair dryers, built-in benches and solid surface counters, interior signage.
Finishes	**Walls** Durable, low maintenance, water-resistant materials, such as porcelain tile.
	Floor Durable, low maintenance, water-resistant materials, such as porcelain tile, epoxy flooring.
	Base To match/coordinate with flooring
	Ceiling Durable, humidity-resistant material ,such as painted gypsum wallboard or SAPC].
Plumbing	Showers, sinks, [toilets].
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support required equipment, such as hand dryers and hair dryers.
Lighting	Provide general and decorative lighting.
Telecommunications	**Telephone** None required.
	Data None required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	As required.
Furnishings and Equipment	Waste receptacles (if not included in construction), shower curtains, benches.
Special Requirements	May be incorporated inside toilets or locker rooms as required.
Adjacencies / Location within Facility	Collocate with toilets, locker rooms, fitness rooms.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table 4-19 Fitness Room

Description/ Usage	Optional area with several fitness machines for staff use, if fitness or wellness facilities are not nearby.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	Provide an interior window to the corridor at 42 in. (1.07 m) above finished floor, a minimum of 36 in. (0.91 m) high and a minimum of 10 sq. ft. (0.93 sq. m.) total window area.
Doors	Lockable entrance door with a vision panel.
Interior Construction / Built-in Equipment	Provide a minimum of one wall- or ceiling-TV mount. Provide an 8 ft. (2.4 m) high mirror covering one full wall. interior signage.
Finishes	**Walls** Painted gypsum board, double layer (impact side).
	Floor Durable, low maintenance, resilient seamless rubber sheet flooring.
	Base Rubber wall base.
	Ceiling Durable, humidity-resistant material, such as SAPC or painted gypsum wallboard.
Plumbing	Provide an electric water cooler with bottle filler.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and properly sized and placed outlets to support required equipment. Provide outlet(s) for wall- or ceiling-mounted televisions.
Lighting	Provide general and decorative lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data None required.
	CATV Provide outlets for wall- or ceiling-mounted TV(s). Coordinate with selected fitness equipment to accommodate equipment with built-in or attached TV(s).
Security	**IDS** None required.
	ACS None required.
	CCTV Provide outlets for full cameral coverage.
Acoustics	Provide partition construction with a minimum STC rating of 52.
Furnishings and Equipment	Waste and recycling receptacles (if not included in construction), benches.
Special Requirements	
Adjacencies / Location within Facility	Collocate with toilets, locker rooms, shower rooms.

	For Use during project execution by appropriate Service
Occupancy	Staff
	Other
Min. net Ft^2 (m^2)	

Table 4-20 Auditorium

Description/ Usage	Auditoriums accommodate 50 or more people for large presentations, ceremonies or distance learning.
Ceiling Height	Varies with size and function of auditorium space.
Windows	Not required.
Doors	Doors with minimum 50 STC rating or as required.
Interior Construction / Built-in Equipment	Tiered floor with fixed seating [and lecture hall tables] and a stage or raised platform, [projection screens,] acoustic treatment, interior signage.
Finishes	**Walls** Structural partitions that extend from finished floor to structure above, acoustically engineered to support the room function.
	Floor Carpet tile with attached cushion or luxury/solid vinyl tile; low maintenance, rated for severe traffic; wood or simulated wood flooring for stage or raised platform.
	Base Rubber or wood wall base.
	Ceiling Provide an acoustically engineered ceiling system.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general and specialized power to support required equipment. May require floor receptacles to accommodate power requirements at seating [and fixed lecture hall tables].
Lighting	Provide general, decorative, and special lighting to support the functions of the room.
Telecommunications	**Telephone** Provide multiple lines with internal two-way communication as required. May require floor receptacles to accommodate telephone requirements at seating [and fixed lecture hall tables].
	Data Provide outlets to support the required equipment such as VTC, flat screen monitors, projector, and other similar equipment. May require floor receptacles to accommodate data requirements at seating [and fixed lecture hall tables].
	CATV As required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide STC 55 or greater.
Furnishings and Equipment	FF&E Package: Lecture hall tables and seating if not fixed and in construction.

	AV package: Flat screen monitors, projectors, screens, VTC systems, smart lectern, or as required.
Special Requirements	Provide an integrated, multi-disciplined design solution for effective acoustics, lighting, and audiovisual displays.
Adjacencies / Location within Facility	As required for organization function or mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table 4-21 Classroom/Training Room

Description/ Usage	Enclosed conference or training space for 30 - 50 people for flexible arrangements of conference and classroom settings. May be used for extended or daylong meetings, ceremonies, or distance learning.
Ceiling Height	10 ft. (3.0 m) minimum.
Windows	Not required.
Doors	Door(s) with minimum 35 STC rating or as required.
Interior Construction / Built-in Equipment	Provide marker boards, tack boards, projection [surfaces,] [screens,] Built-in casework for equipment or buffet; acoustic treatment, interior signage.
Finishes	**Walls** Painted gypsum wallboard. Provide partitions that extend from the finished floor to the structure above. Provide acoustical insulation in the partitions to achieve a minimum 50 STC rating.
	Floor Carpet tile with attached cushion; low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support the required equipment. May require floor receptacles to accommodate power requirements at the conference table.
Lighting	Provide multiple lighting solutions to include general lighting, accent lighting, and dimmable lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication, or as required. May require floor receptacles to accommodate telephone requirements at the conference table.
	Data Provide for computer, projection, flat monitor or lectern connectivity as required. May require floor-mounted receptacles to accommodate data requirements at the conference table.
	CATV As required by organization function or mission.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide STC 45 or greater.
Furnishings and Equipment	FF&E Package: Modular conference tables to be configured for conference, seminar or classroom settings with power and data connectivity; seminar chairs or swivel conference seating, [upholstered, flexible backs, casters] mobile marker boards.

	AV package: Flat screen monitors, projectors, screens, VTC systems, smart lecterns or as required.
Special Requirements	Presentation or VTC functions; instructional or distance learning; power and data connectivity.
Adjacencies / Location within Facility	As required for organization function or mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table 4-22 Conference/Training Room

Description/ Usage	Enclosed space for 10 - 30 people for meetings, presentations, training, and occasional social or ceremonial functions.
Ceiling Height	10 ft. (3.0 m) minimum.
Windows	None required.
Doors	Door with minimum 35 STC rating or as required.
Interior Construction / Built-in Equipment	Provide acoustic wall treatment to achieve the required acoustical performance in addition to wall construction. Provide marker boards, [projection screen,] interior signage.
Finishes	**Walls** Painted gypsum wallboard. Provide partitions that extend from the finished floor to the structure above. Provide acoustical insulation in the partitions to achieve a minimum STC of 50.
	Floor Carpet tile with attached cushion; low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC; provide a ceiling with a high Ceiling Attenuation Class (CAC) rating capable of reducing sound transmission.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support the required equipment. May require floor receptacles to accommodate power requirements at the conference table.
Lighting	Provide multiple lighting solutions to include general lighting, accent lighting and dimmable lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication, or as required. May require floor receptacles to accommodate telephone requirements at the conference table.
	Data Provide for computer, projection, flat monitor, or lectern connectivity as required. May require floor mounted receptacles to accommodate data requirements at the conference table.
	CATV As required by organization function or mission.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide STC 45 or greater.
Furnishings and Equipment	FF&E package: Conference table, swivel conference chairs, side seating, credenza for AV equipment, podium, artwork, [logos].

	AV package: Flat monitor(s), projector, screen, smart lectern, VTC system or equipment as required by the organization function and mission.
Special Requirements	For VTC, provide appropriately placed outlets, room dimensions, and furniture selection. Accommodate a built-in projector and projection screen if required. If located in a Command Suite, provide upgraded finishes and appurtenances.
Adjacencies / Location within Facility	As required by the organization function and mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table 4-23 Team/Collaboration Room

Description/ Usage	Enclosed space for 6-10 staff for meetings and collaboration.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	Not required.
Doors	Door with minimum 35 STC rating or as required.
Interior Construction / Built-in Equipment	Provide marker boards, tack boards, interior signage, acoustic treatment, [demountable partitions,] [projection screen].
Finishes	**Walls** Painted gypsum wallboard or demountable partitions, Minimum 45 STC.
	Floor Carpet tile with attached cushion; low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC; provide a ceiling with a high Ceiling Attenuation Class (CAC) rating capable of reducing sound transmission.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support the required equipment.
Lighting	Provide general and dimmable lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data Provide connectivity in this space as determined by the organization function and mission.
	CATV As required by organization function or mission
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide a minimum of 45 STC.
Furnishings and Equipment	FF&E package: Conference table for 6 -10 people, swivel conference chairs; or individual or group lounge seating for relaxed collaboration. AV package: Flat screen monitors, projectors, screens, VTC systems, or as required.
Special Requirements	May be used for small scale VTC room. If located in a Command Suite, provide upgraded finishes and appurtenances.
Adjacencies / Location within Facility	As required by the organization function and mission.

	For Use during project execution by appropriate Service
Occupancy	Staff
	Other
Min. net Ft^2 (m^2)	

Table 4-24 Focus Room

Description/ Usage	Enclosed space for 1-2 staff for privacy and collaboration.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	Not required.
Doors	Door with minimum 35 STC rating or as required.
Interior Construction / Built-in Equipment	Provide marker boards, tack boards, interior signage, acoustic treatment, [demountable partitions,] [clear and/or frosted glass partition(s)].
Finishes	**Walls** Painted gypsum wallboard or demountable partitions, Minimum 45 STC.
	Floor Carpet tile with attached cushion; low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC; provide a ceiling with a high Ceiling Attenuation Class (CAC) rating capable of reducing sound transmission.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support the required equipment.
Lighting	Provide general and dimmable lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data Provide connectivity in this space as determined by the organization function and mission.
	CATV As required by organization function or mission
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide a minimum of 45 STC.
Furnishings and Equipment	FF&E package: height-adjustable worksurface or table, 2 task or conference chairs; or individual or lounge seating for relaxed collaboration; task lighting, as required. Consider prefabricated focus room units. AV package: Flat screen monitors, as required.
Special Requirements	

Adjacencies / Location within Facility	As required by the organization function and mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table 4-25 General Filing and Storage Room

Description/ Usage	Storage of files, supplies, and equipment. Provide a separate lockable room for storage of sensitive or high-value equipment.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Doors with passage lock [access control].
Interior Construction / Built-in Equipment	Interior signage, [high density filing,] [plastic laminate clad wall and base cabinets with counters], [demountable partitions].
Finishes	**Walls** Painted gypsum wallboard or demountable partitions or as required depending on the agency and the level of security required.
	Floor Carpet tile with attached cushion, rubber tile or luxury/solid vinyl tile; low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC [Exposed structure].
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets.
Lighting	Provide general lighting.
Telecommunications	**Telephone** As required.
	Data As required.
	CATV As required.
Security	**IDS** As required.
	ACS As required.
	CCTV As required.
Acoustics	None required.
Furnishings and Equipment	Open utility shelving, file cabinets, or specialized storage systems as required by organization function and mission.
Special Requirements	Additional structural support for concentrated loads. ESS depending on security level.
Adjacencies / Location within Facility	As required by organization function and mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other

Min. net Ft^2 (m^2)	

Table 4-26 Technical Equipment Room

Description/ Usage	Room for specialized equipment specific to an organization's function and mission such as an IT laboratory/service shop, energy monitoring and control functions, or radio and equipment check out and charging.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Doors with minimum STC 35. Lockable for high value equipment.
Interior Construction / Built-in Equipment	As required for organization function and mission.
Finishes	**Walls** Painted gypsum wallboard or demountable partitions
	Floor Carpet tile with attached cushion or luxury/solid vinyl tile; [rubber tile,] [static dissipative tile,] low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC.
Plumbing	As required for organization function and mission.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support required equipment.
Lighting	As required.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data Provide general outlets and outlets to support required equipment.
	CATV Non required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide minimum STC 35.
Furnishings and Equipment	As required for organization function and mission.
Special Requirements	As required for organization function and mission.
Adjacencies / Location within Facility	As required for organization function and mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table 4-27 Controlled Entry/Quarterdeck

Description/ Usage	Secure space to control the access of personnel into a facility or area within the facility. May include display of flag or organizational memorabilia. May be staffed.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	As required.
Doors	Door(s) with integrated access control system in hardware.
Interior Construction / Built-in Equipment	Provide main facility signage and/or directory, chain of command board (if not in Lobby); [transaction window,] [entrance mat,] [casework,] [reception desk,] Interior signage, and as required by organization function or mission.
Finishes	**Walls** Painted gypsum wallboard [with architectural feature wall panel system using material such as acrylic, wood, metal or other upgraded durable panel material].
	Floor Provide low maintenance, durable flooring such as stone, terrazzo or porcelain tile. [provide carpet or luxury/solid vinyl tile with low maintenance, with severe wear rating.] Provide walk-off mat at entrance as an extension of the entrance vestibule.
	Base Resilient or tile to match/coordinate with floor material.
	Ceiling Durable, humidity resistant material such as acoustic tile or painted gypsum wallboard [metal,] [decorative,] [specialty ceiling].
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general electrical outlets and outlets to support required equipment. [Provide a minimum of a quad outlet at reception desk.]
Lighting	Provide general, decorative and task lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data Provide an outlet at reception desk, [electronic] [directory] [flat screen monitor] or as required.
	CATV As required.
Security	**IDS** As required by organization function or mission.
	ACS As required by organization function or mission.
	CCTV As required by organization function or mission.
Acoustics	As required.
Furnishings and Equipment	As required by organization function or mission. [Ergonomic task seating; reception desk, workstation, guest seating, flags, artwork, display cases.]

Special Requirements	May require a transaction counter or window or CCTV, speaker, phone for visibility or communication between visitor and personnel. May require adjacent bunkroom if a 24/7 facility.
Adjacencies / Location within Facility	Vestibule, main corridor, departmental entrance, reception, waiting.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table 4-28 Secure Visitor Space

Description/ Usage	Secure space for visitors to wait until received by personnel. Requirement for this space based on organization's function or mission.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	As required.
Doors	As required.
Interior Construction / Built-in Equipment	Interior signage.
Finishes	**Walls** Painted gypsum wallboard partitions.
	Floor Carpet tile with attached cushion or luxury/solid vinyl tile; low maintenance, rated for severe traffic.
	Base Rubber wall base.
	Ceiling SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets, or as required.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data Provide one outlet or as required.
	CATV
Security	**IDS** As required by organization function or mission.
	ACS As required by organization function or mission.
	CCTV As required by organization function or mission.
Acoustics	As required.
Furnishings and Equipment	Seating; occasional tables; lamps; artwork, display units for literature, bulletins, or memorabilia.
Special Requirements	As required by organization function or mission.
Adjacencies / Location within Facility	Vestibule, entrance, main corridor, reception.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other

Min. net Ft^2 (m^2)	

Table 4-29 SCIF

Description/ Usage	Sensitive Compartment Information Facility (SCIF); an accredited area, room, or group of rooms, where sensitive compartmentalized information is stored, used, discussed, or electronically processed
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Comply with UFC 4-010-05.
Interior Construction / Built-in Equipment	Acoustic treatment, interior signage, raised access flooring. Comply with UFC 4-010-05.
Finishes	**Walls** Painted gypsum wallboard.
	Floor Carpet tile with attached cushion; low maintenance, rated for heavy traffic.
	Base Rubber wall base.
	Ceiling SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	As required.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication, and as required for secure communication.
	Data As required.
	CATV As required.
Security	**IDS** As required by organization function or mission.
	ACS As required by organization function or mission.
	CCTV As required by organization function or mission.
Acoustics	Comply with UFC 4-010-05.
Furnishings and Equipment	As required by organization function or mission.
Special Requirements	Comply with UFC 4-010-05. If located in a Command Suite, provide upgraded finishes and appurtenances.
Adjacencies / Location within Facility	As required by organization function or mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other

Min. net Ft^2 (m^2)	

Table 4-30 Vault Room

Description/ Usage	A vault room is a secured area for handling classified material. Depending on the level of classification, refer to requirements for classified facilities requiring more stringent security requirements and specific design guidance such as Open Storage Secret (OSS), Sensitive Compartmented Information Facility (SCIF), Special Access Program Facilities (SAPF) and Top Secret/Sensitive Compartmented Information (TS/SCI).
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Doors with passage lock [access control].
Interior Construction / Built-in Equipment	Acoustic treatment, interior signage, raised access flooring.
Finishes	**Walls** Painted gypsum wallboard.
	Floor Carpet tile with attached cushion; low maintenance, rated for heavy traffic.
	Base Rubber wall base.
	Ceiling SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	As required.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication, and as required for secure communication.
	Data As required.
	CATV As required.
Security	**IDS** As required by organization function or mission.
	ACS As required by organization function or mission.
	CCTV As required by organization function or mission.
Acoustics	As required.
Furnishings and Equipment	As required by organization function or mission.
Special Requirements	If located in a Command Suite, provide upgraded finishes and appurtenances.
Adjacencies / Location within Facility	As required by organization function or mission.
	For Use during project execution by appropriate Service

Occupancy	Staff
	Other
Min. net Ft^2 (m^2)	

APPENDIX A BEST PRACTICES

A-1 BUILDING CONFIGURATION AND LAYOUT.

Critical elements of an efficient administrative building layout include the design of the building core, the dimensions of floor depth, structural bay spacing, and the office and workstation design and layout. A rectangular floor plan is generally preferred because it facilitates more efficient space planning. The simple shape with a high area-to-perimeter ratio yields the most economical facility.

A-1.1 Building Core.

To permit efficiency in floor plan design, the width of the building core is typically 20 to 40 ft. (6.1 to 12.2 m.). The length of the building core will vary depending on building requirements; 40 ft. (12.2 m.) is a suggested minimum.

A-1.2 Floor Depth.

The suggested floor depth for initial planning purposes is between 35 ft. (10.7 m.) and 40 ft. (12.2 m.). Floor depths of approximately 50-65 ft. (15.2 to 19.8 m.) can be configured at the ends of the building core to accommodate programmed space that is not dependent on natural light, such as computer or file storage rooms.

A-1.3 Structural Bays.

Consider the size and shape of the structural bays to allow for flexibility in workstation layout. Consider clear spans and columns beyond workstation footprint to improve the efficiency of interior space. This impacts the number and size of workstations that can be accommodated. For example, there may be the overall square footage of space to accommodate a certain number of workstations, but if the location of a structural column interferes with the location of a workstation, the actual number of workstations will be lower than the planning number. Because the bay dimension is repeated on each building floor, the results of poorly coordinated bay design is multiplied by the number of building floors with office layouts.

Typical bay spacing ranges from 20 to 30 ft. (6.1 to 9.1 m). However, this can vary depending upon the structural system employed, such as structural steel, reinforced concrete, precast concrete.

A-1.3.1 Circulation.

Circulation in Administrative Office planning is highly dependent on the mixture of enclosed and open spaces. As mentioned previously, facilities with more open office workstations and collaboration areas will require a higher circulation factor than a facility with more enclosed offices and conference rooms. The following excerpts from a GSA study “Circulation: Defining and Planning” illustrate this relationship.

Figure A-1 Circulation Case Study 0/100

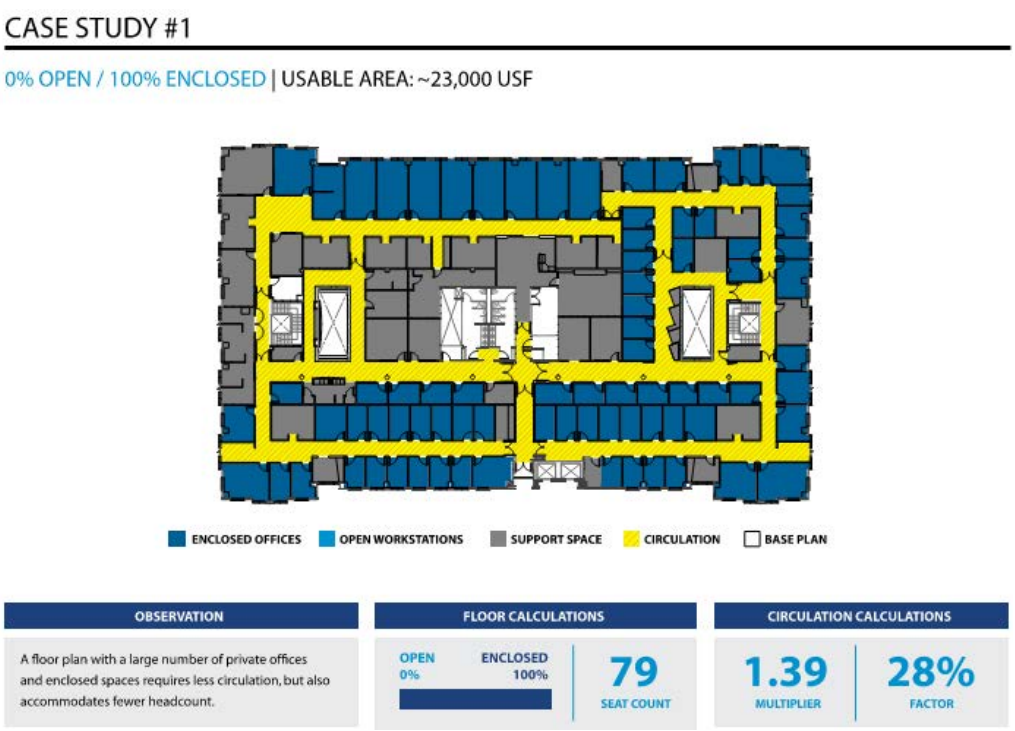


Figure A-2 Circulation Case Study 33/67

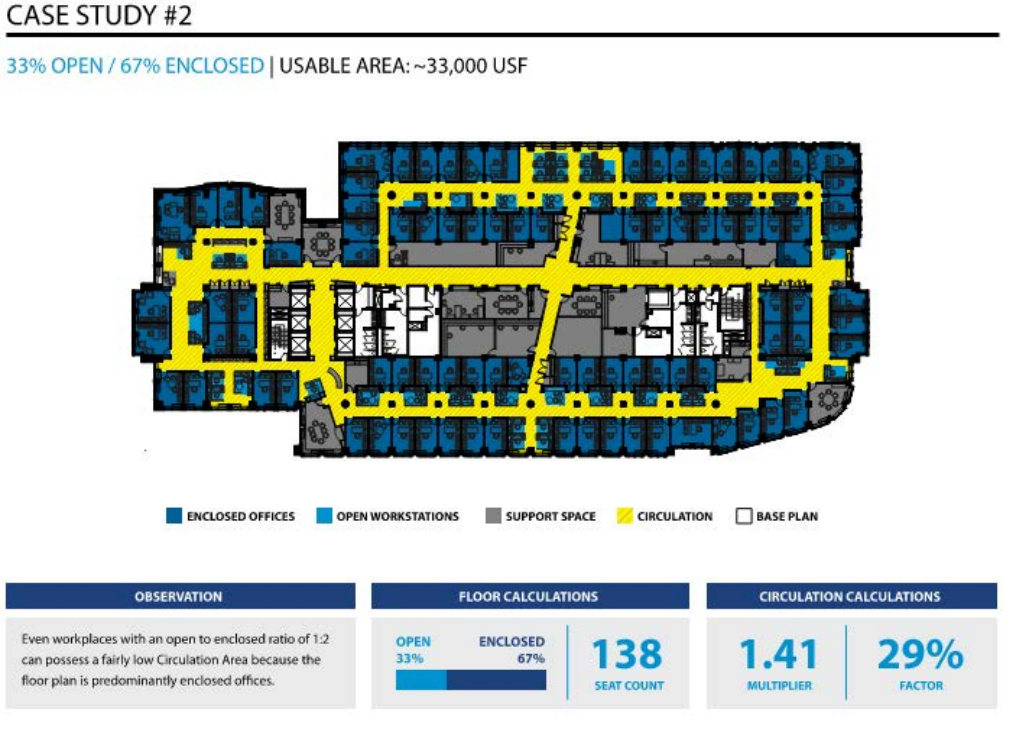


Figure A-3 Circulation Case Study 80/20

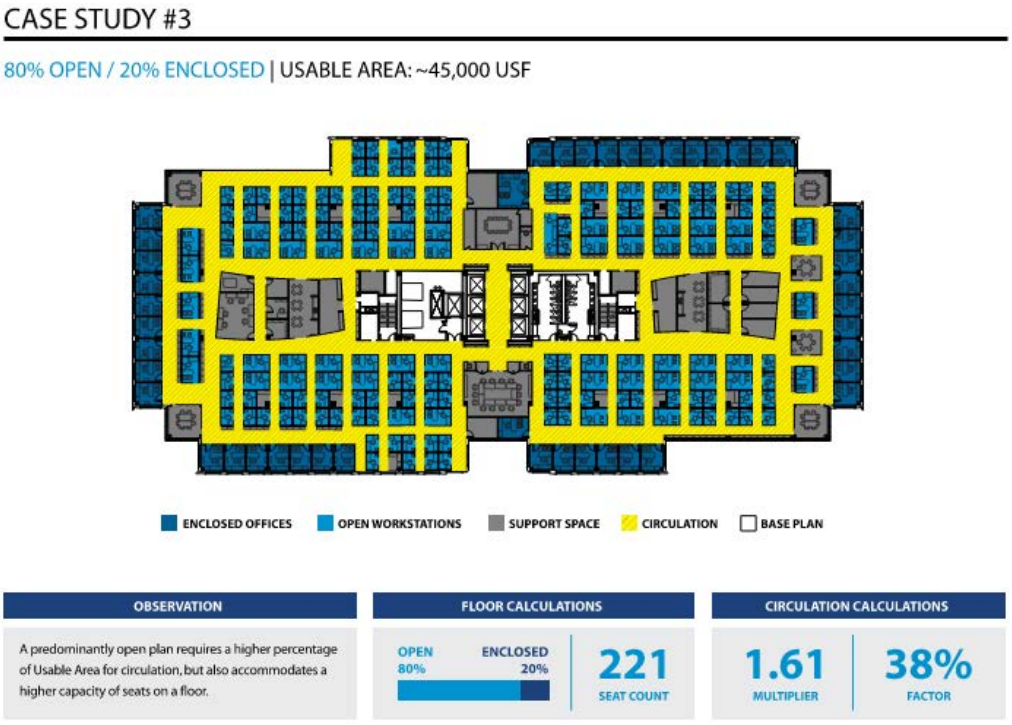
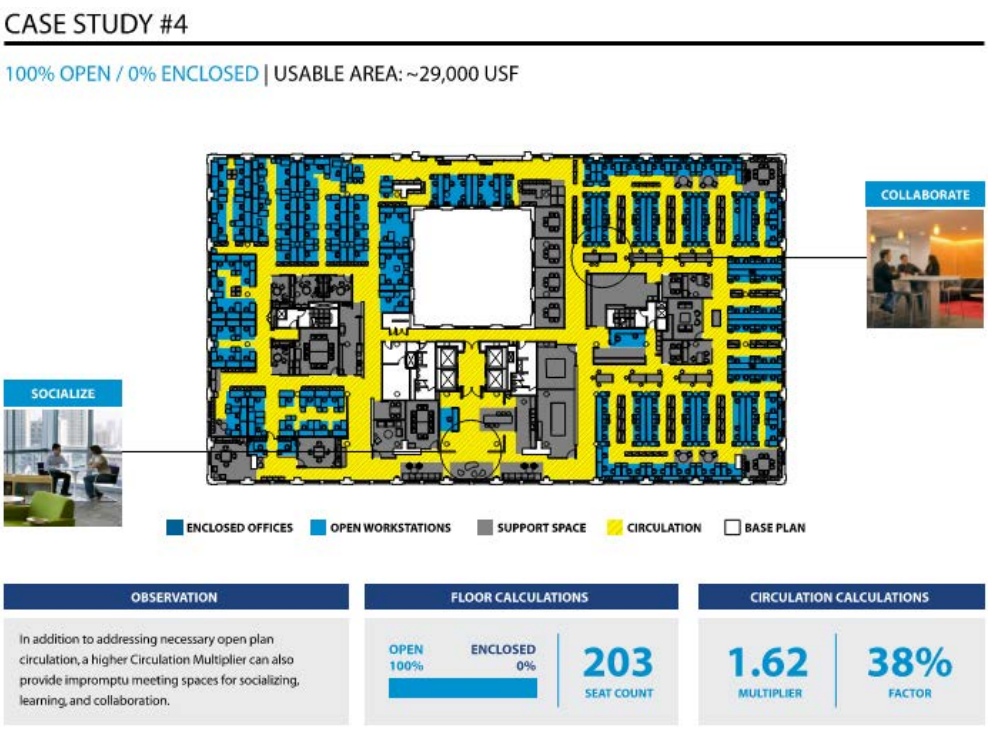


Figure A-4 Circulation Case Study 100/0



The basic building blocks of an administrative facility are the workstations and private offices. The sizes and features of these elements are critical to the efficiency of each worker, and the grouping or layout is critical to the efficiency of the organization. It is essential to understand the relationships between workstation/office design and the building design and systems.

A-2.1 Design for Flexibility.

Design the interior of Administrative Facilities for flexibility of use. Minimize the number of different workstation and offices sizes. This will ease the planning process and provide greater flexibility in the final design. Design the workstation for the task being performed and the size of the user, to the best extent possible. Make sure the furniture fits the user, supports them properly, and adjusts to their activities; use furniture systems that can be reconfigured easily for different users. **\1** Consider teleworking, shared workspaces, flex workstations, hoteling, and secure storage for daily personal items when selecting furniture. **/1/**

With furniture systems, it is possible to construct stations of any size or configuration—when necessary, consider larger workstations that accommodate meeting space. However, the open office environment can quickly become noisy and distracting if too many conversations occur. Meetings are best conducted in specifically designed meeting space.

A-2.2 Design for Modularity.

Design workstation sizes with a common dimension to facilitate grouping stations of different sizes. Two appropriate workstation sizes that can accommodate just about any office function are 8 ft. x 8 ft. (2.4 m x 2.4 m) and 8 ft. x 10 ft. (2.4 m x 3.0 m). Individual workstations should not be less than 6 ft. x 8 ft. (1.8 m x 2.4 m) and workstations in team work areas should not be less than 6 ft. x 6 ft. (1.8 x 1.8 m).

These same rules apply to private offices. Three appropriate office sizes are 10 ft. x 12 ft. (3.0 m x 3.7 m), 15 ft. x 12 ft. (4.6 m x 3.7 m), and sometimes 20 ft. x 12 ft. (6.1 m x 3.7 m.). If private offices are located against exterior window walls, coordinate the office sizes with the window mullion spacing so that office partitions occur at a mullion or solid wall component. Common mullion spacing is 5 ft. (1.5 m), which accounts for the common denominator of one dimension of the office sizes noted above.

A-2.3 Natural Daylight and Views.

Design the workstations and offices to maximize the admission of natural daylight and views. If private offices are on the exterior window walls, design interior partitions with glazing or sidelights or place the private offices against the building core. Ensure that the entire exterior wall is not blocked by private offices to maximize natural daylight admission and views into the building. Consider issues such as the even distribution of light, glare control, and heat gain and loss when designing space with good natural light qualities.

APPENDIX B AUSTERE ADMINISTRATIVE FACILITIES (NAVY ONLY)

B-1 PURPOSE.

The purpose of this appendix is to provide implementation requirements for the austere construction established by Commander, Navy Installations Command (CNIC). These requirements were developed to address construction of support facilities in CNIC designated operating environments.

B-2 DEFINITION AND SCOPE.

An austere facility is defined as a structure designed and constructed with minimal infrastructure, footprint area, and finishes, incorporating applicable building codes and facility criteria to assure adherence to all health, accessibility, and life safety standards and regulations required to fulfill the mission, including Anti-Terrorism Force Protection appropriate to each site. Austere facilities must be built with the least total ownership costs (TOC) possible, including purchase, maintenance, and use of consistently available alternative local goods.

B-3 APPLICABILITY.

Austere construction is intended for facilities in locations determined by CNIC and approved by OPNAV to be eligible for austere facilities construction. The austere standards are intended to be applied flexibly and in varying degrees to all facilities at locations designated as austere. This flexibility must be allowed to ensure the criteria are appropriate for individual austere locations.

Design these facilities with consideration of a timeframe appropriate to austere facilities, regionally appropriate acquisition of equipment, Base Operating Support (BOS) difficulties, and logistical difficulties.

B-4 MODIFICATIONS.

For austere design and construction use UFC 4-610-01, Administrative Facilities with the following (generally deductive) modifications of this appendix.

CHAPTER 2 PLANNING AND PROGRAMMING

2-3.1 Administrative Personnel.

Limit austere facilities to one Private Office with all other personnel in open office space. Delete these spaces unless mission-required:

- Semi-Private Office
- Private Flex Office
- Open Office – Flex Staff
- Command Suite

2-3.2 Administrative Support Spaces.

Delete these spaces unless mission-required:

- Reception and Waiting Area
- Locker, Shower, Fitness Rooms
- Nursing Mother's Room
- Shipping and Receiving (centralized location assumed)
- Trash and Recycling (centralized location assumed)

2-3.3 Assembly Spaces.

Limit austere facilities to one conference room unless mission required. Delete these spaces:

- Auditorium
- Large Conference Rooms
- Team/Collaboration Room
- Break Room/Areas

2-3-4 Equipment and Storage.

Delete these spaces unless mission-required:

- Large Format Production room
- Mail Center
- Technical Equipment Room

2-3.5 Secure Spaces.

Delete all spaces unless mission-required.

CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 BUILDING CONFIGURATION AND LAYOUT.

Add the following:

For austere facilities, limit permanent interior partitions to those required for a single private office and a single conference room. Maximize the use of an open floor plan and provide well-designed furniture systems.

3-1.1 Building Core.

Use this paragraph with the following exception:

Elevators are prohibited in austere facilities.

3-2.2 Entrance.

Add the following:

Canopies will not be used in austere facilities unless needed for weather conditions.

3-2.4 Raised Access Floor Systems.

Raised access floor systems are prohibited in austere facilities unless mission-required.

3-2.5 Demountable and Operable Partitions.

Demountable and Operable Partitions are prohibited in austere facilities.

CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-3 FUNCTIONAL DATA SHEETS.

Replace all FDSs with the following:

Table B-1 Austere Private Office (Replaces Table 4-1)

Description/ Usage	Provide enclosed space for one person with visual and/or acoustic privacy based on assignment or functional requirements.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	Provide daylighting.
Doors	Door with minimum 35 STC rating or as required. Privacy lock or passage set.
Interior Construction / Built-in Equipment	Provide markerboard, changeable room signage.
Finishes	**Walls** Painted gypsum wallboard extended from finished floor to suspended ceiling; for higher privacy requirements, extend partitions to structure. Minimum 40 STC.
	Floor Sealed concrete.
	Base Rubber wall base.
	Ceiling Exposed ceiling, painted or SAPC.
Plumbing	None required.
HVAC	As required.

Fire Protection and Life Safety	As required.
Power	Provide two quad electrical receptacles on separate walls or as needed to support the required equipment.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication.
	Data Provide a minimum of two lines/outlets or more to support the required equipment.
	CATV As required by organization function or mission.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide a minimum 40-45 STC depending on occupant privacy requirements.
Furnishings and Equipment	Limit private office to 10 ft. x 12 ft. (3.0 m x 3.7 m). Office desk/workstation, ergonomic task chair, filing and book storage, task lighting, [wardrobe], two guest chairs.
Special Requirements	As required by organization function or mission.
Adjacencies / Location within Facility	As required by organization function or mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table B-2 Austere Open Office (Replaces Table 4-3)

Description/ Usage	Open office space for full-time staff includes systems furniture, workstation clusters, filing and storage, and informal meeting spaces.
Ceiling Height	10 ft. (3.0 m) minimum.
Windows	Provide daylighting.
Doors	Provide doors at the perimeter walls of the open office space.
Interior Construction / Built-in Equipment	Interior wayfinding and workstation signage, marker boards, tack boards, casework.
Finishes	**Walls** Painted gypsum wallboard.
	Floor Sealed concrete.
	Base Rubber wall base.
	Ceiling Exposed ceiling, painted or SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide multiple circuits to the space to connect systems furniture workstations to building power. Exposed wiring is [and power poles are] not allowed. Plan power capacity for a minimum of four receptacles per person, per workstation or as required.
Lighting	Provide general lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication per person. Coordinate communication distribution through the systems furniture and as required.
	Data Provide one outlet per staff unless multiple systems are required. Provide additional outlets for each printer, copier, scanner, shredder, and other similar equipment. Coordinate data distribution through the systems furniture and as required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV As required by organization function or mission.
Acoustics	None required.
Furnishings and Equipment	For Austere Facilities, limit workstations to 6 ft. x 8 ft. (1.8 m x 2.4 m) configured for staff assignments and functionality; ergonomic task seating, guest seating, task lighting, lateral file cabinets, counter height work/storage/meeting islands for files

	and supplies. Provide worksurfaces for printers, scanners and other equipment as required to be used in the open office area.
Special Requirements	Coordinate telecom and data distribution, equipment, and connection points requirements with workstation configurations and open office layouts.
Adjacencies / Location within Facility	As required by organization function or mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table B-3 Austere Toilet Rooms (Replaces Table 4-8)

Description/ Usage	Toilet rooms are sized per code and occupancy and may be single or multiple fixture toilets. Usually part of the building core, toilets may be located within an organization's perimeter.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Doors as required
Interior Construction / Built-in Equipment	Toilet compartment partitions and accessories, hand [and hair] dryers, built-in solid surface counters, interior signage.
Finishes	**Walls** Durable, low maintenance, water resistant materials such as porcelain tile.
	Floor Durable, low maintenance, water resistant materials such as porcelain tile, epoxy flooring.
	Base To match/coordinate with flooring.
	Ceiling Durable, humidity-resistant material, such as painted gypsum wallboard [or SAPC].
Plumbing	Sinks, toilets, urinals.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support required equipment such as hand dryers and hair dryers.
Lighting	Provide general and decorative lighting.
Telecommunications	**Telephone** None required.
	Data None required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	As required.
Furnishings and Equipment	Waste receptacles (if not included in construction).
Special Requirements	
Adjacencies / Location within Facility	Collocate with toilets, locker rooms, fitness rooms.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table B-4 Austere Janitor's Closet (Replaces Table 4-9)

Description/ Usage	A janitor's closet accommodates equipment and supplies for the maintenance of the toilets and building. Usually part of the building core, it may be located within an organization's perimeter.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Doors as required
Interior Construction / Built-in Equipment	Mop rack and shelving, interior signage.
Finishes	**Walls** Durable, low maintenance, water-resistant materials such as fiberglass reinforced wall panel, stainless steel, or porcelain tile.
	Floor Durable, low maintenance, water-resistant materials such as porcelain tile, epoxy flooring.
	Base To match/coordinate with flooring.
	Ceiling Durable, humidity-resistant material such as painted gypsum wallboard [or SAPC].
Plumbing	Mop basin, [Utility sink].
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support required equipment.
Lighting	Provide general lighting.
Telecommunications	**Telephone** None required.
	Data None required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	As required.
Furnishings and Equipment	Waste receptacles (if not included in construction).
Special Requirements	May be incorporated inside toilets or locker rooms as required.
Adjacencies / Location within Facility	Collocate with toilets, locker rooms, shower rooms.
	For Use during project execution by appropriate Service
Occupancy	**Staff**

	Other
Min. net Ft^2 (m^2)	

Table B-5 Austere Classroom/Training Room (Replaces Table 4-17)

Description/ Usage	Enclosed conference or training space for 30-50 people for flexible arrangements of conference and classroom settings. May be used for extended or daylong meetings, ceremonies, or distance learning.
Ceiling Height	10 ft. (3.0 m) minimum.
Windows	Not required.
Doors	Door(s) with minimum 35 STC rating or as required.
Interior Construction / Built-in Equipment	Provide marker boards, tack boards, Projection [surfaces,] [screens,] Built-in casework for equipment or buffet; Interior signage.
Finishes	**Walls** Painted gypsum wallboard. Provide partitions that extend from the finished floor to the structure above. Provide acoustical insulation in the partitions to achieve a minimum 50 STC rating.
	Floor Sealed concrete.
	Base Rubber wall base.
	Ceiling Exposed ceiling, painted or SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets and outlets to support the required equipment. May require floor receptacles to accommodate power requirements at the conference table.
Lighting	Provide multiple lighting solutions to include general lighting, accent lighting, and dimmable lighting.
Telecommunications	**Telephone** Provide one line with internal two-way communication, or as required. May require floor receptacles to accommodate telephone requirements at the conference table.
	Data Provide for computer, projection, flat monitor, or lectern connectivity as required. May require floor-mounted receptacles to accommodate data requirements at the conference table.
	CATV As required by organization function or mission.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	Provide STC 45 or greater.
Furnishings and Equipment	FF&E Package: Modular conference tables to be configured for conference, seminar, or classroom settings, with power and data connectivity, seminar chairs or swivel conference seating [upholstered, flexible backs, casters], and mobile marker boards. AV package: Flat screen monitors, projectors, screens, VTC systems, smart lecterns, or as required.

Special Requirements	Presentation or VTC functions, instructional or distance learning, power and data connectivity.
Adjacencies / Location within Facility	As required for organization function or mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other
Min. net Ft^2 (m^2)	

Table B-6 Austere General Filing and Storage Room (Replaces Table 4-22)

Description/ Usage	Storage of files, supplies, and equipment. Provide a separate lockable room for storage of sensitive or high-value equipment or archives.
Ceiling Height	9 ft. (2.7 m) minimum.
Windows	None required.
Doors	Doors with passage lock [access control].
Interior Construction / Built-in Equipment	Interior signage, plastic laminate-clad wall and base cabinets with counters.
Finishes	**Walls** Painted gypsum wallboard as required, depending on the agency and the level of security required.
	Floor Sealed concrete.
	Base Rubber wall base.
	Ceiling Exposed ceiling, painted or SAPC.
Plumbing	None required.
HVAC	As required.
Fire Protection and Life Safety	As required.
Power	Provide general outlets.
Lighting	Provide general lighting.
Telecommunications	**Telephone** None required.
	Data None required.
	CATV None required.
Security	**IDS** None required.
	ACS None required.
	CCTV None required.
Acoustics	None required.
Furnishings and Equipment	Open utility shelving, file cabinets, or specialized storage systems as required by organization function and mission.
Special Requirements	Additional structural support for concentrated loads. Access control depending on security level.
Adjacencies / Location within Facility	As required by organization function and mission.
	For Use during project execution by appropriate Service
Occupancy	**Staff**
	Other

Min. net Ft^2 (m^2)	

APPENDIX C GLOSSARY

C-1 ACRONYMS AND ABBREVIATIONS.

AC	Articulating Class
ACS	Access Control System
AFCEC	Air Force Civil Engineer Center
AFI	Air Force Instruction
AFMAN	Air Force Manual
AR	Army Regulation
AV	Audio Visual
ASTM	American Society for Testing and Materials
BIA	Bilateral Infrastructure Agreement
BOS	Base Operating Support
CAC	Ceiling Attenuation Class
CATV	Cable Television
CCR	Criteria Change Request
CCTV	Close Circuit Television
CMU	Concrete Masonry Unit
CNIC	Commander, Naval Installations Command
CO	Commanding Officer
CONUS	Continental United States
DD1391	U.S. Department of Defense Form, FY__ Military Construction Project Data
DoD	Department of Defense
ECB	Engineering and Construction Bulletin
EP	Engineer Pamphlet
ESS	Electronic Security System

FC	Facility Criteria
FDS	Functional Data Sheet
FF&E	Furnishings, Fixtures and Equipment
Ft.	Foot or Feet
GFCI	Ground Fault Circuit Interrupter
GSA	General Services Administration
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
HVAC	Heating Ventilation Air Conditioning
IDS	Intrusion Detection System
In.	Inch
IT	Information Technologist
LAN	Local Area Network
m.	Meters
MCO	Marine Corps Order
MIL-STD	Military Standard
NAVFAC	Naval Facilities Engineering Systems Command
NAVFACINST	Naval Facilities Instruction
NRC	Noise Reduction Coefficient
OCONUS	Outside Continental United States
OPNAV	Navy Operations
OPNAVINST	Navy Operations Instruction
OSS	Open Storage Secret
PBS	Public Building Services
PM	Program Manager
SAPF	Special Access Program Facilities

SAPC	Suspended Acoustical Panel Ceiling
SCIF	Sensitive Compartmented Information Facility
SOFA	Status of Forces Agreements
Sq.	Square
STC	Sound Transmission Coefficient
TI	Technical Instruction
TOC	Total Ownership Cost
TS/SCI	Top Secret/Sensitive Compartmented Information
TV	Television
UFC	Unified Facilities Criteria
U.S.	United States
USD	Under Secretary of Defense
VTC	Video-Teleconferencing
WBDG	Whole Building Design Guide

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APPENDIX D REFERENCES

ASTM INTERNATIONAL

https://www.astm.org

ASTM E1130-16 *Standard Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index*

GENERAL SERVICES ADMINISTRATION

PBS-P100 *Facilities Standards for Public Buildings Service,* https://www.wbdg.org/ffc/gsa/criteria/pbs-p100

Study: *Circulation: Defining and Planning,* www.gsa.gov/cdnstatic/Circulation_-_Defining_and_Planning_%28May_2012%29.pdf.

MILITARY STANDARD

MIL-STD 3007G *Standard Practice for United Facilities Criteria and United Facilities Guide Specifications,* https://www.wbdg.org/ffc/dod/federal-military-specifications-standards/mil-std-3007

USD (AT&L) Memorandum dated 29 May 2002, https://www.wbdg.org/FFC/DOD/ufc_implementation.pdf

UNITED STATES AIR FORCE

http://www.afcec.af.mil/

AFMAN 32-1084, *Facility Requirements,* https://www.wbdg.org/ffc/af-afcec/manuals-afm/afman-32-1084

AFI 32-1015, *Integrated Installation Planning* https://static.e-publishing.af.mil/production/1/af_a4/publication/afi32-1015/afi32-1015.pdf

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UNITED STATES ARMY, U.S. ARMY CORPS OF ENGINEERS

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TI 800-01, *Design Criteria*,
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MCO P11000.12C, *Real Property Facilities Management Volume II - Facilities Planning and Programming*,
http://www.marines.mil/Portals/59/Publications/MCO%20P11000.12C%20W%20CH%201.pdf

OPNAVINST 11010.20H, *Facilities Projects Manual*,
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OPNAVINST 5100.23G, *Navy Safety and Occupational Health Program Manual,*
https://www.secnav.navy.mil/doni/Directives/05000%20General%20Management%20Security%20and%20Safety%20Services/05-100%20Safety%20and%20Occupational%20Health%20Services/5100.23G%20w%20CH-1.pdf

UNITED STATES DEPARTMENT OF DEFENSE, UNIFIED FACILITIES CRITERIA
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 1-200-01, *DoD Building Code*

FC 2-000-05N, *Facility Planning Criteria for Navy and Marine Corps Shore Installations*

UFC 2-100-01, *Installation Master Planning*

UFC 3-120-01, *Design: Sign Standards*

UFC 4-010-05, *Sensitive Compartmented Information Facilities Planning, Design and Construction*

UFC 4-010-06, Cybersecurity of Facility-Related Control Systems

UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*

UFC 4-021-02, *Electronic Security Systems*

FC 4-760-10N, *Navy Museums and Historic Resource Facilities*

FC 4-610-04F
28 October 2015

FACILITIES CRITERIA (FC)

AIR FORCE
LEGAL FACILITIES

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FACILITIES CRITERIA (FC)

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This FC supersedes the *Air Force Base Legal Facilities Design Guide*.

FOREWORD

Facilities Criteria (FC) provide functional requirements (i.e., defined by users and operational needs of a particular facility type) for specific DoD Component(s), and are intended for use with unified technical requirements published in DoD Unified Facilities Criteria (UFC). FC documents are applicable only to the DoD Component(s) indicated in the title, and do not represent unified DoD requirements. Differences in functional requirements between DoD Components may exist due to differences in policies and operational needs.

All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the FC, the SOFA, the HNFA, and the BIA, as applicable.

Because FC documents are coordinated with unified DoD technical requirements, they form an element of the DoD UFC system applicable to specific facility types. The UFC system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and is applicable to the Military Departments, Defense Agencies, and the DoD Field Activities. The UFC System also includes technical requirements and functional requirements for specific facility types, both published as UFC documents and FC documents.

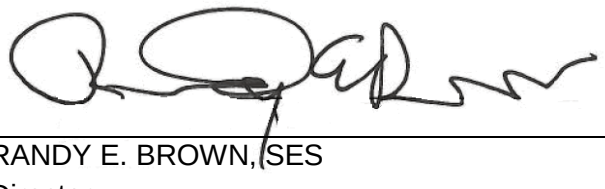
FCs are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content is the responsibility of the cognizant DoD working group. Send recommended changes with supporting rationale to the respective Service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet site listed below.

FCs are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Refer to UFC 1-200-01, *General Building Requirements*, for implementation of new issuances on projects.

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FACILITIES CRITERIA (FC)
NEW SUMMARY SHEET

Document: FC 4-610-04F, *Air Force Legal Facilities*

Superseding: *Air Force Base Legal Facilities Design Guide*

Description: This FC provides requirements for planning, programming, designing, and constructing legal facilities. The information in this FC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental United States (CONUS) and outside the continental United States (OCONUS). It also applies to the procurement of design/build services for the above-noted types of projects. Alteration and renovation projects should update existing facilities to meet the guidance and criteria within budgetary constraints.

Reasons for Document: This FC is the initial release to establish minimum requirements for a variety of different legal facility types. It provides the criteria for determining appropriately sized, flexible, cost-optimized, durable, quality-designed facilities on a life cycle basis to support the mission.

Impact: This FC will facilitate and standardize the design of legal facilities throughout the Air Force. It will provide more complete and consistent project requirements, expedite the programming and design of facilities, and reduce initial design cost.

Unification Issues: None.

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CHAPTER 1 INTRODUCTION

1-1 GENERAL INFORMATION

This standard facility prototype design criteria was developed to assist Air Force planners to prepare and validate DD Form 1391 requirements and to assist architect and engineering (A-E) design professionals with approved project-specific design requirements. It is a source of basic programming and functional information for legal facilities. This standard is consistent with Air Force Corporate Facility Standards (AFCFS) and Unified Facilities Criteria (UFC). This standard, in conjunction with the AFCFS, is intended to define Air Force expectations for project programming and A-E design decisions.

The standard facility prototype design program defines consistent facility requirements across the Air Force enterprise to expedite delivery of a facility. This standard was designed in compliance with AFMAN 32-1084. The objective is to deliver appropriately sized, flexible, cost-optimized, durable, and quality-designed facilities on a life cycle basis to support the Air Force mission.

The mission of the Air Force Judge Advocate General's Corps (AFJAGC) is to deliver professional, candid, independent counsel and full-spectrum legal capabilities to the command and the warfighter. In so doing, the AFJAGC ensures the lawful accomplishment of the Air Force mission, the discipline of the force, the defense of Air Force resources, and the preservation of prerogatives for Air Force leaders. In addition, the AFJAGC represents accused Airmen, supports victims' rights, and assists Airmen and their families in resolving personal legal problems. Legal canons of ethics drive confidentiality for attorney-client discussions, which in turn necessitate private offices with higher than normal sound transmission ratings. Additionally, legal facilities should evince a professional image, reflective of the rule of law.

1-2 GENERAL BUILDING REQUIREMENTS

Comply with UFC 1-200-01. UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as accessibility, anti-terrorism (AT), security, high-performance and sustainability requirements, and safety. Use this Facilities Criteria (FC), in addition to UFC 1-200-01 and the UFCs, and government criteria referenced therein.

Lighting systems must meet ASHRAE 90.1. Refer to UFC 1-200-02 for the publication year of ASHRAE. Note that the requirements of this UFC refer to ASHRAE 90.1-2010. When UFC 1-200-02 adopts a newer publication year for ASHRAE 90.1, it will have precedence over these FC requirements.

1-3 REFERENCES

Appendix A contains a list of related documents and references to be used in conjunction with this FC. The publication date of the code or standard is not included. In general, use the latest available issuance of the reference, unless otherwise noted.

1-4 INSTRUCTIONS

The standard facility prototypes in this FC were developed by determining personnel counts, allowable/authorized space/room sizes, adjacency diagrams between the functional spaces, and overall facility space requirements. It establishes Air Force criteria for the facility type. Use these criteria, in conjunction with other Air Force policies and regulations, such as Air Force departmental publications (e.g., AFIs, AFMANs) and UFCs, when programming and designing this facility type.

Supplement this FC with a thorough review by individual program managers and operations staff.

1-4.1 Standard Facility Prototype Tools

These standard facility prototypes consist of three parts to be used by programmers and A-Es:

- Facilities criteria for standard prototype (this FC document)
- Interactive programming sheet
- Facility Building Information Modeling (BIM) drawings

1-4.2 Facilities Criteria

The facilities criteria consist of three primary components:

- Space standards for common facilities
- Composite facility adjacency diagrams/composite floor plans
- Module components with associated room data sheets

1-4.2.1 Notional Sites

The notional site plan diagrams demonstrate key site development criteria. Site plan diagrams for a base legal facility and an Area Defense Counsel (ADC) office are included to demonstrate key site development criteria since they are legal facility types that might be stand-alone facilities. They are not site-specific solutions, but represent the land requirements to construct these facilities and include associated AT standoff distances and parking. Utilization of existing or shared parking is allowable and may reduce the total acreage required for the facilities. Adapt the requirements to the specific site and location, and comply with the applicable Installation Development Plan (IDP) and Area Development Plan (ADP) for facility siting.

1-4.2.2 Composite Office Adjacency Diagrams

The adjacency diagrams identify the proximity requirements between major standard spaces and ways to conceptually assemble them into functional composite areas. They are not intended to be definitive building designs.

1-4.2.3 Composite Notional Floor Plans

The composite floor plans are conceptual solutions that illustrate functional user and adjacency requirements. Plan variations may be rotated, flipped, or reversed to fit the actual site. A thorough compliance check of all other applicable criteria is required, even when using the conceptual solutions provided in this FC.

1-4.2.4 Flexibility/Adjustments

Utilization of the provided modules is highly recommended to maintain functional relationships, adjacencies, and allowed program areas. Modules contain fixed attributes that are essential to functional requirements. Modules may be rotated, flipped, or reversed to accommodate an overall composition or site issue. When the modules cannot be arranged to produce a constructible floor plan due to site constraints, their proportions may be adjusted to create a constructible plan. Manipulating the module shape must not result in an overall increase in square feet and/or reduce the functionality of any module or the required adjacencies in the composite plan.

Some modules are linked to space requirements that increase or decrease in size based on the unit's Unit Manning Document (UMD) staffing and typical equipment for that particular mission. In these cases, increase or decrease the size of the module or number of offices to match the revised scope calculation. This may sometimes require minor adjustments in other adjacent modules so they properly fit together to create a constructible facility floor plan. Spaces must comply with any critical dimensions on module plans. Manipulate as few modules as possible to create a constructible facility. The resulting composite plan must respect the established module's adjacencies and must not exceed the authorized project scope.

1-4.2.5 Room Data Sheets

Specific requirements for each room, space, or area are provided on room data sheets located in either the space standards or following in their respective group discussion. Information contained on the data sheets defines the functional and physical requirements for each of the spaces within the facility or office type.

1-4.3 Programming Sheets

This tool is provided in two formats. A PDF programming sheet is provided in each Judge Advocate (JA) unit section, primarily as a reference, and reflects the baseline standard facility program. An additional interactive programming sheet provides a tool for planners and programmers. It allows the input of authorized personnel positions and special purpose spaces. Updated inputs are automatically calculated and provide new

required square footage for each space and the overall facility/office size. A link is provided in Appendix B for access to the interactive tool.

1-4.4 Additions and Alterations

For additions and alterations to existing facilities, use the adjacencies sizing/scope and detailed requirements in the adjacency diagrams and room data sheets to the maximum extent possible. The functionality and adjacency of the standard spaces are still valid, but may require some manipulation to fit into existing spaces. This standard may be slightly modified to accommodate the existing structure. The A-E shall determine the most efficient means to balance the placement of modules within existing spaces or as a facility addition.

1-4.5 Sustainability

Meet the requirements of UFC 1-200-02 and achieve green building certification in accordance with the current Air Force Sustainable Design and Development (SDD) Implementing Guidance.

CHAPTER 2 GENERAL FACILITIES

2-1 GENERAL FACILITIES OVERVIEW

The majority of legal offices coexist in buildings with other occupants. However, if an office is a stand-alone facility, it is typically a one-story structure. The most common stand-alone facilities are base legal and Area Defense Counsel (ADC) offices.

AFCFS: Consult the AFCFS to determine exterior quality standards for this facility group. This standard facility prototype is considered a Group 1 hierarchy.

Facility Users/Occupants: These facilities are operated by active duty, civilian, National Guard, and Reserve military personnel. The number of occupants varies from office to office; thus, the design is based on the UMD for the specific unit, counting active duty military and civilian personnel.

Operational Aspects: Hours of operation for legal offices are driven by workload volume and often exceed standard operating hours. In the case of ADCs and SVCs, attorneys routinely meet with clients after normal hours to accommodate client schedules.

2-1.1 Professional Image

The most visible symbols of the rule of law in the Air Force are legal facilities. Trial courtrooms are the soul and public face of the military justice system and must promote respect for the tradition and purpose of the law and judicial process. To emphasize legal professionalism, courtroom designs must express solemnity, stability, integrity, and fairness. Legal facilities need to reflect the dignity of the profession and respect for the rule of law. Finish interiors so that legal job performance, mission accomplishment, and commander and client satisfaction are optimized. Use materials that invoke a sense of permanence and have consistency. Select colors that are subdued and complement the materials used. Use architectural elements that are proportional and arranged in hierarchy to denote order. Choose finishes that are durable and easy to maintain. The following key planning drivers are critical to the success of this FC.

2-1.2 Confidentiality

An Air Force attorney must maintain the confidentiality of all information relating to the representation of a client, in accordance with AFI 51-110, Atch 2, Rule 1.6; the American Bar Association Model Rules of Professional Conduct; and the rules of professional conduct in any state or territorial bar in which the attorney is licensed. These rules are mandatory, and violations can result in the loss of the attorney's professional license and/or designation to practice law in the Air Force. In addition, violations place the Air Force at risk of being sued or of losing the confidence of Congress and the public.

Confidentiality applies to any conversation with a client about the subject of the representation, any related interviews or discussions with others, and any associated

work by the attorney. Clients include personal clients, such as legal assistance clients (for base-level and other qualified legal assistance attorneys), defense clients (for defense counsel), sexual assault victims (for SVCs), and disability clients (for Office of Airman's Counsel attorneys), as well as government officials. Whenever an organization such as the Air Force is the client, confidentiality is required for authorized officials acting on behalf of the client. Conversations about legal matters with clients, prospective clients, and others must be kept completely confidential, unless the client gives informed consent for the release of information to other parties. The same protection applies to the attorney's work product (e.g., notes, observations, research, and written opinions). Materials must be kept confidential and properly safeguarded from unauthorized viewing, which affects the type of storage provided in the office.

In addition to the need to protect confidential information, Air Force attorneys are called upon, more than members of almost any other career field, to review and advise on information protected from release or disclosure by other laws, rules, or regulations. For instance, attorneys often handle matters governed by the Privacy Act, the Procurement Integrity Act, the Freedom of Information Act, the Health Insurance Portability and Accountability Act, or the Safety Privilege. They regularly advise commanders, first sergeants, and supervisors on military justice matters, misconduct by subordinates, and problems in the workplace. They commonly review and discuss investigative reports (prepared by the Air Force Office of Special Investigations [AFOSI], Security Forces, or other investigators), pre-decisional data, and other highly sensitive or classified material. In addition, they are involved in advising on the legality of proposed governmental actions, consulting on plans and ways ahead, and formulating litigation strategy or the defense of governmental actions or decisions. All of these activities require safeguarding discussions and protected material so they remain solely between those with the need to know. Even other attorneys in the same office frequently fall outside the bounds of those who should overhear or be privy to such exchanges, or view the information.

Air Force attorneys are regularly involved in the above activities. In addition, some Air Force paralegals routinely conduct client interviews, prepare witnesses, and counsel victims. As such, they require closed private office space with sufficient sound attenuation so in-person and telephone conversations remain confidential. This arrangement also provides a critical layer of protection for attorney work product. Furthermore, attorneys have the ethical responsibility to communicate frequently with clients (AFI 51-110, Atch 2, Rule 1.4). Not having a private office would place an unreasonable burden on an attorney to find a suitable location to conduct these recurrent communications. The same would apply to paralegals with routine confidential responsibilities.

Finally, the very nature of an Air Force legal office underscores the need for private offices for attorneys. Legal offices are a hub of activity wherever they are located. They are a bustling intersection of clients, defense counsel, accused, victims, commanders, first sergeants, senior officials, and others. In order to keep client business between the attorney and client, Air Force attorneys must have separate offices, properly insulated, to safeguard the work they do and comply with their ethical obligations. Failure to do so

jeopardizes client confidentiality, the attorneys' ability to practice law, and mission effectiveness.

The nature of the work performed determines the levels of privacy in designing an office. A low level of privacy would involve an open reception area or low-walled workstation. A medium level would apply to a workstation with higher walls so it is visually separated from a corridor or reception area. A high level of privacy would be a space, such as a private office or suite, that is acoustically treated so conversations or discussions are not distinguishable from the travel way or a neighboring office.

2-1.3 Room Interiors and Finishes

Select office furniture from Air Force Furniture Commodity Council mandatory sources. Interior finish standards are based on a limited range (see Figure 2-1) used to select the appropriate type of furnishings. Select commercial-grade furniture that is durable, low-maintenance, and utilizes colors compatible with other interior features. The following definitions describe each level of finish.

Level 1: Use durable, cost-effective finishes that are easy to clean and maintain, with resilient or tile flooring, painted gypsum board walls, plastic laminate-clad millwork, and storage units (e.g., shelving, file cabinets). This finish is considered typical for "back-of-house" areas.

Level 2: Use commercial-grade carpet on floors, with painted gypsum board walls; include some accent areas that provide a professional atmosphere. In open office environments, use panel-supported or desk-based systems furniture that provides flexibility. In private offices, provide freestanding, executive wood-finish desks and credenzas.

Level 3: Use a higher grade commercial carpet or other floor types of finish; limited use of wood paneling and wainscoting is allowed. Use freestanding executive wood furniture in private offices or higher-level leadership suites.

Figure 2-1 lists the typical JA spaces included in each of the finish categories and applies to the standard spaces discussed later in this FC. The exceptions to these standards are described under the individual JA group heading, if and when they occur. In those instances where support spaces, such as a copy area or storage room, are very small, match the finishes with the adjacent areas. Match hallways leading to individual spaces with the finish level of whichever space is considered most significant (e.g., the corridor to the courtroom will have a Level 3 finish).

Figure 2-1 Interior Finishes Summary

LEVEL 1	LEVEL 2	LEVEL 3
Work room	Private office	Courtroom
Mail room	Open office area	Judge's chamber
Storage area	Reception/waiting area	AFLOA command suite
Coffee bar	Huddle room	SJA office/leadership suite
Break room	AFJAGS student lounge	Legal office conference room
	AFJAGS classroom	AFJAGS auditorium
		AFJAGS executive conference room

2-2 SPACE STANDARDS ORGANIZATION

2-2.1 General

JA offices vary in scope and mission, but share commonalities in space types, whether in freestanding buildings or as tenants in larger buildings. The following rooms/spaces occur in each legal facility and are composed of common spaces classified as either an office space or as shared support space, each scalable to specific unit requirements. All legal offices are a combination of these common types of spaces and are discussed in detail in the following pages. Included in each section are room descriptions, floor plans, and room data sheets. Chapters 3 through 9 discuss specific office requirements for each general category of legal office, as well as the directorates, divisions, and field support centers (FSC) in the Air Force Legal Operations Agency (AFLOA). Only specific space types and requirements that are unique and not standard are discussed in detail in the individual sections. However, some space requirements may require local justification during the programming and planning stages of a new construction or remodeling project.

2-2.2 Common Spaces

2-2.2.1 Offices

Eight office types are common in Air Force legal offices, along with two types of systems furniture workstations:

- A1 - General Office: Private office, due to job requirements (e.g., visiting attorney or court reporter)
- A2 - General Attorney/Instructor Office: Private office with two guest chairs and sound attenuation
- A3 - Deputy Senior Attorney Office: Private office with side table, two guest chairs, and sound attenuation
- A4 - Senior Attorney Office: Private office with conference table (seating for six), two guest chairs, and sound attenuation
- A5 - Commander Office: Large private office, for the AFLOA Commander in the Jones Building, with seating for six and sound attenuation
- A6 - General Attorney Office (Jones Building): Private office with two guest chairs and sound attenuation
- A7 - Director Office (Jones Building): Private office with small conference table (seating for four), guest chairs, and sound attenuation
- P1 - Paralegal Workstation: Standard workstation
- P2 - Paralegal Office: Private office due to job requirements (e.g., performing client interviews or witness preparation, or serving as Law Office Superintendent)
- P3 - Senior Paralegal Office: Large private office, due to job requirements (i.e., serving as MAJCOM Functional Manager or Command Paralegal)
- P4 - Large Workstation: Specifically for the Jones Building

2-2.2.2 Shared Support

Spaces shared amongst several different private offices or workstations with similar functional adjacencies, which can be centrally located within each office group and/or combined with other individual group requirements listed in paragraphs 2-2.2.3 through 2-2.2.7.

2-2.2.3 Storage Spaces

Three storage types are common in legal offices:

- Open Storage Area: In shared, open office area
- Closed Secure Area: In secured, lockable file room
- Special Storage: As required (e.g., safe or sensitive compartmented information facility [SCIF])

2-2.2.4 Waiting/Reception Area

Access control point to regulate transit from the waiting area to other areas of the legal office. Access control can include buzzer entry systems or digital locking mechanisms. Seating numbers will vary based on office requirements.

2-2.2.5 Huddle/Conference Room

Room size varies based on group requirements; usually huddle (small), medium, large, and extra-large, with seating for 6 to 45 staff members; audio visual (A/V) and video teleconferencing (VTC) capabilities are frequently provided.

2-2.2.6 Work Room

Centralized work space, to include multifunctional copier/printer/fax machine, shredders, supply storage, and work area. Larger offices may utilize small satellite copier alcoves, in addition to a centralized work room.

2-2.2.7 Coffee Bar/Break Room

Kitchenette, ranging from no seating to seating for 8 to 16, with a sink, coffee maker, microwave, and full-size refrigerator.

Table 2-1 Summary of Common Spaces

Space	Size (SF)	Symbol
General office	100	A1
General attorney/instructor office	120	A2
Deputy senior attorney office	150	A3
Senior attorney office	216	A4
Commander office	300	A5
General attorney (Jones Building)	130	A6
Director (Jones Building)	200	A7
Paralegal workstation	64	P1
Paralegal office	100	P2
Senior paralegal office	120	P3
Large workstation (Jones Building)	100	P4
Huddle room (small)	168	C1
Conference room (medium)	304	C2
Conference room (large)	450	C3
Conference room (extra-large)	600	C4
Work space (small)	60	W1
Work room (medium)	120	W2
Work room (large)	200	W3
Coffee bar	60	B1
Break room (small)	120	B2
Break room (medium)	252	B3
Break room (large)	399	B4

2-2.3 Attorney Offices

Design attorney offices with standards and guidelines that are simplified, with space allocated according to functional requirements and flexibility. This principle recognizes that fewer barriers to change, less disruption when change occurs, and lower costs in money and time can be accomplished by standardizing office sizes.

Standard attorney offices are of six main types. A1 is a small office, 100 square feet in size, with an L-shaped desk and return, two chairs for clients, and a marker board. A2, the standard attorney office, is 120 square feet in size, with similar furnishings as A1. A3 is slightly larger, 150 square feet in size, with an L-shaped desk and return, bookshelves, two chairs for clients, and a marker board. A4 is the largest office, 216 square feet in size, with an executive desk, a credenza, bookshelves, a rectangular table with seating for six, two additional chairs for clients, a flat screen monitor, and a marker board. A6 (not pictured in Figure 2-2), 130 square feet in size, is the standard attorney office in the Jones Building, with similar furnishings as A1. A7, 200 square feet in size, is the standard director office in the Jones Building, with similar furnishings as A4, except for a smaller table with seating for four. In addition to the standard offices, A5, 300 square feet in size, is unique to the AFLOA Commander in the Jones Building, with an executive desk, a conference table with seating for four, a credenza, additional chairs, and an end table.

Office walls dividing offices from other spaces must meet a Sound Transmission Class (STC) minimum rating of 50. The door and window assemblies within these walls must meet an STC rating of 45. Higher STC ratings for door and window assemblies may be specified for specific projects or spaces. Field testing and on-site verification of the assembly of the final STC ratings are required for these applications. Exterior windows must meet AT requirements.

Figure 2-2 Standard Offices

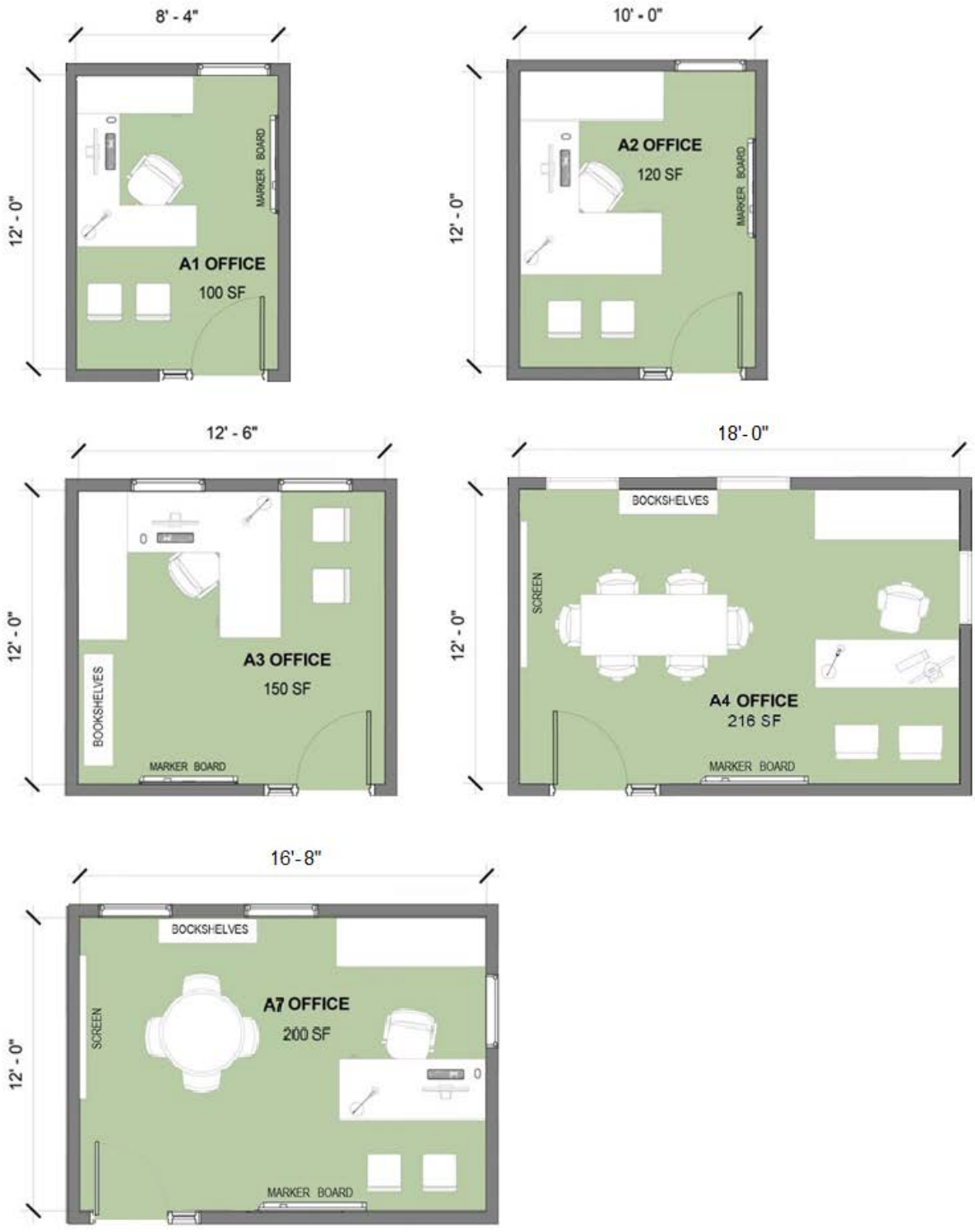


Figure 2-3 General Office Room Data Sheet

Description/Usage		A1 private office for a visiting attorney or a non-attorney with responsibilities necessitating a private office (e.g., a paralegal conducting witness interviews or a court reporter).
Ceiling Height		9'-0" minimum
Windows		Exterior insulated, AT compliant
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Side view panels
Finishes	**Walls**	Level 2
	Floor	Level 2
	Base	Level 2
	Ceiling	Level 2
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	Duress alarm
Acoustics		Per UFC 3-450-01, for noise control. When the office is to be used routinely for legally confidential discussions, it requires additional acoustical privacy. In that case, floors, partitions, and ceilings meet or exceed the STC 50 requirement, and windows and doors meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E)		Provide one 6' wood-finish, L-shape systems furniture, with return and phone/data connections. Include one swivel chair, two straight visitor chairs, and marker board.
Special Requirements		When the office is to be routinely used for confidential discussions, extend partitions between the structural floor slabs and enhance the space with acoustical insulation to decrease sound transmission. STC requirements are for the entire assembly and not individual components (door, window, etc.).

Figure 2-4 Attorney Office Room Data Sheet

Description/Usage		A2, A3, and A6 (in the Jones Building) are private attorney offices. A2 can also be used as an instructor's office at the AFJAG School.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated, AT compliant
Doors	**Type**	Wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Side view panels
Finishes	**Walls**	Level 2
	Floor	Level 2
	Base	Level 2
	Ceiling	Level 2
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One per desk
	Data	NIPR, SIPR (as required)
	CCTV	N/A
	CATV	N/A
	Security	Duress alarm
Acoustics		Floors, partitions, and ceilings meet or exceed the STC 50 requirement. Windows and doors meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E)		Provide 6' wood-finish systems furniture with computer connections. Include 1 swivel chair, 2 straight visitor chairs, a whiteboard, and a bookshelf (for A3).
Special Requirements		Offices require additional acoustical privacy; extend partitions between the structural floor slabs and enhance the space with acoustical insulation to decrease sound transmission. STC requirements are for the entire assembly and not just individual components (door, window, etc.).

Figure 2-5 Senior Attorney Office Room Data Sheet

Description/Usage		A4 is a large private office for the senior attorney, styled for leadership functions, with upgraded finishes. A7 is a similar office for AFLOA directors in the Jones Building.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated, AT compliant
Doors	**Type**	Wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Side view panels
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One per desk
	Data	NIPR, SIPR (as required)
	CCTV	Yes
	CATV	N/A
	Security	Duress alarm
Acoustics		Floors, partitions, and ceilings meet or exceed the STC 50 requirement. Windows and doors meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E)		For A4, provide a 6' free-standing wood executive desk, credenza, a leather swivel chair, 2 leather visitor chairs, and a 30" x 72" rectangular wood table with 6 leather swivel chairs. Include a bookshelf, marker board, flat screen monitor, and lateral file storage. A7 has the same furnishings, except for a circular table seating 4.
Special Requirements		Offices require additional acoustical privacy; extend partitions between the structural floor slabs and enhance the space with acoustical insulation to decrease sound transmission. STC requirements are for the entire assembly and not just individual components (door, window, etc.).

2-2.4 Paralegal Work Spaces

A paralegal is someone trained and certified in legal matters and procedures who assists attorneys in practicing law. Paralegal work spaces are divided into two types – workstations and offices – depending on the work assigned. P1 is a 64-square-foot workstation with an L-shaped desk and rear work surface. P4 is a 100-square-foot workstation, limited to the Jones Building, with additional space for seats or cabinets. Individual workstations are typically grouped together in an open office arrangement and have specialized visual and acoustical considerations. The height of the partitions depends on Air Force corporate standards. Integrate the workstation design with power, communications, and other building systems. P2 is a private office (same as the A1 office) required for certain responsibilities (e.g., performing client interviews, preparing witnesses, counseling victims, or serving as law office superintendent [LOS]). P3 is a private office for major command (MAJCOM) functional managers, with the same requirements as the A2 office.

Figure 2-6 Paralegal Work Spaces

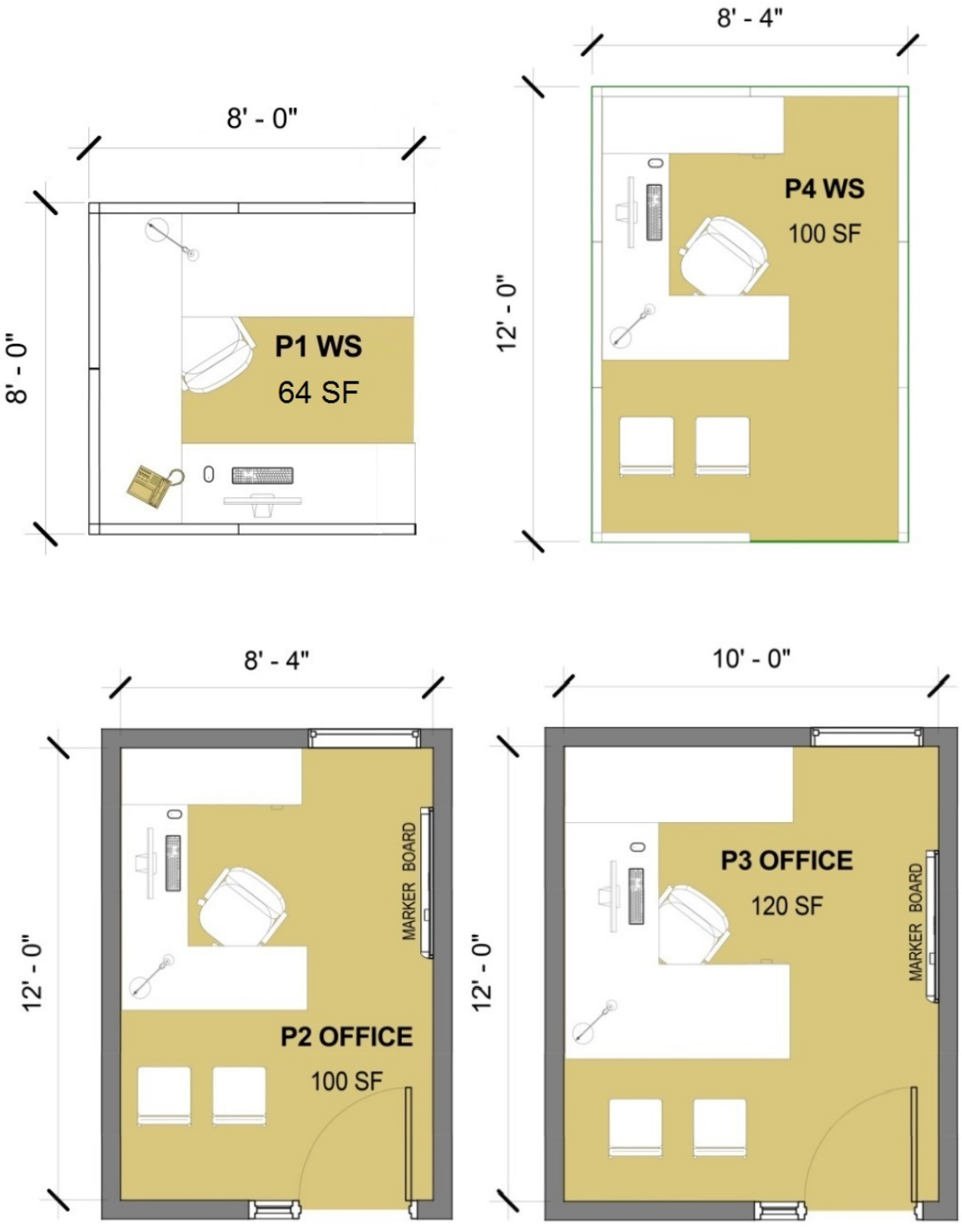


Figure 2-7 Paralegal Workstation Room Data Sheet

Description/Usage		An open office space designed to utilize furniture system components that delineate space and provide visual privacy.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	N/A
	Security/ Hardware	N/A
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 2
	Floor	Level 2
	Base	Level 2
	Ceiling	Level 2
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		For P1, provide modular systems furniture with computer connection capabilities, demountable partitions with fabric walls, and a swivel chair. Include work surfaces, storage, lighting, and electrical and communications distribution. Maximize storage in the furniture system design; include task lighting for each workstation. Integrate power, data, and communications with the furniture system panel.
Special Requirements		For P2 and P3, see room data sheets for General Office (Figure 2-3) and A2 Attorney Office (Figure 2-4), respectively.

2-2.5 Conference Rooms

Conference rooms are areas used for staff meetings, training, teleconferences, witness interviews, meetings with commanders and investigators, and other activities. Conference space requires flexibility, durable finishes to anticipate maximum use, and integrated utility lines, such as voice, data, and power, to accommodate a variety of multimedia presentations and VTCs, when required. Conference rooms are divided into four types. C1 is a small space (huddle room) with seating for six. C2 is the standard conference room, with seating for nine at the table. C3 is a larger room, with seating for 15 at the table. Both C2 and C3 can double as library space, if required. C4 is the largest room, with seating for 21 at the table. When not in use for large gatherings, C4 can be divided into two smaller meeting spaces. C2, C3, and C4 are large enough to accommodate VTC presentations, a lectern, and flags for an award ceremony, as well as bookshelves, file storage, or secondary seating along the walls.

Figure 2-8 Conference Rooms

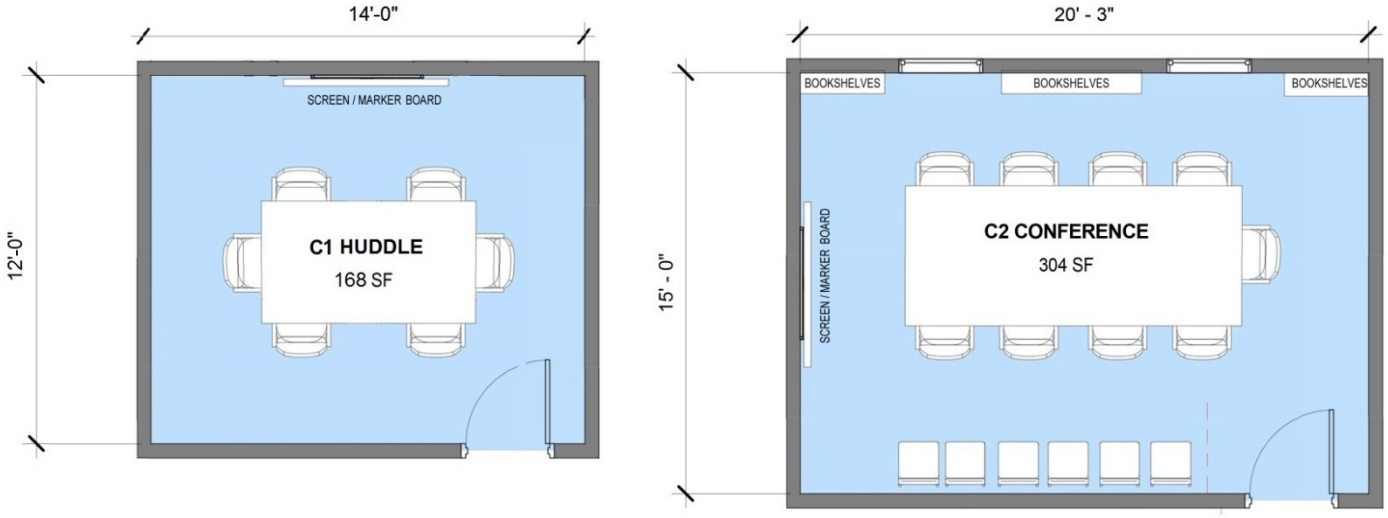


Figure 2-8 Conference Room (continued)

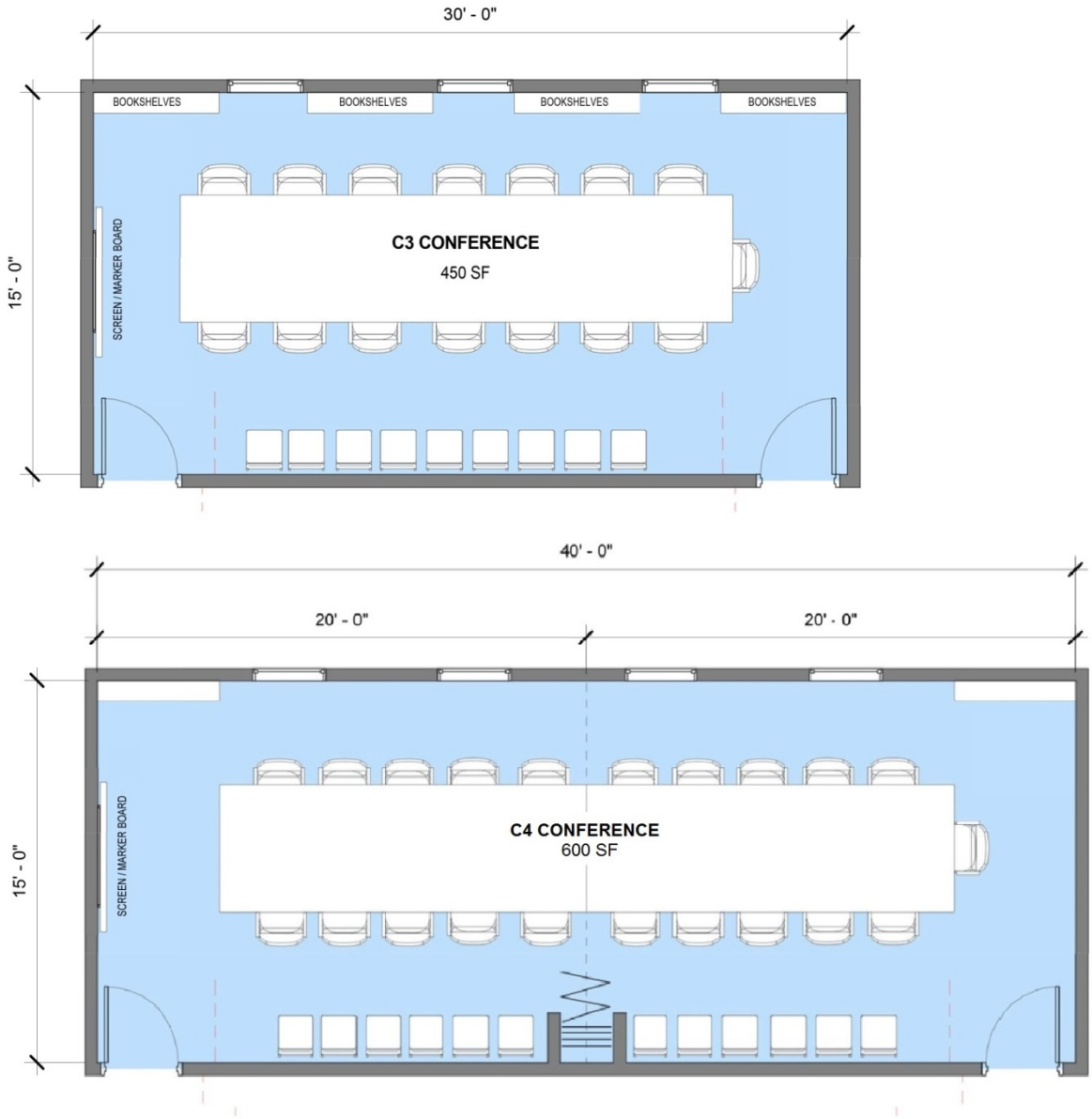


Figure 2-9 Conference Room Data Sheet

Description/Usage		Meeting space that serves both senior staff and office personnel for a variety of meetings. Size varies based on the office UMD.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated, AT compliant
Doors	**Type**	Wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One conference-ready phone
	Data	NIPR, SIPR (as required)
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Floors, partitions, and ceilings meet or exceed the STC 50 requirement. Windows and doors meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E)		For C1, include 30" x 72" rectangular table; for C2, include 5 'x 12' table; for C3, include 5' x 22' table; for C4 include two 5 'x 13' tables. For C2, C3, and C4, provide wall-mounted video monitor, VTC capable (when required), swivel chairs for number of seats at table, chairs for secondary seating along the walls. Include bookshelves and file storage if used for other purposes.
Special Requirements		Room STC requirements are for the entire assembly and the individual components (door, window, etc.). Enclose the conference room with partitions that extend from the finished floor to the structure above. Provide clearance around conference table, with extra seating along at least one wall.

2-2.6 Work Rooms

Work rooms can accommodate a variety of office systems, such as printer/copiers, facsimile machines, scanners, and shredders, as well as files, office supplies, safes, and actual work spaces. There are three primary types: a small, open work space and two larger, scalable spaces that can be enlarged to meet specific office requirements. W1 includes space for a copier, a supply cabinet, and two file cabinets. W2 is a standard-size work room, with space for one copier, supply storage, and a countertop work space. W3 is sized for larger offices and includes space for two copiers, supply material storage, two to four lateral file cabinets, and a work table area.

Figure 2-10 Work Rooms

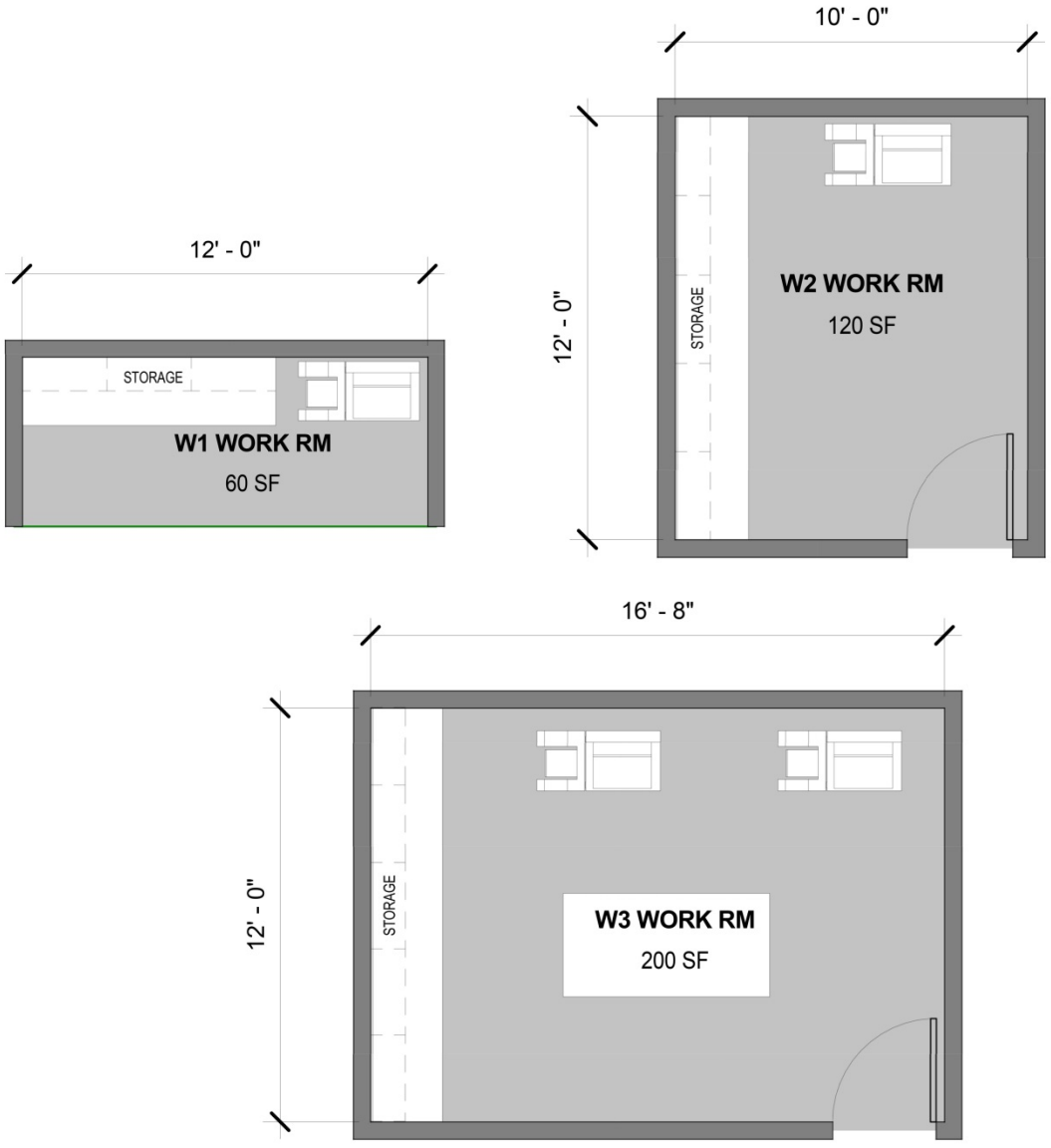


Figure 2-11 Work Room Data Sheet

Description/Usage		Common space that is available for all personnel in the office. Room provides space for a large, production-quality print/copy machine, and for staff to assemble reports and records of trial, prepare for litigation, review evidence, assist in investigations, etc.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	View panels, 5" x 20", for door to corridor
Finishes	**Walls**	Level 1
	Floor	Level 1
	Base	Level 1
	Ceiling	Level 1
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One, wall-mounted
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		For W1, W2, and W3, provide file cabinets, storage cabinets, and work countertop. W3 includes 3' x 6' work table and two multipurpose machines.
Special Requirements		Provide clearance around work table, when applicable.

2-2.7 Coffee Bar/Break Rooms

The activity levels in legal offices are often intense, requiring “eating in,” and the offices are frequently manned after normal work hours. Thus, it is beneficial for the staff to have access to a break area. Use one of four standard designs, depending on the size of the staff. In small offices, provide a stand-alone, walk-up coffee bar with a sink, microwave, and refrigerator. This can be combined with a copy room or work room. For medium-sized offices, provide a small break room with the same amenities as the coffee bar, along with table seating of 4 to 8 and a vending machine. For larger offices, provide a full break room with coffee bar amenities, along with space for two to four tables, seating 8 to 16, and two vending machines.

Figure 2-12 Coffee Bar/Break Rooms

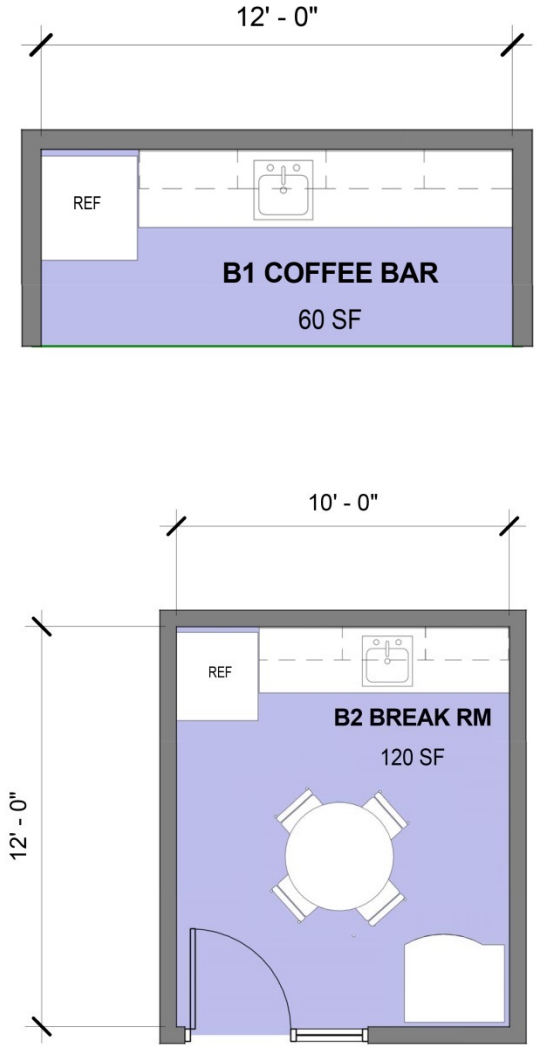
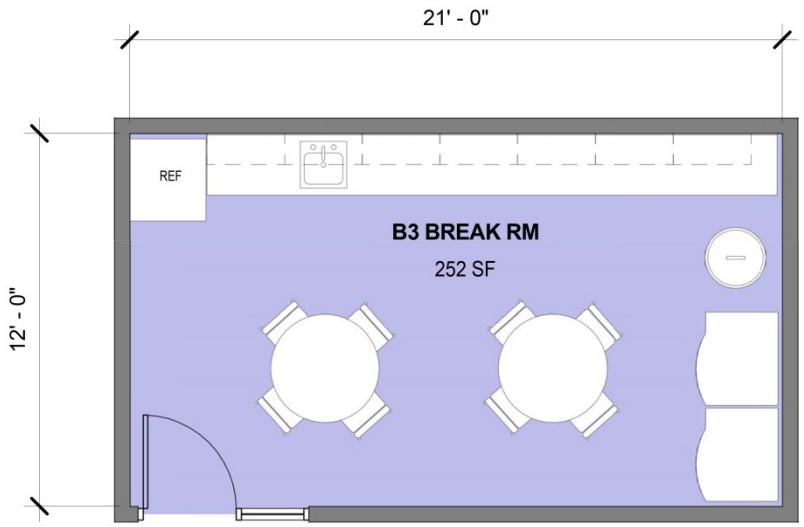


Figure 2-12 Coffee Bar/Break Rooms (continued)



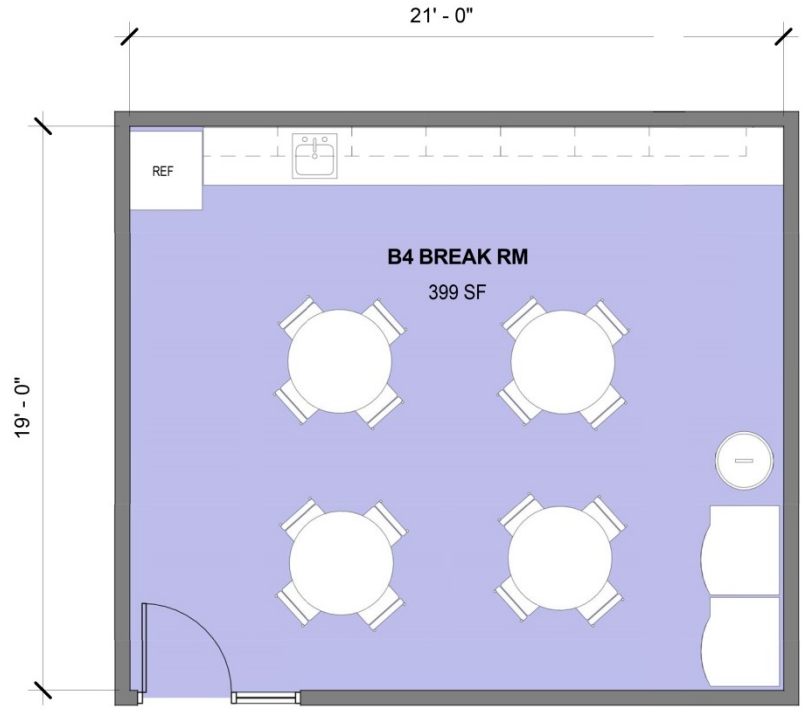


Figure 2-13 Coffee Bar Room Data Sheet

Description/Usage		A kitchenette open to the main work space, providing a small area for coffee-making, a microwave, a refrigerator, and a sink.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	N/A
	Security/ Hardware	N/A
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 1
	Floor	Level 1
	Base	Level 1
	Ceiling	Level 1
Plumbing		Sink with disposal, per UFC 3-420-01
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Provide 120V dedicated circuits for coffee maker, microwave, and refrigerator. Include 120V convenience outlets, per UFC 3-520-01.
Lighting		Per UFC 3-530-01
Communication	**Telephone**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Refrigerator, microwave, sink, water heater (under sink), upper and lower cabinets, and solid-surface countertop.
Special Requirements		N/A

Figure 2-14 Break Room Data Sheet

Description/Usage		Break rooms are used as informal gathering spaces for staff during lunch and breaks. They include a kitchenette for storage, warming, and minimal food preparation.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated, AT compliant
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	View panels, 5" x 20"
Finishes	**Walls**	Level 1
	Floor	Level 1
	Base	Level 1
	Ceiling	Level 1
Plumbing		Sink with disposal, per UFC 3-420-01
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		120V dedicated circuits for coffee maker, microwave, and refrigerator; 120V convenience outlets, per UFC 3-520-01.
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One, wall-mounted
	Data	NIPR
	CCTV	N/A
	CATV	One, wall-mounted (for B3 and B4)
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Provide refrigerator, microwave, dishwasher, sink, water heater (under sink), and solid-surface countertops for all break rooms. For B2 to B4, include vending machines and bulletin board. Include 1 to 4 round 36" plastic laminate tables, with 4 chairs per table for B3 and B4.
Special Requirements		Match break room finishes with surrounding area. Ensure appropriate utilities for all appliances.

2-2.8 Reception/Waiting Areas

The character and function of a reception/waiting area influences a client's or visitor's first impression of a legal office. Provide a space that balances aesthetics, security, and operational considerations. Separate client/visitor seating from, and control access to, the working portion of the office. Generally, provide for a receptionist in the waiting area. When required, depending on office operations, provide a CCTV or a secured partition/wall with a view window. If there is no receptionist, provide a door notification device.

Figure 2-15 Waiting/Reception Area

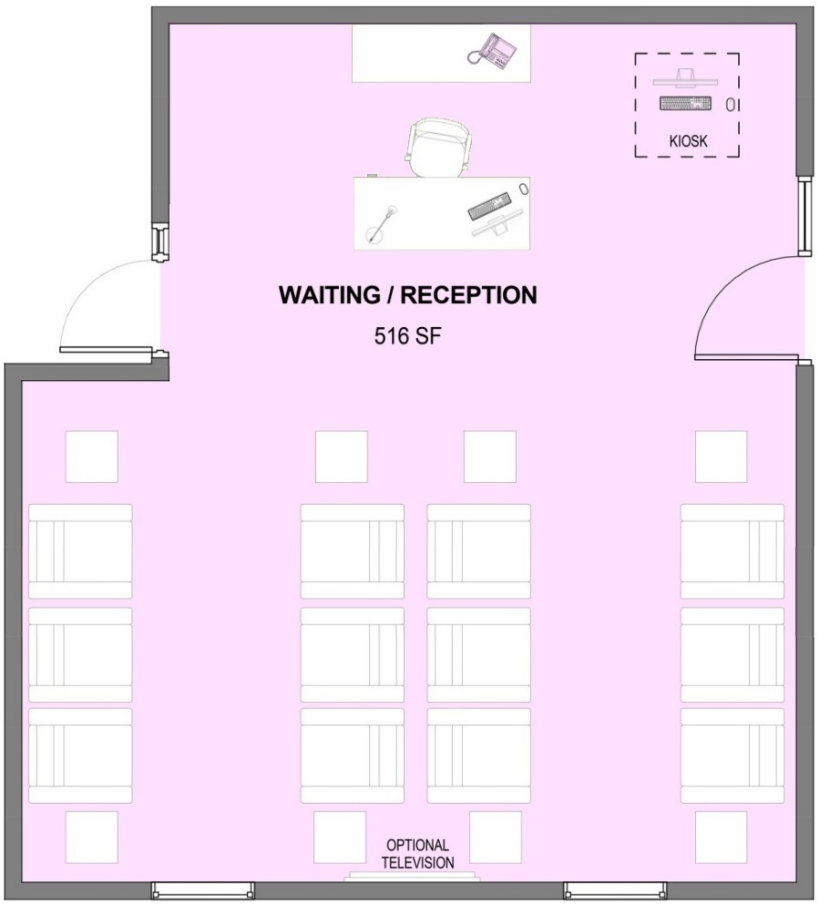


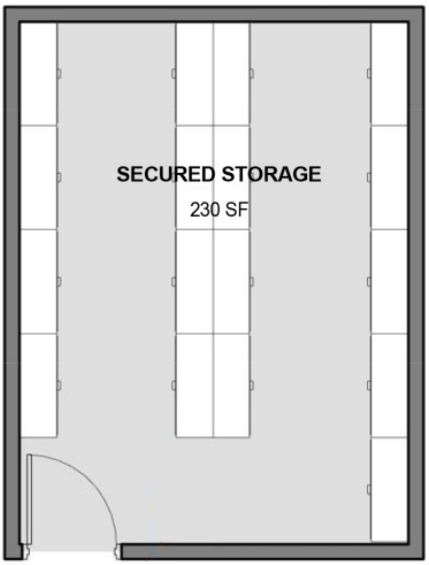
Figure 2-16 Waiting/Reception Area Room Data Sheet

Description/Usage		Waiting area and access control point where visitors are greeted by a receptionist prior to meeting with legal staff members. Seating area provided.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated, AT compliant
Doors	**Type**	Wood, 3' x 7'
	Security/ Hardware	Keyed lock set; cypher lock (as required)
	View Panels/ Kick-Plates	View Panels, 5" x 20"
Finishes	**Walls**	Level 2
	Floor	Level 2
	Base	Level 2
	Ceiling	Level 2
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One per desk
	Data	NIPR
	CCTV	N/A
	CATV	User justified
	Security	IDS, duress alarm (as required)
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Upholstered seating for visitors/clientele, depending on office requirements, with wood end tables. Include wood desk for receptionist when applicable. Provide space for a computer for check-ins and legal assistance support.
Special Requirements		Larger waiting areas include a TV.

2-2.9 Storage Areas

Storage areas are shared spaces containing files, materials, or equipment. Locate near the attorneys, paralegals, or administrative staff members that regularly use them. Storage areas may be enclosed with hard walls or in an open office area, depending on the type of materials stored and the need for security. Storage areas are utilitarian spaces that can be secured (lockable) or unsecured. Classified material storage must be in accordance with UFC 4-010-05.

Figure 2-17 Storage Rooms



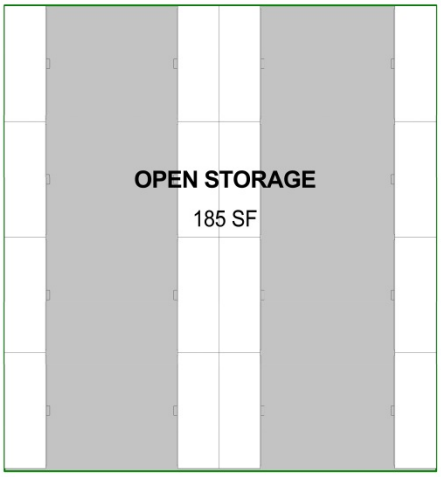


Figure 2-18 Secure Storage Area Room Data Sheet

Description/Usage		Space is used for storing files, supplies, and equipment. Provide a separate lockable room for storage of sensitive materials or high-value equipment.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set; IDS
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 1
	Floor	Level 1
	Base	Level 1
	Ceiling	Level 1
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	IDS
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Provide systems furniture bookshelves or lateral filing cabinets.
Special Requirements		Classified material storage must be in accordance with UFC 4-010-05.

Figure 2-19 Open Storage Area Room Data Sheet

Description/Usage		General open office area set aside for lateral files or storage cabinets.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	N/A
	Security/ Hardware	N/A
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 1
	Floor	Level 1
	Base	Level 1
	Ceiling	Level 1
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Provide bookshelves and/or lateral filing cabinets that match the office systems furniture design.
Special Requirements		N/A

CHAPTER 3 PENTAGON AND BASE LEGAL FACILITY

3-1 PENTAGON OFFICES

The Office of The Judge Advocate General, the Office of the Air Force General Counsel, and subordinate AF/JA and SAF/GC staffs are located primarily in the Pentagon. Because Pentagon facility design standards govern all Pentagon tenants, the requirements for those offices are not covered in this FC.

3-2 BASE LEGAL FACILITY/TRIAL COURTROOM

3-2.1 Function and Adjacency

Base legal facilities consist of the Office of the Staff Judge Advocate, supporting staff offices and work spaces, and a trial courtroom. The base legal office provides legal advice and counsel to base organizations and personnel in five major legal practice areas: military justice, civil law (i.e., administrative law, claims, contract law, environmental law, and labor law), operations law, international law (where applicable), and legal assistance. The overall size of a base legal office will vary, depending on unit mission and workload, but the size of individual offices and work spaces will follow the standard spaces previously described. The courtroom and its adjacent areas are essentially static and consist of three basic components: the courtroom itself, the arrangement of its internal components, and ancillary support spaces. Some support spaces, such as restrooms and a break room, can be shared with the base legal office to the extent they are collocated. Tax centers, where they exist, are command-level programs operated during tax season and are not accounted for in base legal facility requirements. Tax centers shall not be collocated in legal offices, absent additional space.

3-2.2 Base Legal Office Suite

Programming sheet: Figure 3-2

Special requirements: The office suite includes the SJA suite, attorney offices, LOS office, court reporter office, paralegal and administrative workstations, a conference room, a waiting/reception area, a work area, storage areas, and a break area. Additionally, nearby parking is required.

3-2.3 Trial Courtroom

Programming sheet: Figure 3-3

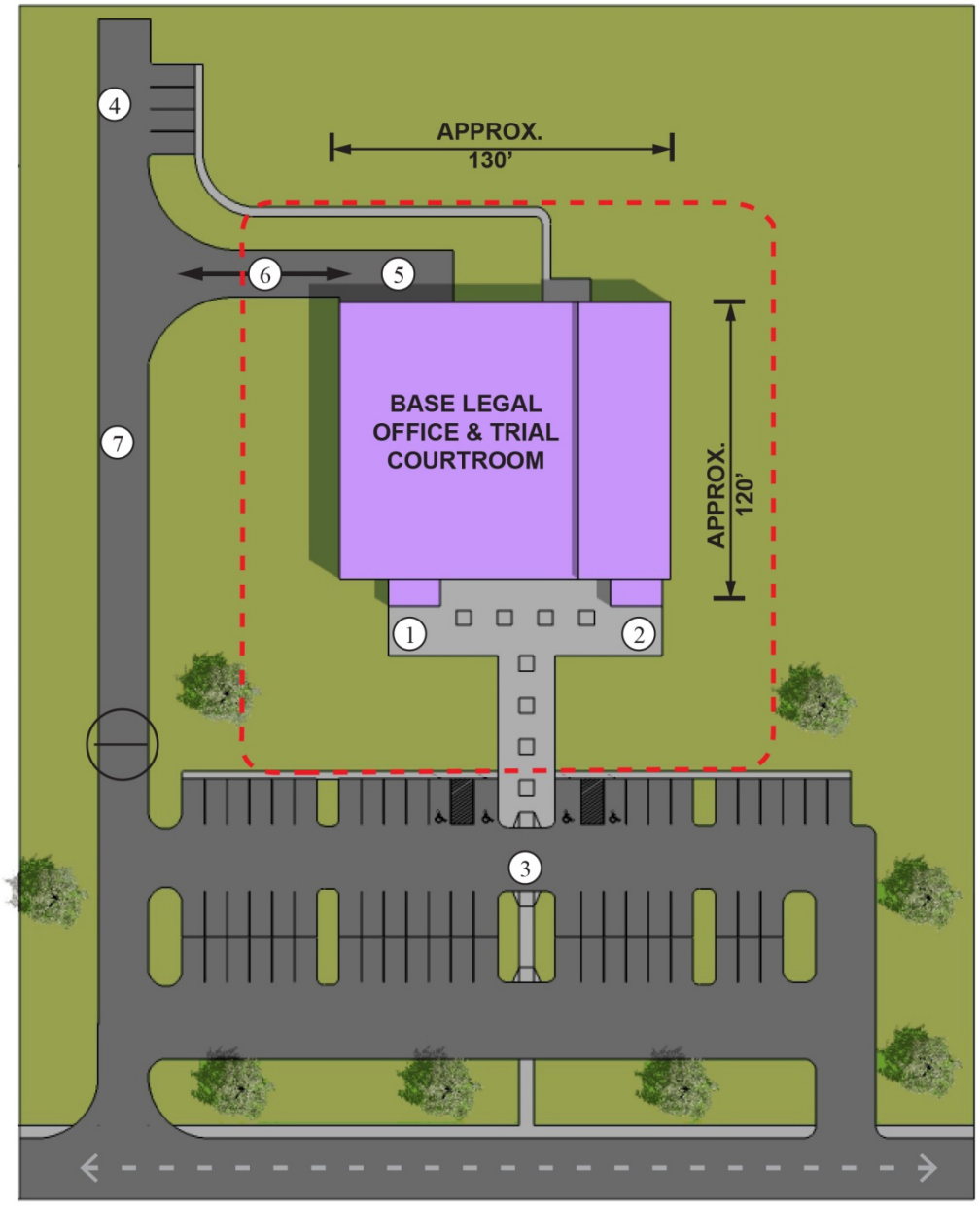
Special requirements: Include the judge’s bench, a court reporter station, a witness stand, a bailiff’s seat, the members’ box, trial and defense counsel tables, a gallery area, a judge’s chamber, private deliberation/conference room with coffee bar, trial and defense counsel preparation areas, witness/waiting rooms, a communications room, a judge’s restroom, a unisex restroom, and public restrooms.

3-2.4 Site Location

Base legal facilities are typically secondary tenants in buildings that serve another primary function (e.g., wing headquarters building). However, sometimes they are stand-alone facilities. Facility location is selected as part of the base master planning process, IDP, and ADP. Control public access to the office through a common reception area. Locate attorney offices so they are easily accessible from the reception area for legal assistance clients and other clients and visitors. In medium- and large-sized offices, personnel will be grouped in sections corresponding with the major legal practice areas (e.g., military justice, civil law, and international law). Locate the military justice section away from travel ways and in close proximity with the courtroom. Provide a direct connection to a front door for the public/visitors, with easy access, visibility, and well-lit, designated parking spaces for clients and those attending courtroom proceedings.

- Collocate base legal offices with or near the office of the installation commander.
- Avoid location near the ADC office, the SVC office, the Sexual Assault Response Coordinator (SARC) office, or the Inspector General (IG) office.

Figure 3-1 Base Legal/Trial Courtroom Notional Site Diagram



1. BASE LEGAL OFFICE ENTRY
2. COURTROOM ENTRY
3. POV PARKING
4. LEADERSHIP PARKING
5. UTILITY YARD
6. TRUCK ACCESS
7. SERVICE DRIVE (TWO WAY)

STANDOFF DISTANCE
REFERENCE UFC 4-010-01

ACCESS STREET

CONTROL POINT

Figure 3-2 Base Legal Office Programming Sheet

(This programming sheet is notional, in that it reflects the space requirements for the base legal office depicted in Figures 3-4 and 3-5. However, it can be used for all offices of the same type, using the formulas listed in the comments.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Base Legal Office							
Offices:							
A1: Court Reporter/Visiting Attorney	1	0	3	100	300	27.87	1,10
A2: Attorney	1	0	9	120	1080	100.332	1,10
A3: Deputy SJA	1	0	1	150	150	13.935	1,10
A4: SJA	1	0	1	216	216	20.0664	1,10
Paralegal Work Spaces:							
P1: Open	1	0	18	64	1152	107.0208	2,10
P2: LOS	1	0	1	100	100	9.29	2,10
P3: MAJCOM Functional Manager	1	0	0	120	0	0	2,10
Conference Rooms:							
C1: Huddle Room	6	0	0	168	0	0	3,10
C2: Small	15	0	0	304	0	0	3,10
C3: Medium	30	0	1	450	450	41.805	3,10
C4: Large	45	0	0	600	0	0	3,10
Work Rooms:							
W1: Open Work Area	0	0	0	60	0	0	4,10
W2: Work Room	0	0	0	120	0	0	4,10
W3: Work Room	0	0	1	200	200	18.58	1,5
Break Rooms:							
B1: Coffee Bar	0	0	0	60	0	0	5,10
B2: Break Room	0	0	0	120	0	0	5,10
B3: Break Room	0	0	0	252	0	0	5,10
B4: Break Room	0	0	1	399	399	37.0671	5,10
Storage:							
S1: Open Storage	0	0	1	184	184	17.0936	6,10
S2: Closed/Secure Area	0	0	1	238	238	22.1102	6,10
S3: Special Storage	0	0	0	0	0	0	7,10
Other:							
Waiting/Reception Area	16	0	1	707	707	65.6803	8,10
Total Facility Net Floor Area					5176	480.85	
Net to Gross	15.00%				776	72.13	
Total Facility Gross Area					5952	552.98	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	31				31	9
Clients	13				13	9
Total Number of Parking Spaces					44	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A4 - 1, for SJA; A3 - 1, for DSJA; A2 - for other attorneys, as authorized on UMD; A1 - for court reporter(s), as authorized on UMD, and visiting attorney space (1, for 3-9 authorized attorneys; 2, for 10 or more authorized attorneys).
2. Paralegal/Administrative Work Spaces: P2 - 1, for LOS; P1 - for other paralegals and administrative staff, as authorized on UMD.
3. Conference Rooms: C1 - 1-6 personnel; C2 - 7-15 personnel; C3 - 16-30 personnel; C4 - 31 or more personnel, as authorized on UMD. Seating at table and along one long wall. 150 sq. ft. added in C3 and C4 for speaker, per AFMAN 32-1084, Table 6.4.
4. Work Rooms: W1 - 1-4 personnel; W2 - 5-10 personnel; W3 - 11 or more personnel, as authorized on UMD.
5. Break Rooms: B1 - 1-10 personnel; B2 - 11-20 personnel; B3 - 21-30 personnel; B4 - 31 or more personnel, as authorized on UMD.
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: As required (e.g., safe or SCIF).
8. Waiting/Reception Area: # authorized attorneys X 1.5.
9. Parking spaces (basic requirement): # authorized personnel (staff) + # authorized attorneys + 2 (legal assistance) + 30 (courtroom participants - see Trial Courtroom Sheet).
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

Figure 3-3 Trial Courtroom Programming Sheet

(This programming sheet is notional, in that it reflects the space requirements for the trial courtroom depicted in Figures 3-4 and 3-5.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	INDIVIDUAL ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Trial Courtroom							
Offices:							
Witness/Waiting Room	3	0	3	120	360	33.444	5
Security Office	1	0	1	120	120	11.148	5
Judge's Chamber	1	0	1	200	200	18	5
Conference Rooms:							
Jury Deliberation	12	0	1	355	355	33	1,5
Storage:							
S2: Closed/Secure Area	0	0	1	104	104	9.6616	2,5
Other:							
Courtroom	50	0	1	1750	1750	167	3,5
Lobby	0	0	1	60	60	5.574	5
Vestibule	0	0	1	231	231	21.4599	5
Communications Room	1	0	1	148	148	13.7492	5
Unisex Jury Restroom	1	0	1	108	108	10.0332	4,5
Judge's Restroom	1	0	1	145	145	13.4705	4,5
Total Facility Net Floor Area					3669	231.00	
Net to Gross	15.00%				550	35.00	
Total Facility Gross Area					4219	266.00	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
Courtroom Participants/Spectators	30				30	
Total Number of Parking Spaces					30	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Deliberation room includes space for coffee bar.
2. Storage closet for security and AV equipment.
3. Courtroom includes the judge's bench, court reporter station, witness stand, jury box (with seating for 12), well of the court (including 2 tables with seating for 3 each facing the bench), gallery (with seating for 25-30 spectators), and VTC capability. A private entrance for jury members connects circulation, courtroom, and deliberation spaces. A vestibule should be included for transition from the judge's chamber to the bench.
4. Restrooms included for judge, jury, counsel, and witnesses.
5. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

Figure 3-4 Base Legal Office and Trial Courtroom Adjacency Diagram

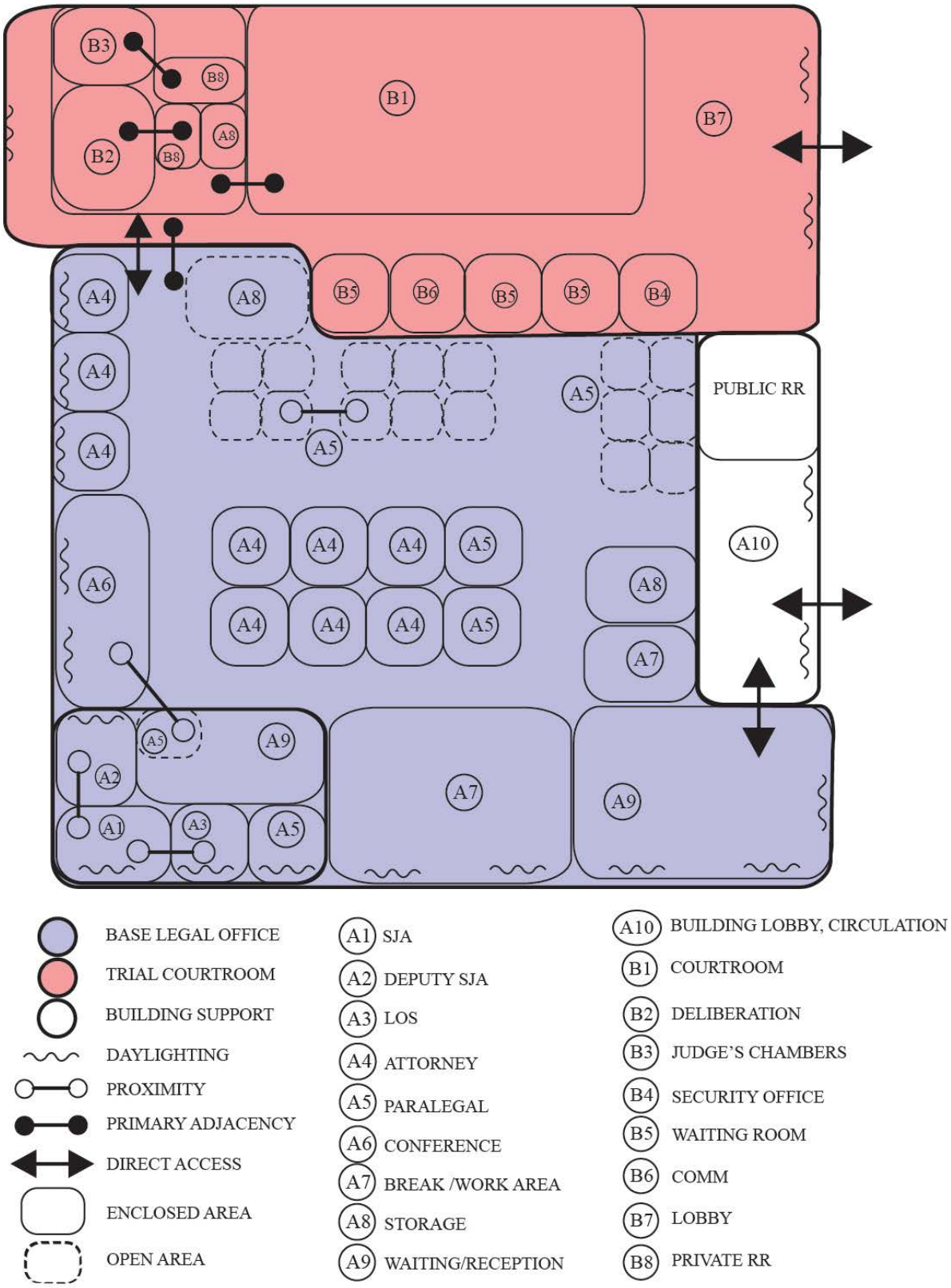
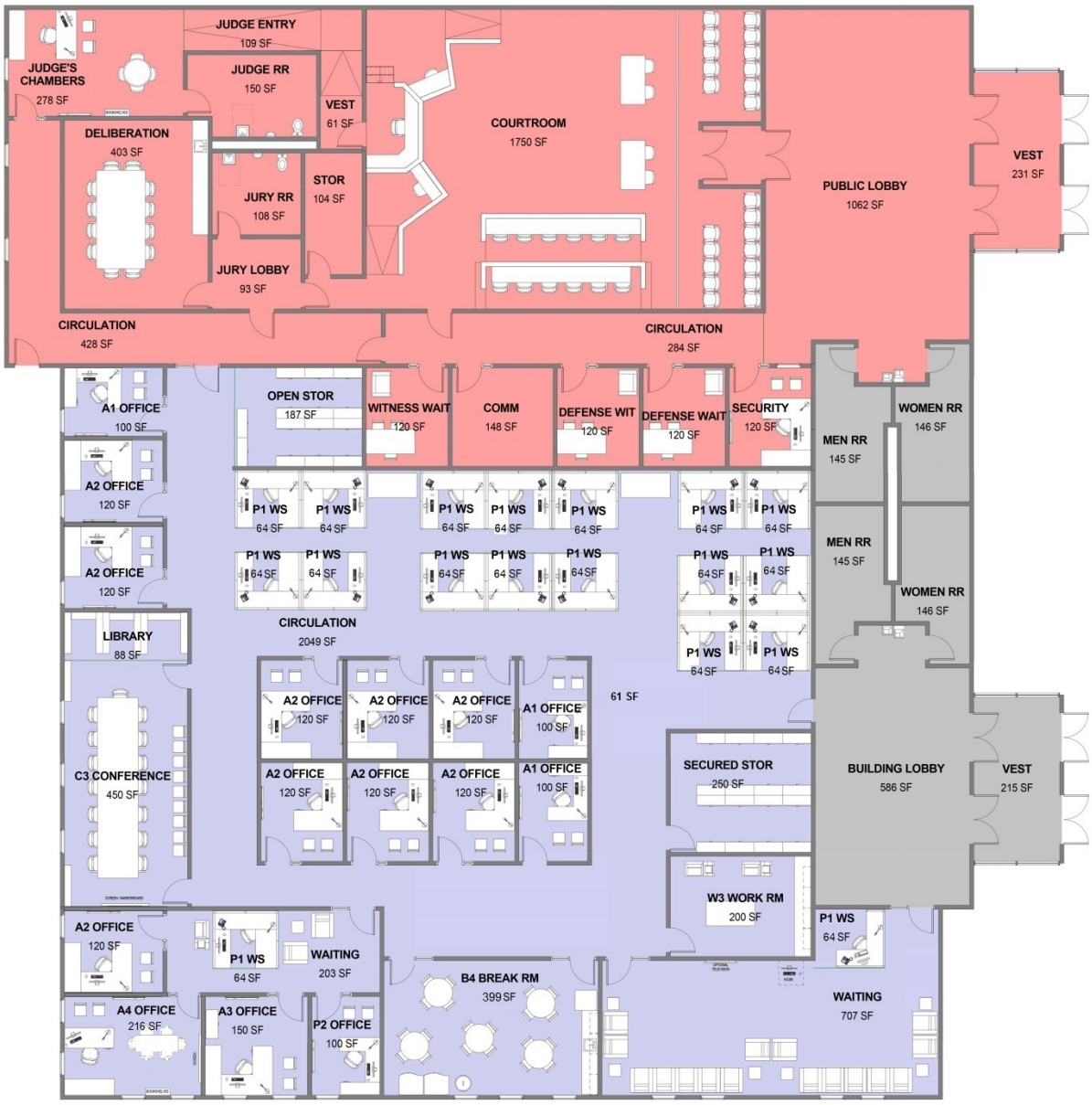


Figure 3-5 Base Legal Office and Trial Courtroom Notional Floor Plan



3-2.5 Base Legal Office Room Data Sheet

Figure 3-6 A3 and A4 Leadership Suite Room Data Sheet

Description/Usage		The leadership suite includes offices for the SJA, Deputy SJA, LOS, and a secretary (if assigned). The suite may also include a small waiting area for visitors.
Ceiling Height		9'-0" minimum
Windows		Exterior glazing, AT compliant
Doors	**Type**	Solid wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Side view panel
Finishes	**Walls**	A3 - Level 2; A4 - Level 3
	Floor	A3 - Level 2; A4 - Level 3
	Base	A3 - Level 2; A4 - Level 3
	Ceiling	A3 - Level 2; A4 - Level 3
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One per desk
	Data	NIPR, SIPR (as required)
	CCTV	N/A
	CATV	N/A
	Security	Duress alarm
Acoustics		Floors, partitions, and ceilings will meet or exceed the STC 50 requirement. Windows and door meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		For A3, provide a L-shaped desk, credenza, one leather swivel chair, two leather visitor chairs, whiteboard, bookshelf, and lateral file storage. For A4, provide a 6' free-standing wood executive desk, credenza, one leather swivel chair, two leather visitor chairs, marker board, bookshelf, a 30" x 72" rectangular wood table with 6 leather swivel chairs, and a wall-mounted flat screen monitor.
Special Requirements		Offices require additional acoustical privacy; extend partitions between the structural floor slabs, and enhance the space with acoustical insulation to decrease sound transmission. STC requirements are for the entire assembly and not just individual components (door, window, etc.).

3-2.6 Trial Courtroom Room Data Sheets

Figure 3-7 Courtroom Room Data Sheet

Description/Usage		Courtrooms are used to conduct judicial and other proceedings. Spaces include a judge's bench, court reporter station, witness stand, jury members' box, gallery area, trial and defense counsel areas, bailiff seat, a judge's chambers, witness/waiting rooms, deliberation/conference room with coffee bar, communications room, unisex restroom, judge's restroom, and public restrooms. Gallery area sits 25–30 spectators.
Ceiling Height		12'-0" minimum
Windows		Clearstory or no windows
Doors	**Type**	Solid wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels Kick-Plates	None
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles for all equipment at court reporter stand and counsel tables, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	Include amplification, recording system, microphones for judge, witness, counsel, and members
	Data	NIPR for judge and court reporter; VTC and speaker telephone capability
	CCTV	N/A
	CATV	N/A
	Security	Duress alarms at judge's bench and court reporter station
Acoustics		Floors, partitions, and ceilings meet or exceed the STC 50 requirement. Doors and windows meet or exceed the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		Provide 16 high-back leather swivel chairs and one straight upholstered witness chair. Include theater-style chairs for gallery, with movable rail. Include two 3'-6" x 7'-0" counsel tables and six straight upholstered chairs. Provide an integrated bench/workstation for judge, court reporter, and witness, a bailiff's seat, and a pull-down projection screen.
Special Requirements		Elevate judge's bench 18" from finished floor, face with bullet-resistant front panels. Elevate witness stand/court reporter 8" from finished floor. Jury members' box area to be double-tiered raised platform.

Figure 3-8 Courtroom Lobby/Foyer Data Sheet

Description/Usage		Open public space for spectators to gather and wait until the courtroom opens.
Ceiling Height		12’-0” minimum
Windows		Exterior glazing, AT compliant
Doors	**Type**	Wood double doors, 3’ x 7’
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Glass center panels, with blinds
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		Per UFC 3-420-01
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	IDS
Acoustics		Floors, partitions, and ceilings will meet or exceed the STC 30 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		N/A
Special Requirements		Provide floor electrical outlet in center of space to accommodate security scanning equipment.

Figure 3-9 Judge's Chamber Data Sheet

Description/Usage		Judge will have a private area contiguous to the courtroom, with direct access to the bench. Private office includes small conference area with seating for four.
Ceiling Height		9'-0" minimum
Windows		Exterior glazing, AT compliant
Doors	**Type**	Solid wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Side-view panel
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		Per UFC 3-420-01
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	Duress alarm
Acoustics		Floors, partitions, and ceilings will meet or exceed the STC 50 requirement. Windows and doors meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		Provide 6'-0" wood executive desk, credenza, leather executive swivel chair. Include four swivel leather chairs, two guest upholstered chairs, 4' round table, projection screen, and whiteboard.
Special Requirements		Provide direct access from courtroom for the judge to avoid passing other court participants or observers when entering or leaving the chamber. Include adjacent bathroom.

Figure 3-10 Witness/Waiting Room Data Sheet

Description/Usage		Quiet private rooms for both prosecution and defense witnesses, located with easy access to the courtroom. Interiors not visible to spectators.
Ceiling Height		9'-0" minimum
Windows		None
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	None
Finishes	**Walls**	Level 2
	Floor	Level 2
	Base	Level 2
	Ceiling	Level 2
Plumbing		None
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One, wall-mounted
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	Duress alarm
Acoustics		Floors, partitions, and ceilings will meet or exceed the STC 50 requirement. Windows and doors meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		Provide table/desk and three swivel chairs.
Special Requirements		Standard applies to both prosecution and defense witness rooms.

Figure 3-11 Deliberation Room Data Sheet

Description/Usage		The deliberation room is a conference room that accommodates 12 to 14 jury members. It includes adjacent unisex restroom and a minimal coffee bar with sink.
Ceiling Height		9'-0" minimum
Windows		None
Doors	**Type**	Solid wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 2
	Floor	Level 2
	Base	Level 2
	Ceiling	Level 2
Plumbing		Per UFC 3-420-01
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One, wall-mounted
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Floors, partitions, and ceilings will meet or exceed the STC 50 requirement. Doors will meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		Provide A/V equipment and cabinet, 12-person wood conference table, 12 swivel chairs with 2 extra chairs, and whiteboard.
Special Requirements		Direct access to courtroom near the jury members' box to ensure the jury has as little contact as possible with other participants in the proceedings.

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CHAPTER 4 INTERMEDIATE HEADQUARTERS LEGAL OFFICES

4-1 INTERMEDIATE HEADQUARTERS LEGAL OFFICES (MAJCOM, NAF, CENTER, AND DRU)

4-1.1 Function and Adjacency

- Major command (MAJCOM) offices
- Numbered Air Force (NAF) offices
- Center offices (under Air Force Materiel Command [AFMC])
- Direct reporting unit (DRU) offices (see paragraph 4-2)

4-1.2 MAJCOM Offices

The ten MAJCOM legal offices function primarily as legal advisors to the senior MAJCOM staff. They also exercise professional oversight and supervision over the geographically separated base legal offices in their commands.

Programming sheet: Figure 4-1

4-1.3 NAF Offices

NAF legal offices are generally smaller and have an operational focus. The 19 NAF offices serve as legal advisors to the NAF staffs and concentrate primarily on military justice and operations law.

Programming sheet: Figure 4-2

4-1.4 Center Offices

The six Center legal offices in AFMC focus variously on military justice, procurement, technology transfer and development, and installation support management.

Programming sheet: Figure 4-2

Note: The Space and Missile Center at Los Angeles AFB, California, and the Air Force Warfare Center at Nellis AFB, Nevada, both provide installation-level legal support and use Figures 3-2 and 3-3.

4-1.5 Site Location

Intermediate headquarters (IHQ) legal offices will vary in size, depending on the organizations and missions they support. However, similar to base legal offices, the sizes of individual offices and support spaces will remain constant and reflect the previously established space standards in Chapter 2.

The preferred location is in a command headquarters building, with easy access to the commander.

The office does not need direct access to the main entrance.

Figure 4-1 MAJCOM Programming Sheet

(This programming sheet is notional, in that it reflects the space requirements for the MAJCOM legal office depicted in Figures 4-3 and 4-4. However, it can be used for all offices of the same type, using the formulas listed in the comments.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Intermediate HQ Legal Offices (MAJCOMs)							
Offices:							
A1: General Office/Visiting Attorney	1	0	1	100	100	9.29	1,10
A2: Attorney	1	0	7	120	840	78.036	1,10
A3: Deputy SJA	1	0	1	150	150	13.935	1,10
A4: SJA	1	0	1	216	216	20.0664	1,10
Paralegal Work Spaces:							
P1: Open	1	0	5	64	320	29.728	2,10
P2: LOS/Standard	1	0	1	100	100	9.29	2,10
P3: MAJCOM Funtional Manager	1	0	1	120	120	11.148	2,10
Conference Rooms:							
C1: Huddle Room	6	0	0	168	0	0	3,10
C2: Small	15	0	1	304	304	28.2416	3,10
C3: Medium	30	0	0	450	0	0	3,10
C4: Large	45	0	0	600	0	0	3,10
Work Rooms:							
W1: Open Work Area	0	0	0	60	0	0	4,10
W2: Work Room	0	0	0	120	0	0	4,10
W3: Work Room	0	0	1	200	200	18.58	4,10
Break Rooms:							
B1: Coffee Bar	0	0	0	60	0	0	5,10
B2: Break Room	0	0	1	120	120	11.148	5,10
B3: Break Room	0	0	0	252	0	0	5,10
B4: Break Room	0	0	0	399	0	0	5,10
Storage:							
S1: Open Storage Area	0	0	0	185	0	0	6,10
S2: Closed/Secure Area	0	0	1	215	215	19.9735	6,10
S3: Special Storage	0	0	0	210	0		7,10
Other:							
Waiting/Reception Area	2	0	1	220	220	20.438	8,10
Total Facility Net Floor Area					2905	269.87	
Net to Gross	15.00%				436	40.48	
Total Facility Gross Area					3341	310.36	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	16				16	9
Total Number of Parking Spaces					16	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A4 - 1, for SJA; A3 - 1, for DSJA; A2 - for other attorneys, as authorized on UMD; A1 - for visiting attorney (1, for 3-9 authorized attorneys; 2, for 10 or more authorized attorneys).
2. Paralegal/Administrative Work Spaces: P3 - 1, for MAJCOM Functional Manager; P2 - 1, for LOS; P1 - for other paralegals and administrative personnel, as authorized on UMD.
3. Conference Room: C1 - 1-6 personnel; C2 - 7-15 personnel; C3 - 16-30 personnel; C4 - 31 or more personnel, as authorized on UMD. Seating at table and along one long wall. 150 sq. ft. added in C3 and C4 for speaker, per AFMAN 32-1084, Table 6.4.
4. Work Room: W1 - 1-4 personnel; W2 - 5-10 personnel; W3 - 11 or more personnel, as authorized on UMD.
5. Break Room: B1 - 1-10 personnel; B2 - 11-20 personnel; B3 - 21-30 personnel, as authorized on UMD.
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: As required (e.g., safe or SCIF).
8. Waiting/Reception Area: 2, in leadership suite.
9. Parking spaces (basic requirement): # authorized on UMD.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

Figure 4-2 NAF and Center Programming Sheet

(This programming sheet is notional, in that it reflects the space requirements for the NAF legal office depicted in Figures 4-5 and 4-6. However, it can be used for all NAF and AFMC Center offices, using the formulas listed in the comments.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Intermediate HQ Legal Offices (NAFs & Centers)							
Offices:							
A1: General Office/Visiting Attorney	1	0	1	100	100	9.29	1,10
A2: Attorney	1	0	3	120	360	33.444	1,10
A3: Deputy SJA	1	0	1	150	150	13.935	1,10
A4: SJA	1	0	1	216	216	20.0664	1,10
Paralegal Work Spaces:							
P1: Open	1	0	3	64	192	17.8368	2,10
P2: NAF Paralegal Manager/LOS/Standard	1	0	1	100	100	9.29	2,10
P3: MAJCOM Function Manager	1	0	0	120	0	0	2,10
Conference Rooms:							
C1: Huddle Room	6	0	0	168	0	0	3,10
C2: Small	15	0	1	304	304	28.2416	3,10
C3: Medium	30	0	0	450	0	0	3,10
C4: Large	45	0	0	600	0	0	3,10
Work Rooms:							
W1: Open Work Area	0	0	0	60	0	0	4,10
W2: Workroom	0	0	1	120	120	11.148	4,10
W3: Workroom	0	0	0	200	0	0	4,10
Break Rooms:							
B1: Coffee Bar	0	0	1	60	60	5.574	5,10
B2: Breakroom	0	0	0	120	0	0	5,10
B3: Breakroom	0	0	0	252	0	0	5,10
B4: Breakroom	0	0	0	399	0	0	5,10
Storage:							
S1: Open Storage Area	0	0	0	185	0	0	6,10
S2: Closed/Secure Area	0	0	1	254	254	23.5966	6,10
S3: Special Storage	0	0	0	215	0	0	7,10
Other:							
Waiting/Reception Area	2	0	1	220	220	20.438	8,10
	0	0	0	0	0	0	
	0	0	0	0	0	0	
	0	0	0	0	0	0	
Total Facility Net Floor Area					2076	192.86	
Net to Gross	15.00%				311	28.93	
Total Facility Gross Area					2387	221.79	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	9				9	9
Total Number of Parking Spaces					9	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A4 - 1, for SJA; A3 - 1, for DSJA; A2 - for other attorneys, as authorized on UMD; A1 - for visiting attorney (1, for 3-9 authorized attorneys; 2, for 10 or more authorized attorneys).
2. Paralegal/Administrative Work Spaces: P2 - 1, for NAF Paralegal Manager/LOS; P1 - for other paralegals and administrative personnel, as authorized on UMD.
3. Conference Room: C1 - 1-6 personnel; C2 - 7-15 personnel; C3 - 16-30 personnel; C4 - 31 or more personnel, as authorized on UMD. Seating at table and along one long wall. 150 sq. ft. added in C3 and C4 for speaker, per AFMAN 32-1084, Table 6.4.
4. Work Room: W1 - 1-4 personnel; W2 - 5-10 personnel; W3 - 11 or more personnel, as authorized on UMD.
5. Break Room: B1 - 1-10 personnel; B2 - 11-20 personnel; B3 - 21-30 personnel; B4 - 31 or more personnel, as authorized on UMD.
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: As required (e.g., safe or SCIF).
8. Waiting/Reception Area: 2, in leadership suite.
9. Parking spaces (basic requirement): # authorized on UMD.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

Figure 4-3 MAJCOM Legal Office Adjacency Diagram

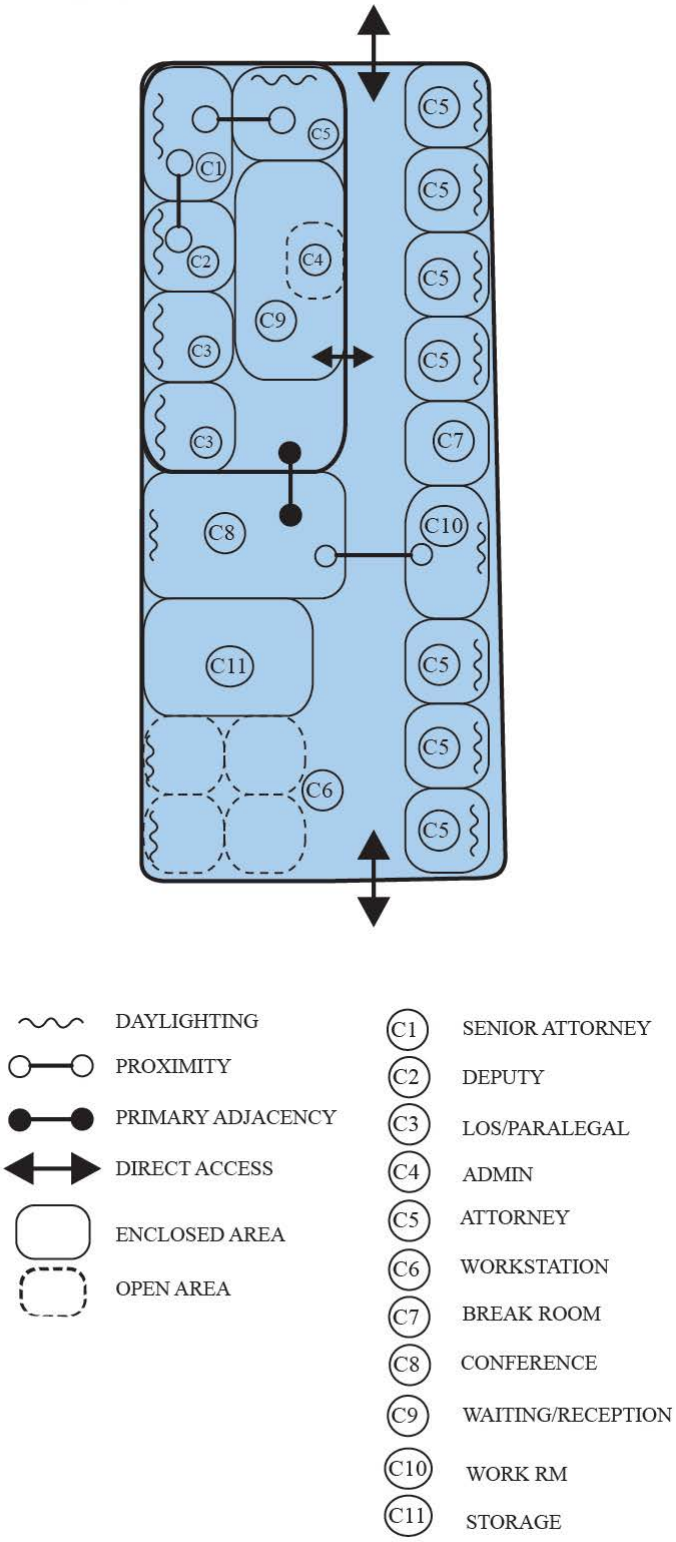


Figure 4-4 MAJCOM Legal Office Notional Floor Plan

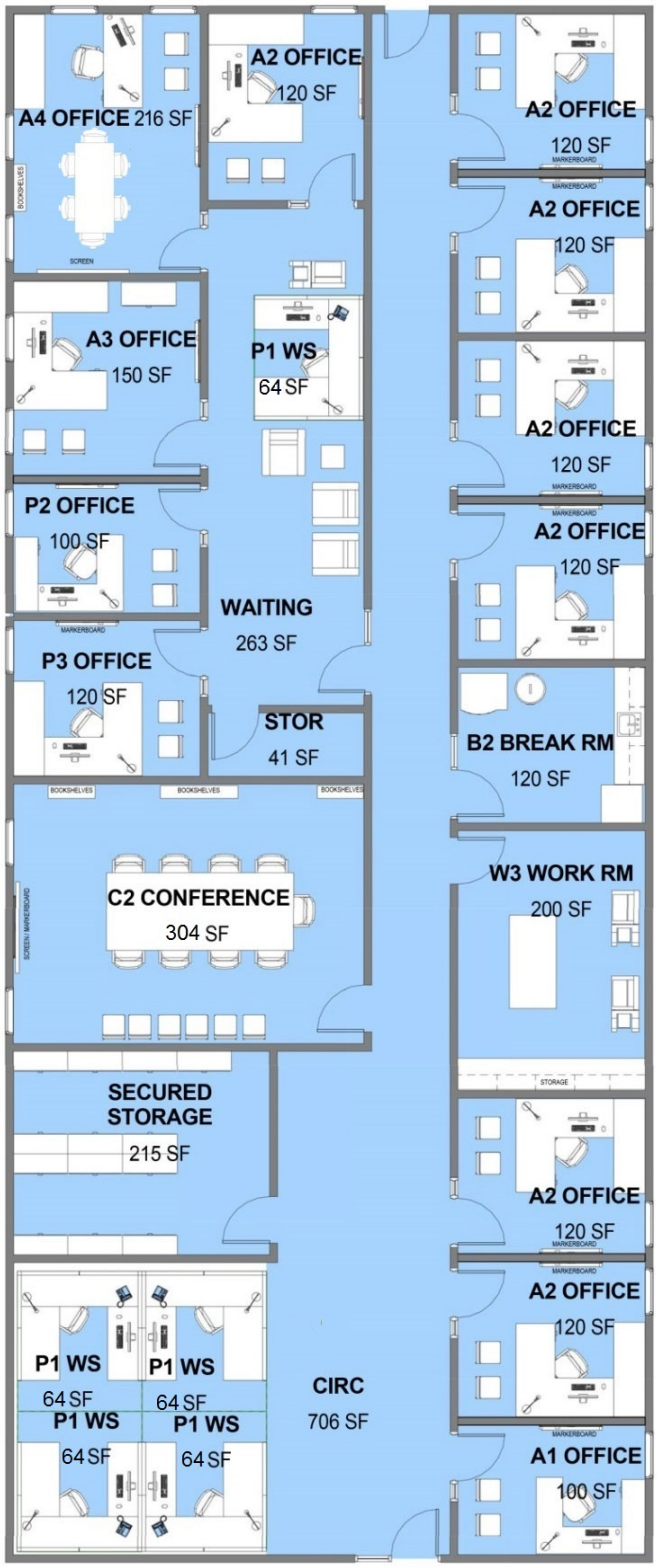


Figure 4-5 NAF/Center Legal Office Adjacency Diagram

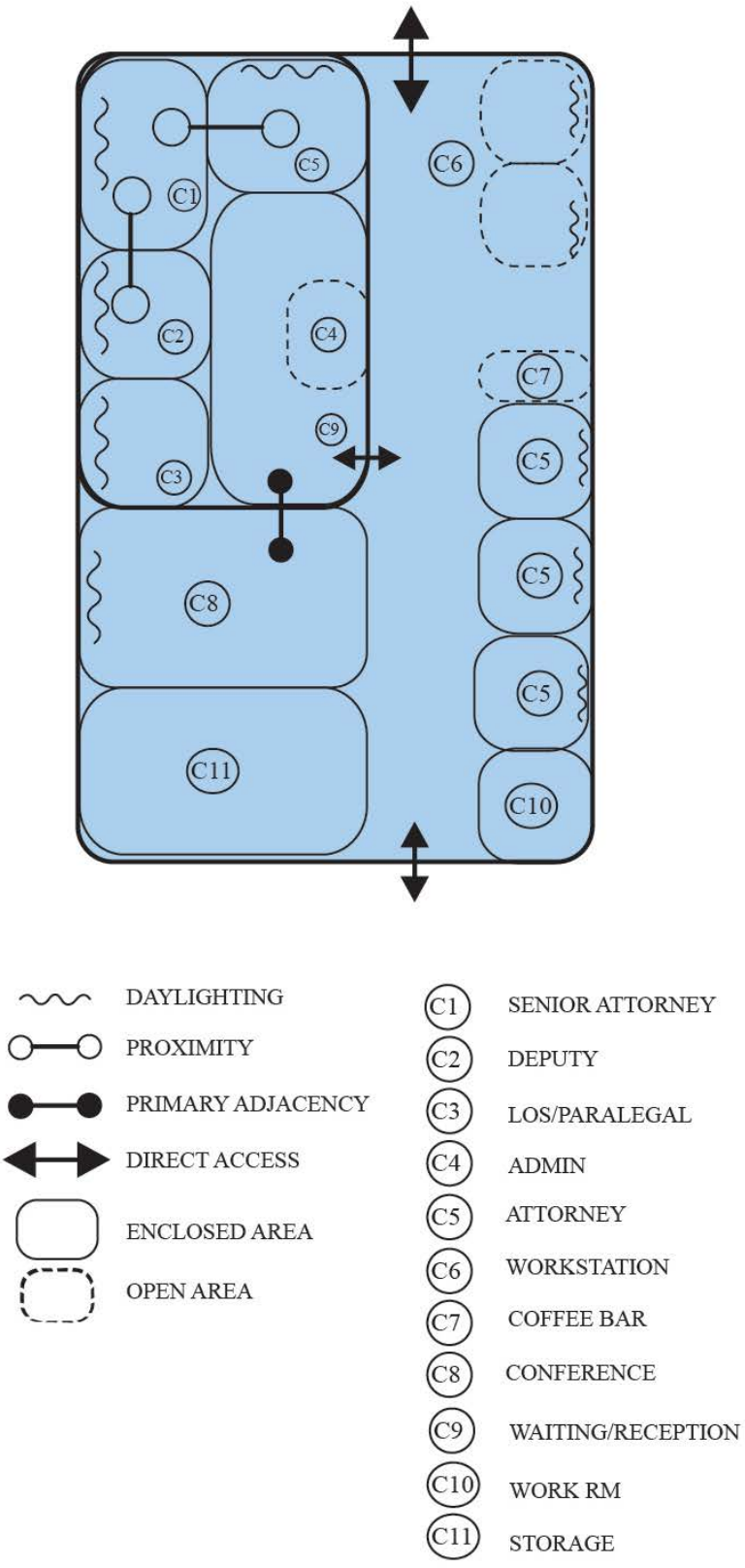
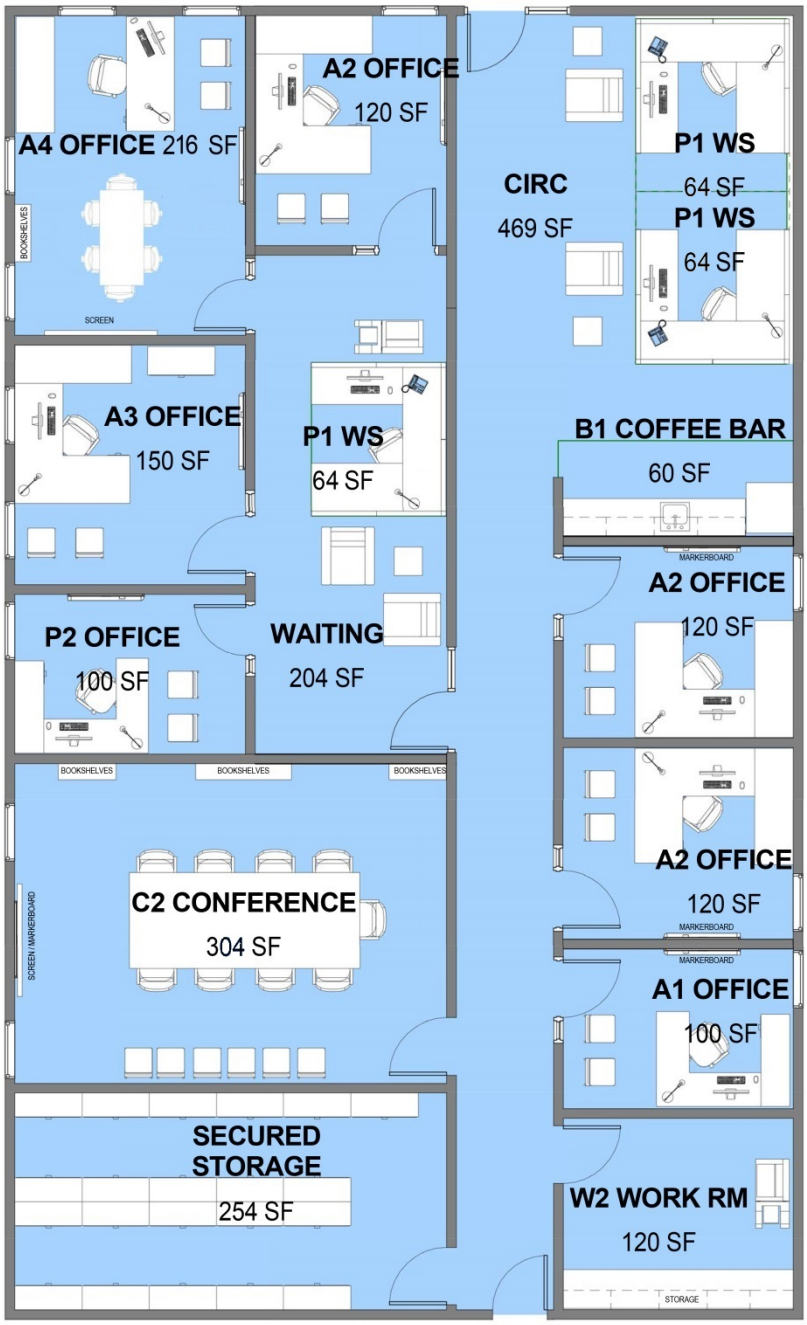


Figure 4-6 NAF/Center Legal Office Notional Floor Plan



4-2 DIRECT REPORTING UNIT (DRU) LEGAL OFFICES

4-2.1 Function and Adjacency

DRUs report directly to the Air Staff and have specialized missions. There are three DRU legal offices, each serving an activity with a markedly different mission:

- Air Force District Washington (AFDW)
- Air Force Academy (USAFA)
- Air Force Operational Test and Evaluation Center (AFOTEC)

4-2.2 Air Force District Washington (AFDW)

AFDW is the designated Air Force component lead for planning and implementing Air Force, joint contingency, and ceremonial activities in the National Capital Region (NCR). AFDW also provides military justice, personnel, and other support for Headquarters Air Force (HAF), AFDW units, and assigned Air Force elements worldwide. AFDW is primarily composed of the 11th Wing, the 79th Medical Wing, and the 844th Communication Group, all located at JB Andrews - Naval Air Facility Washington, Maryland, and the Air Force element at JB Anacostia-Bolling, Washington, D.C.

Programming sheet: Figure 4-1

Special requirement: The command paralegal manager, similar to a MAJCOM functional manager, is entitled to a P3 office.

4-2.3 Air Force Academy (USAFA)

USAFA is the military academy for Air Force officer candidates, located in Colorado Springs, Colorado. The Academy's stated mission is “to educate, train, and inspire men and women to become officers of character, motivated to lead the USAF in service to our nation.” The USAFA legal office advises the Academy leadership and staff and performs the functions of a base legal office. It also has a courtroom.

Programming sheets: Figures 3-2 and 3-3

Special requirements: None

4-2.4 Air Force Operations Test and Evaluation Center (AFOTEC)

AFOTEC, located at Kirtland AFB, New Mexico, is an independent agency responsible for testing new systems being developed for Air Force and multi-Service use under operationally realistic conditions. As a single attorney office, the legal office is embedded in the command suite and shares support spaces.

Programming sheet: None.

Special requirements:

- The attorney is entitled to an A4 office.

- All support spaces (e.g., conference room, storage area, safe, waiting area, visiting attorney office, work room, break room, restrooms, and parking) are shared with other building occupants.

CHAPTER 5 AIR FORCE LEGAL OPERATIONS AGENCY (AFLOA)

5-1 AFLOA LEGAL OFFICES - JONES BUILDING

5-1.1 Function and Adjacency

AFLOA is the field operating agency (FOA) of The Judge Advocate General (TJAG). It consists of six directorates:

- Air Force Judiciary (JAJ)
- Civil Law and Litigation Directorate (JAC)
- Commercial Law and Litigation Directorate (JAQ)
- Community Legal Services Directorate (CLS)
- Air Force Judge Advocate General's School (AFJAGS) (see Chapter 7)
- Legal Information Systems Directorate (JAS) (see Chapter 8)

In addition, the agency operates nine field support centers (FSC), including the Accident Investigation Board FSC, the Air Force Claims Service Center, the Commercial Litigation FSC, the Contract Law FSC, the Environmental Law FSC, the Labor Law FSC, the Medical Law FSC, the Medical Cost Reimbursement Program, and the Utility Law FSC.

5-1.2 Site Selection

AFLOA’s command suite, along with the leadership suites for JAJ, JAC, JAQ, and CLS, is located in the Jones Building on JB Andrews - Naval Air Facility Washington. The command suite will be in close proximity to other AFLOA directorate and division offices.

Programming sheet: Figure 5-1

Special requirements: The command suite includes the commander’s office, deputy commander’s office, command paralegal office, and open workstations for the executive officer, commander’s secretary, and other members of the command section. It also includes conference rooms, a library, a storage room, a work area, and a break area.

Other AFLOA offices in the Jones Building will vary in size, depending on the organization, its mission, and responsibilities. The directorate leadership suites will be in close proximity to their subordinate division offices. The space standards for AFLOA offices and support spaces in the Jones Building reflect those published in AFI 32-9010, Atch 2, and Chapter 2 of this FC.

Figure 5-1 AFLOA Command Suite Programming Sheet

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
AFLOA Command Suite							
Offices:							
A1: General Office	1	0	0	100	0	0	1,10
A2: Attorney	1	0	0	120	0	0	1,10
A3: Division Chiefs	1	0	0	150	0	0	1,10
A5: Commander	1	0	1	300	300	27.87	1,10
A7: Deputy Commander	1	0	1	200	200	1.858	1,10
Paralegal Work Spaces:							
P1: Open	1	0	0	64	0	0	2,10
P2: Standard	1	0	0	100	0	0	2,10
P3: Command Paralegal	1	0	1	120	120	11.148	2,10
P4: Large Work Station	1	0	7	100	700	65.03	2,10
Conference Rooms:							
C1: Huddle Room	6	0	0	168	0	0	3,10
C2: Small	15	0	1	304	304	28.2416	3,10
C3: Medium	30	0	1	450	450	41.805	3,10
C4: Large	45	0	0	600	0	0	3,10
Work Rooms:							
W1: Open Work Area	0	0	1	60	60	5.574	4,10
W2: Work Room	0	0	0	120	0	0	4,10
W3: Work Room	0	0	0	200	0	0	4,10
Break Rooms:							
B1: Coffee Bar	0	0	1	60	60	5.574	5,10
B2: Break Room	0	0	0	120	0	0	5,10
B3: Break Room	0	0	0	252	0	0	5,10
B4: Break Room	0	0	0	399	0	0	5,10
Storage:							
S1: Open Storage Area	0	0	0	0	0	0	6,10
S2: Closed Secure Area	0	0	1	164	164	15.2356	6,10
S3: Special Storage	0	0	0	0	0	0	6,10
Other:							
Waiting/Reception Area	4	0	1	80	160	14.864	7,10
Library/Conference Room	0	0	1	1957	1957	181.8053	9,10
Total Facility Net Floor Area					4475	399.01	
Net to Gross	15.00%				671	59.85	
Total Facility Gross Area					5146	458.86	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	N/A				N/A	8
Total Number of Parking Spaces					N/A	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A5 - 1, for Commander (applies only to AFLOA HQ); A7-1 - for Deputy Commander.
2. Paralegal/Administrative Work Spaces: P3 - 1, for Command Paralegal; P4 - for Executive Officer and administrative personnel, as authorized on UMD, and 7 extra P4 spaces.
3. Conference Rooms: C2; C3, with VTC capability.
4. Work Room: W1.
5. Break Room: B1.
6. Storage requirements: securable room, with 143 linear ft. of storage.
7. Waiting/Reception Area: 4 seats (20 sq. ft. per person)
8. Parking: As provided for Jones Building occupants.
9. Library/Conference Room: 2200 sq. ft. Includes VTC capability.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

5-2 AIR FORCE JUDICIARY (JAJ)

5-2.1 Function and Adjacency

JAJ is responsible for administering and improving military justice across the Air Force, and advising TJAG, the Chief of Staff of the Air Force (CSAF), and the Secretary of the Air Force (SecAF) on a full range of military justice matters. The directorate assists convening authorities and SJAs in the field, provides defense services to Airmen, litigates complex cases, and provides government and defense appellate lawyers before the Air Force Court of Criminal Appeals (AFCCA), the Court of Appeals for the Armed Forces (CAAF), and the United States Supreme Court. JAJ is located in the Jones Building and has five divisions:

- Appellate Defense Division (JAJA)
- Trial Defense Division (JAJD)
- Government Trial and Appellate Counsel Division (JAJG)
- Military Justice Division (JAJM)
- Clemency, Corrections, and Officer Review Division (JAJR)

Figure 5-2 Standard AFLOA Programming Sheet (Jones Building)

(This programming sheet reflects the space requirements for AFLOA offices, other than the command suite, in the Jones Building. Items marked "TBD" will be determined according to the notes at the bottom of the programming sheet.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Standard AFLOA Offices (Jones Building)							
Attorney Offices:							
A1: General Office/Visiting Attorney	1	0	0	100	0	0	1,10
A2: Other	1	0	0	120	0	0	1,10
A3: Division Chief	1	0	TBD	150	TBD	TBD	1,10
A6: Attorney	1	0	TBD	130	TBD	TBD	1,10
A7: Director	1	0	TBD	200	TBD	TBD	1,10
Paralegal Work Spaces:							
P1: Open	1	0	0	64	0	0	2,10
P2: Standard Paralegals	1	0	0	100	0	0	2,10
P3: Command Paralegal	1	0	0	120	0	0	2,10
P4: Large Workstation	1	0	TBD	100	TBD	TBD	2,10
Conference Rooms:							
C1: Huddle Room	6	0	TBD	168	TBD	TBD	3,10
C2: Small	15	0	TBD	304	TBD	TBD	3,10
C3: Medium	30	0	TBD	450	TBD	TBD	3,10
C4: Large	45	0	TBD	600	TBD	TBD	3,10
Work Rooms:							
W1: Open Work Area	0	0	TBD	60	TBD	TBD	4,10
W2: Work Room	0	0	TBD	120	TBD	TBD	4,10
W3: Work Room	0	0	TBD	200	TBD	TBD	4,10
Break Rooms:							
B1: Coffee Bar	0	0	TBD	60	TBD	TBD	5,10
B2: Break Room	0	0	TBD	120	TBD	TBD	5,10
B3: Break Room	0	0	TBD	252	TBD	TBD	5,10
B4: Break Room	0	0	TBD	399	TBD	TBD	5,10
Storage:							
S1: Open Storage Area	0	0	TBD	TBD	TBD	TBD	6,10
S2: Closed/Secured Area	0	0	TBD	TBD	TBD	TBD	6,10
S3: Special Storage	0	0	TBD	TBD	TBD	TBD	7,10
Other:							
Waiting/Reception Area	TBD	0	TBD	TBD	TBD	TBD	8,10
Total Facility Net Floor Area					TBD	TBD	
Net to Gross	15.00%				TBD	TBD	
Total Facility Gross Area					TBD	TBD	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	N/A				N/A	9
Total Number of Parking Spaces					N/A	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A7 - for Directors; A3 - for Division Chiefs; A2 - for other attorneys, as authorized on UMD.
2. Paralegal/Administrative Work Spaces: P4 - paralegal/administrative personnel, as authorized on UMD.
3. Conference Room: As required and sized.
4. Work Room: As required.
5. Break Room: As required.
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific requirements.
7. Special Storage: As required (e.g., safe or SCIF).
8. Waiting/Reception Area: As required in leadership suites.
9. Parking: As provided for Jones Building occupants.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

5-2.2 JAJ Leadership Suite

Programming sheet: Figure 5-2

Special requirements:

- Work area: W1

5-2.3 Appellate Defense Division (JAJA)

JAJA represents Airmen at all stages of the appellate process, which begins once a court-martial conviction is approved by the convening authority. Key responsibilities include representing accused Air Force members before the AFCCA, the CAAF, and the U.S. Supreme Court.

Programming sheet: Figure 5-2

Special requirements:

- Work area: W1
- Open storage: 462 linear feet for storing records of trial in the appellate process

5-2.4 Trial Defense Division (JAJD)

JAJD provides all trial defense services through its worldwide team of area defense counsel, defense paralegals, senior defense counsel, chief senior defense counsel, and defense paralegal managers. In addition to trial services, JAJD provides assistance to Airmen facing Article 15s and adverse administrative actions, including corrective paperwork and administrative discharge boards.

Programming sheet: Figure 5-2

Special requirements:

- Work area: W1

Area defense counsel offices, located on separate installations, are addressed in Chapter 6, paragraph 6-1.

5-2.5 Government Trial and Appellate Counsel Division (JAJG)

JAJG represents the Air Force in both the trial and post-trial stages of the court-martial process. Appellate counsel represent the Air Force in appellate reviews of court-martial before the AFCCA, the CAAF, and the U.S. Supreme Court. The division also provides advanced litigation support and trial advocacy training.

Programming sheet: Figure 5-2

Special requirements:

- Conference room: Includes table, with seating for eight
- Work area: W1
- Closed/secure storage: for storing records of trial in the appellate process
    - In JAJG: 288 square feet, with 350 linear feet of storage
    - In JAJR: 150 square feet, with 120 linear feet of storage
- Break area: B1

5-2.6 Military Justice Division (JAJM)

JAJM issues military justice opinions and policy for SecAF, CSAF, TJAG, and the Air Force. JAJM responds to inquiries on military justice matters by the White House, Congress, DoD, and the Air Staff. The division is the central collection point for records of court-martial and manages them as they move through the appellate process. JAJM acts as the lead agency for Freedom of Information Act (FOIA) requests related to records of trial.

Programming sheet: Figure 5-2

Special requirements:

- Conference room: Includes table, with seating for eight
- Work area: W1
- Closed/secure storage: 402 square feet, with 495 linear feet for storing records of trial in the appellate process prior to staging
- Special storage: 5-drawer safe for storing classified records of trial
- Break area: B1, combined with conference room

5-2.7 Clemency, Corrections, and Officer Review Division (JAJR)

JAJR is responsible for recommending SecAF action in all officer court-martial cases involving a sentence of dismissal and making clemency recommendations in enlisted court-martial cases. The JAJR attorney sits as a member of the Air Force Clemency and Parole Board and serves as counsel to the Air Force Security Forces community on all corrections matters.

Programming sheet: Figure 5-2

Special requirements:

- Work area: W1

5-3 CIVIL LAW AND LITIGATION DIRECTORATE (JAC)

5-3.1 Function and Adjacency

JAC specializes in legal practice areas dealing with Air Force claims and civil litigation (i.e., labor, personnel, information, environmental, utility, and tort litigation). JAC is located in the Jones Building and has three divisions:

- Claims and Tort Litigation Division (JACC)
- Environmental Law and Litigation Division (JACE)
- General Litigation Division (JACL)

5-3.2 JAC Leadership Suite

Programming sheet: Figure 5-2

Special requirements:

- Work area: W1
- Conference room: Includes table, with seating for 10
- Closed/secure storage: Shared with JACE, with 105 linear feet.

5-3.3 Claims and Tort Litigation Division (JACC)

JACC provides specialized tort guidance to, and receives critical investigative support from, Air Force headquarters-level and installation-level judge advocates. It adjudicates sensitive wrongful death, personal injury, and property damage claims arising from Air Force activities worldwide. It consists of four main branches:

- Aviation and Admiralty Law Branch
- Foreign Claims Branch
- General Torts Branch
- Medical Law Branch

In addition, there are four FSCs:

- Accident Investigation Board Field Support Center (AIBFSC)

- Air Force Claims Service Center (AFCSC)
- Medical Cost Reimbursement Program (MCRP)
- Medical Law Field Support Center (MLFSC)

JACC:

- Programming sheet: Figure 5-2
- Special requirements:
  - Conference room: Includes table, with seating for eight
  - Work area: W1
  - Closed/secure storage: 643 square feet, with 245 linear feet for storing claims investigation equipment
- Break area: B1

The AFSC, MCRP, and the MLFSC are located in the field and addressed in Chapter 6, paragraph 6-4.

5-3.4 Accident Investigation Board Field Support Center (AIBFSC)

The AIBFSC provides legal advisors to accident investigation boards (AIB) for mishaps involving aircraft, unmanned aerial systems, missiles, or spacecraft, and to ground accident investigation boards (GAIB) for duty-related ground accidents. The legal advisors advise AIB/GAIB members and help ensure board reports comply with applicable laws and regulations.

Programming sheet: Figure 5-2

Special requirements: None

5-3.5 Environmental Law and Litigation Division (JACE)

JACE provides expert legal support in all forms of environmental and utility litigation, regulation, and legislative matters. JACE advises Air Force clients on installation operation and management, natural infrastructure, environmental compliance, environmental restoration, utility rates, utility contracts, and renewable projects. JACE is responsible for the Environmental Law FSC, the Utility Law FSC, and three other field offices.

Programming sheet: Figure 5-2

Special requirements:

- Work area: W1
- Closed secure/storage area: 849 square feet (shared with JAC and JACL), with 225 linear feet of storage for litigation files
- Break area: B1

The Environmental Law FSC is located at JB San Antonio, Texas, and is addressed in Chapter 6, paragraph 6-4.3.

The Utility Law FSC is located at Tyndall AFB, Florida, and is addressed in Chapter 6, paragraph 6-4.6.

5-3.6 General Litigation Division (JACL)

JACL practices a broad range of civil and administrative litigation and has three branches: the Labor Law Field Support Center (LLFSC), the Military Personnel Litigation Branch, and the Information Litigation Branch. JACL represents the Air Force in federal, civil, and administrative litigation, and defends against lawsuits asserting violations of the Constitution, the Civil Rights Acts, federal labor law, civil service law, the Freedom of Information Act, the Privacy Act, and military personnel policies.

Programming sheet: Figure 5-2

Special requirements:

- Conference room: Includes table, with seating for eight
- Work area: W1
- Closed/secure storage: Shared with JACE, with 653 linear feet for storing litigation files
- Break area: B1

5-3.7 Labor Law Field Support Center (LLFSC)

The LLFSC focuses on matters such as discrimination complaints, dispute resolution, arbitration, labor agreement negotiations, and labor relations management of the Air Force civilian workforce.

Programming sheet: Figure 5-2

Special requirements: Same as paragraph 5-3.6

5-4 COMMERCIAL LAW AND LITIGATION DIRECTORATE (JAQ)

5-4.1 Function and Adjacency

JAQ's mission is to defend the Air Force in bid protests, contract and intellectual property disputes, and contract-related litigation worldwide, specializing in contract and commercial law. Additionally, JAQ handles all protests to the Government Accountability Office (GAO) and works with the Department of Justice (DOJ) on litigation arising from privatization actions. JAQ is located in the Jones Building and has two divisions, each of which serves as an FSC:

- Commercial Litigation FSC (CLFSC)
- Contract Law FSC (KLFSC)

5-4.2 JAQ Leadership Suite

Programming sheet: Figure 5-2

Special requirements:

- Work area: W1
- Closed/secure storage: Same as paragraph 5-4.3
- Break area: B1

5-4.3 JAQC Commercial Litigation Field Support Center (CLFSC)

JAQC litigates bid protests at GAO and provides Air Force acquisition attorneys to serve on multidisciplinary independent review teams (MIRT). The MIRTs function as special teams to identify potential grounds for bid protests prior to source selection in major acquisition programs and represent the Air Force before the Armed Services Board of Contract Appeals (ASBCA).

Programming sheet: Figure 5-2

Special requirements:

- Work area: W1
- Conference room: Includes table, with seating for 16
- Closed/secure storage: 643 square feet (shared with JAQ and JAQK), with 760 linear feet of storage for storing contract litigation files; requirement increasing due to closure of archives for staging
- SCIF: Required for bid protests, but not currently available

- Break area: B1

5-4.4 JAQK Contract Law Field Support Center (KLFSC)

JAQK is a full-spectrum provider of contract legal support Air Force-wide, including contingency contracting, at installation level and below. Additionally, it supports the Air Force legal outreach program, providing educational products and tools for all Air Force acquisition attorneys to enhance the quality and efficiency of acquisition legal support enterprise-wide.

Programming sheet: Figure 5-2

Special requirements:

- Work area: W2
- Conference room: Shared with JAQC
- Closed/secure storage: Same as paragraph 5-4.3
- Break area: B1

5-5 COMMUNITY LEGAL SERVICES DIRECTORATE (CLS)

5-5.1 Function and Adjacency

The CLS mission encompasses all areas of the Air Force legal practice where an Air Force attorney represents a personal client, excluding defense services, and an attorney-client relationship and privilege exist. CLS is located in the Jones Building and has three divisions:

- Office of Airmen’s Counsel (CLSA)
- Community Legal Services Division (CLSL)
- Special Victims’ Counsel Division (CLSV)

CLSA is located on JB San Antonio-Randolph and is addressed in Chapter 6, paragraph 6-3.

5-5.2 CLS Leadership Suite

Programming sheet: Figure 5-2

Special requirements:

- Conference room: Includes table, with seating for eight

- Work area: W1
- Break area: B2
- Waiting area: Seating for eight

5-5.3 Community Legal Issues Division (CLSL)

CLSL is responsible for establishing legal assistance policy impacting Airmen, their families, and retirees, and providing legal assistance training to field attorneys.

Programming sheet: Figure 5-2

Special requirements: Same as paragraph 5-5.2

5-5.4 Special Victims' Counsel (CLSV)

CLSV provides support through independent attorney representation of sexual assault victims, building and sustaining victim resiliency, empowering them by enforcing their rights, and increasing legal assistance.

Programming sheet: Figure 5-2.1

Special requirements: Same as paragraph 5-5.2

SVC offices, located on separate installations, are addressed in Chapter 6, paragraph 6-2.

5-6 AIR FORCE COURT OF CRIMINAL APPEALS (AF/JAH)

5-6.1 Function and Adjacency

AF/JAH is empowered to hear appeals of Air Force courts-martial and certain trial court rulings. As the only appellate court in the Air Force, it is located in the first floor of the Jones Building. It seats nine appellate judges and shares support spaces with the adjacent base trial courtroom.

5-6.2 Appellate Courtroom

Programming sheet: Figure 5-3

Special requirements: The courtroom includes a nine-judge integrated bench, clerk of court station, government and defense counsel areas, gallery area, waiting room, judge's robing room, deliberation/conference room with coffee bar, unisex restroom, and public restrooms.

5-6.3 JAH Office Suite

Programming sheet: Figure 5-3

Special requirements: The office suite includes the chief judge's office, other appellate judge offices, clerk of court office, law clerk and commissioner offices, paralegal workstations, a break area, and restrooms. Judges' offices have bulletproof doors as an additional security precaution.

5-6.4 Site Selection

The nine appellate judge offices are collocated with the appellate courtroom in the Jones Building.

Figure 5-3 JAH Programming Sheet

(This programming sheet reflects the space requirements for the court and legal offices depicted in Figures 5-4 and 5-5.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
AF Court of Criminal Appeals & JAH							
Offices:							
A1: General Office/Court Reporter	1	0	0	100	0	0	1,8
A2: Attorney	1	0	0	120	0	0	1,8
A3: Judge	1	0	13	150	1950	181.155	1,8
A4: Senior Judge	1	0	1	216	216	20.0664	1,8
Paralegal Work Spaces:							
P1: Open	1	0	3	64	192	17.8368	2,8
P2: Standard/Clerk of Court	1	0	1	100	100	9.29	2,8
P3: MAJCOM Functional Manager	1	0	0	120	0	0	2,8
P4: Large Workstation	1	0	0	100	0	0	2,8
Conference Rooms:							
C1: Huddle Room	6	0	0	168	0	0	8
C2: Small	15	0	0	304	0	0	8
C3: Medium	30	0	0	450	0	0	8
C4: Large	45	0	0	600	0	0	8
Work Rooms:							
W1: Open Work Area	0	0	0	60	0	0	8
W2: Work Room	0	0	0	120	0	0	8
W3: Work Room	0	0	0	200	0	0	8
Break Rooms:							
B1: Coffee Bar	0	0	1	60	60	5.574	8
B2: Break Room	0	0	0	120	0	0	8
B3: Break Room	0	0	0	252	0	0	8
B4: Break Room	0	0	0	399	0	0	8
Storage:							
S1: Open Storage Area	0	0	0	0	0	0	4,8
S2: Closed Storage Area	0	0	1	253	253	23.5037	4,8
S3: Secured Area	0	0	0	0	0	0	4,8
Other:							
Courtroom	89	0	1	1948	1948	180.9692	5,6,8
Lobby	0	0	1	788	788	73.2052	5,6,8
Vestibule	9	0	1	56	56	5.2024	5,8
Deliberation Room	9	0	1	170	170	15.793	3,8
Waiting Room	4	0	1	96	96	8.9184	8
Robing Room	9	0	1	215	215	19.9735	5,8
Total Facility Net Floor Area					6044	561.49	
Net to Gross	**15.00%**				907	84.22	
Total Facility Gross Area					6951	645.71	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	N/A				N/A	7
Total Number of Parking Spaces					N/A	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A4 - for Sr. Judge; A3 - for other judges, law clerks, and Court Commissioner, as authorized on UMD.
2. Paralegal Work Spaces: P2 - for Clerk of Court; P1 - for other paralegals, as authorized on UMD.
3. A coffee bar is located in the hallway near the deliberation room.
4. Storage closet for security and AV equipment.
5. Courtroom includes the judge's bench, court reporter station, honors clerk station, well of the court (including 2 tables with seating for 3 each facing the bench), gallery (with seating for 72 spectators), and VTC capability. A private entrance for judges connects circulation, courtroom, and deliberation space. A vestibule should be included for transition from the robing room to the bench and into main courtroom lobby.
6. Public restrooms in lobby; unisex restroom adjacent to deliberation room.
7. Parking spaces (basic requirement): As provided for Jones Building occupants.
8. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

Figure 5-4 JAH Adjacency Diagram

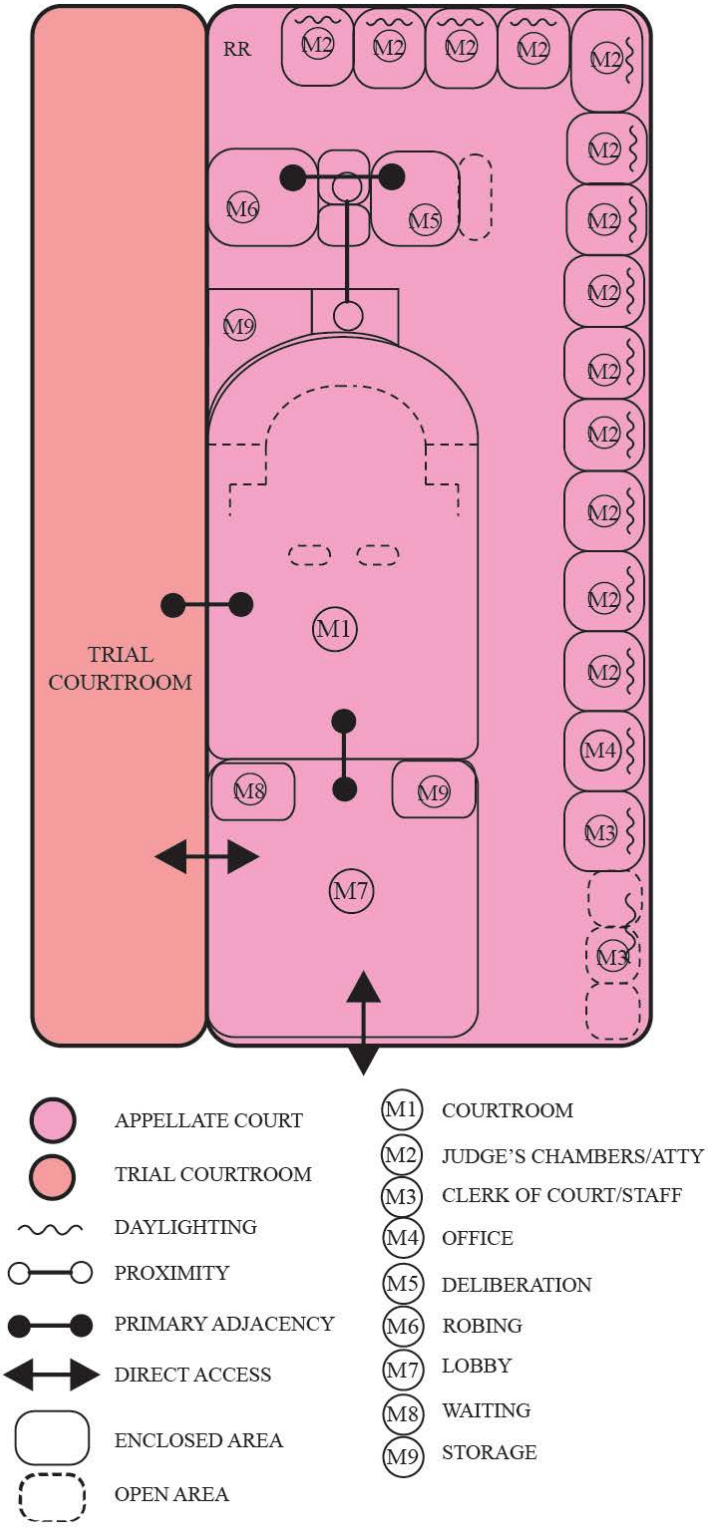
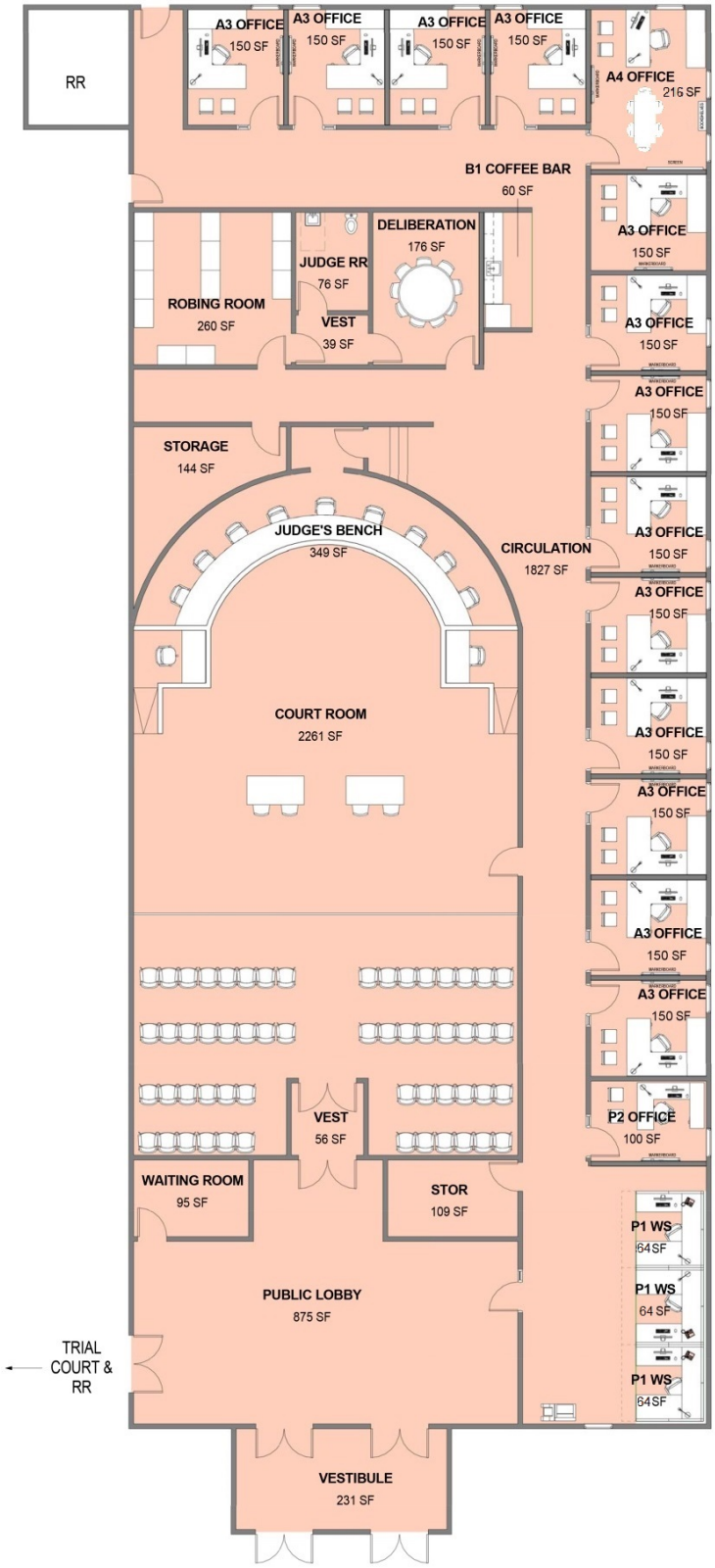


Figure 5-5 JAH Floor Plan



5-6.5 JAH Room Data Sheets

Figure 5-6 Appellate Courtroom Room Data Sheet

Description/Usage		The courtroom is used to conduct appellate judicial proceedings. A nine-judge bench, clerk of court recording station, and honor's clerk station are designated areas in the rear of the courtroom. Other spaces include government and defense counsel area. The gallery seats 72 spectators.
Ceiling Height		12'-0"
Windows		Clearstory or none
Doors	**Type**	Solid wood, double door 3' x 7'
	Security/Hardware	Keyed lock set
	View Panels/ Kick-Plates	None
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles for all equipment at court reporter stand, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	No telephone. Recording system and microphones for judge and counsel.
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	Duress alarm for chief judge station
Acoustics		Floors, partitions, and ceilings meet or exceed the STC 50 requirement. Doors and windows meet or exceed the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E)		Nine high-back leather swivel chairs. Rail to separate gallery from proceedings. Two 3'-6" x 7'-0" counsel tables, six straight upholstered chairs, integrated bench/workstation for judges, clerk of court, and honor's clerk.
Special Requirements		Judge's bench must be elevated 18" off the finished floor. Clerk of court recording and honor's clerk stations must be elevated 8" off the finished floor.

Figure 5-7 Judges' Office Suite Room Data Sheet

Description/Usage		A private office for each judge, for consultations with attorneys and paralegals and other meetings with office personnel.
Ceiling Height		9'-0" minimum
Windows		Exterior glazing for daylighting, AT compliant
Doors	**Type**	Solid wood, 3' x 7', with bulletproof sidelights
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Side-view panel
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		None
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Yes
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	Duress alarm
Acoustics		Floors, partitions, and ceilings will meet or exceed the STC 50 requirement. Windows and door meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		Wood 6' executive desk, credenza, executive swivel chair, two straight upholstered chairs, and 4' round table and four swivel leather chairs (in chief judge's office).
Special Requirements		N/A

Figure 5-8 Courtroom Lobby/Foyer Data Sheet

Description/Usage		Open public space for spectators to gather and wait to enter the courtroom.
Ceiling Height		12’-0” minimum
Windows		Exterior glazing for daylighting, AT compliant
Doors	**Type**	Wood double doors, 3’ x 7’
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Glass center panels
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		Per UFC 3-420-01
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	IDS
Acoustics		Floors, partitions, and ceilings will meet or exceed the STC 30 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		N/A
Special Requirements		Provide floor electrical outlet in center of space to accommodate security scanning equipment.

Figure 5-9 Judge Deliberation Room Data Sheet

Description/Usage		The deliberation room is a conference room that accommodates nine appellate judges. It includes an adjacent unisex restroom and a minimal coffee bar with sink nearby.
Ceiling Height		9'0" minimum
Windows		None
Doors	**Type**	Solid wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 2
	Floor	Level 2
	Base	Level 2
	Ceiling	Level 2
Plumbing		Per UFC 3-420-01
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One, wall-mounted
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Floors, partitions, and ceilings will meet or exceed the STC 50 requirement. Door to meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		Include nine-person wood conference table, nine swivel chairs, and whiteboard.
Special Requirements		Direct access to courtroom, to ensure judges have as little contact as possible with other participants in the proceedings.

5-7 TRIAL JUDICIARY (AF/JAT)

5-7.1 Function and Adjacency

AF/JAT manages the Air Force judicial circuits, ensuring judges are provided for courts-martial, administrative boards, judicial investigations, parole violation hearings, and special hearings related to draft environmental impact statements. AF/JAT is home to the Central Docketing Office, responsible for managing the docket for all events requiring an assigned trial judge.

Programming sheet: Figure 5-2

Special requirements:

- Work area: W1
- Break area: B1

The judicial circuits, located in the field, are addressed in Chapter 6, paragraph 6-6.

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CHAPTER 6 AFLOA FIELD OFFICES AND FIELD SUPPORT CENTERS

6-1 JAJD AREA DEFENSE COUNSEL (ADC) OFFICES

6-1.1 Function and Adjacency

The ADC provides Airmen suspected of offenses or facing adverse administrative action with independent legal advice and representation. ADC personnel provide confidential advice, free from the influence of local chains of command. Operational and spatial separation of ADC offices facilitates attorney-client interaction.

Programming sheet: Figure 6-1

Special requirements:

- Due to client intake and interviewing responsibilities, the defense paralegal is entitled to a P2 office.
- For security, provide duress alarms in all offices, as well as a secondary exit.

6-1.2 Site Location

The ADC office can either be free-standing (preferable) or collocated in a multi-use building. If it is a stand-alone facility, locate the ADC in close proximity with dorms or dining facilities, allowing easy access for Airmen. It is imperative to separate the ADC office from the following facilities:

- Installation legal office
- Sexual Assault Response Coordinator (SARC)
- Special Victims' Counsel (SVC)
- Installation command offices
- Security Forces/AFOSI offices
- Family Advocacy office
- IG office

Figure 6-1 ADC Office Programming Sheet

(This programming sheet is notional, in that it reflects the space requirements for the ADC legal office depicted in Figures 6-2 through 6-4. However, it can be used for all offices of the same type, using the formulas listed in the comments.)

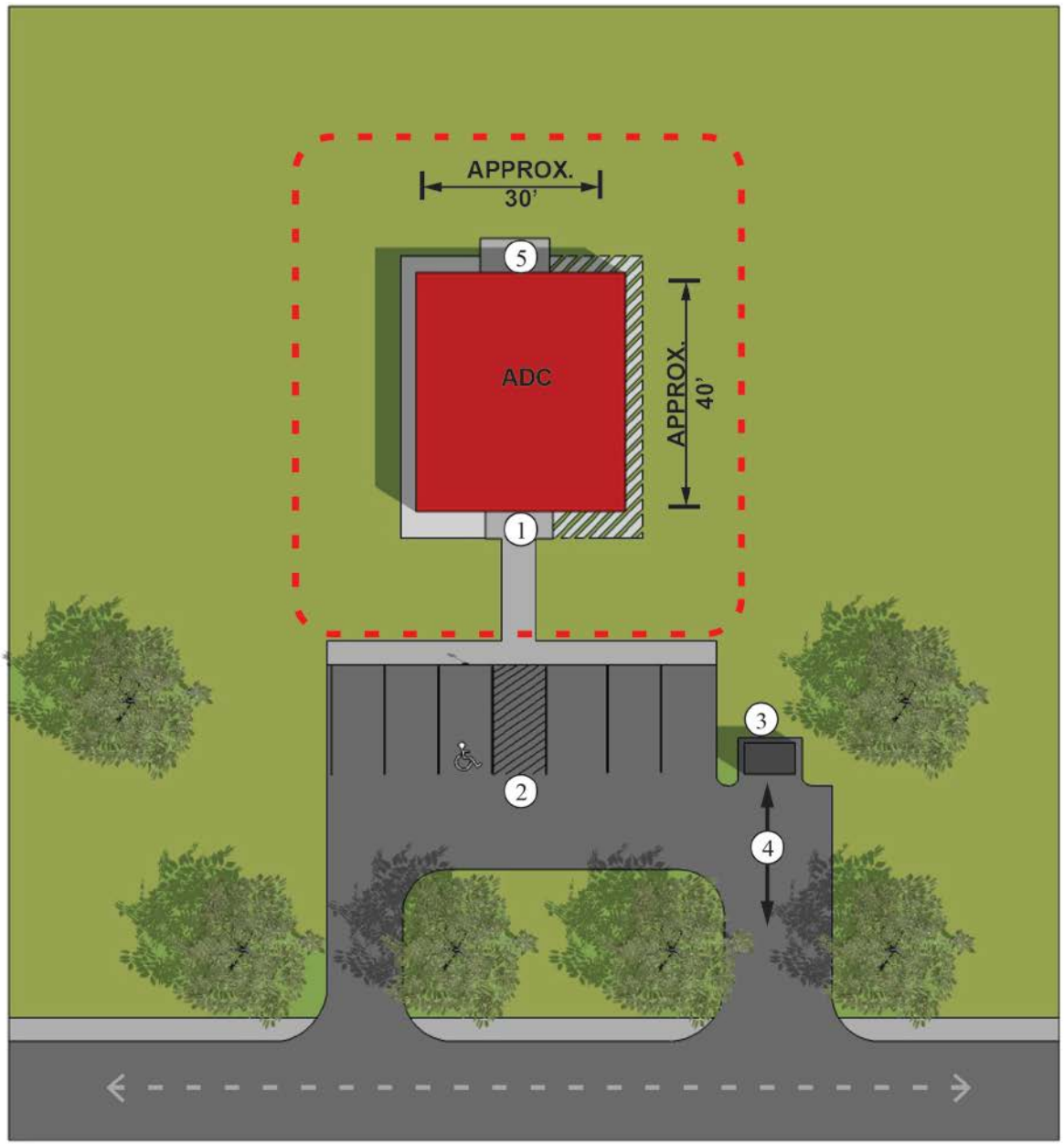
AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Area Defense Counsel Office (ADC)							
Offices:							
A1: General Office	1	0	1	100	100	9.29	1,10
A2: Attorney	1	0	1	120	120	11.148	1,10
A3: Deputy SJA	1	0	0	150	0	0	1,10
A4: SJA	1	0	0	216	0	0	1,10
Paralegal Work Spaces:							
P1: Open	1	0	0	64	0	0	2,10
P2: Standard	1	0	1	100	100	9.29	2,10
P3: MAJCOM Functional Manager	0	0	0	120	0	0	2,10
Conference Rooms:							
C1: Huddle Room	6	0	1	168	168	15.6072	3,10
C2: Small	15	0	0	304	0	0	3,10
C3: Medium	30	0	0	450	0	0	3,10
C4: Large	45	0	0	600	0	0	3,10
Work Rooms:							
W1: Open Work Area	0	0	0	60	0	0	4,10
W2: Work Room	0	0	1	120	120	11.148	4,10
W3: Work Room	0	0	0	200	0	0	4,10
Break Rrooms:							
B1: Coffee Bar	0	0	1	60	60	5.574	5,10
B2: Break Room	0	0	0	120	0	0	5,10
B3: Break Room	0	0	0	252	0	0	5,10
B4: Break Room	0	0	0	399	0	0	5,10
Storage:							
S1: Open Storage Area	0	0	1	60	60	5.574	6,10
S2: Closed Secured Storage	0	0	0	0	0	0	6,10
S4: Special Storage	0	0	0	0	0	0	7,10
Other:							
Waiting/Reception Area	4	0	1	336	336	31.2144	8,10
Total Facility Net Floor Area					1449	134.61	
Net to Gross	15.00%				217	20.19	
Total Facility Gross Area					1666	154.80	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	2				2	9
Clients	4				4	9
Total Number of Parking Spaces					6	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A2 - 1, for defense counsel, as authorized on UMD; A1 - 1, for visiting attorney.
2. Paralegal Work Spaces: P2 - for defense paralegals, as authorized on UMD.
3. Conference Rooms: Typically C1. JBSA - Lackland ADC: C3.
4. Work Room: W2.
5. Break Room: B1.
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: As required (e.g., safe or SCIF).
8. Waiting/Reception Area: # authorized on UMD x 2. JBSA - Lackland ADC: 15.
9. Parking spaces (basic requirement): # authorized on UMD x 3.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

Figure 6-2 ADC Office Notional Site Diagram (If Freestanding Facility)



1. OFFICE ENTRY
2. POV PARKING (ONE WAY)
3. DUMPSTER
4. TRUCK ACCESS
5. SECONDARY EXIT

STANDOFF DISTANCE
REFERENCE UFC 4-010-01

ACCESS STREET

Figure 6-3 ADC Office Adjacency Diagram

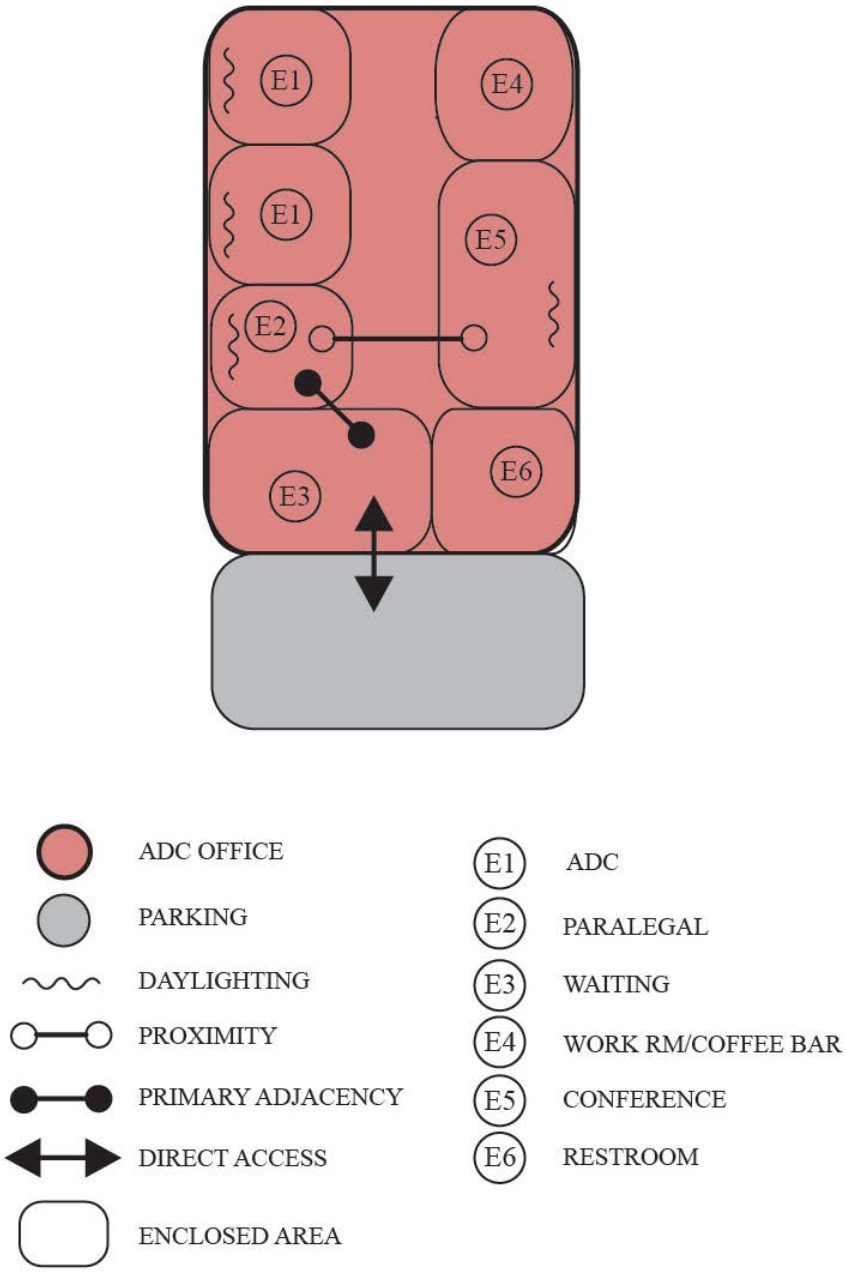
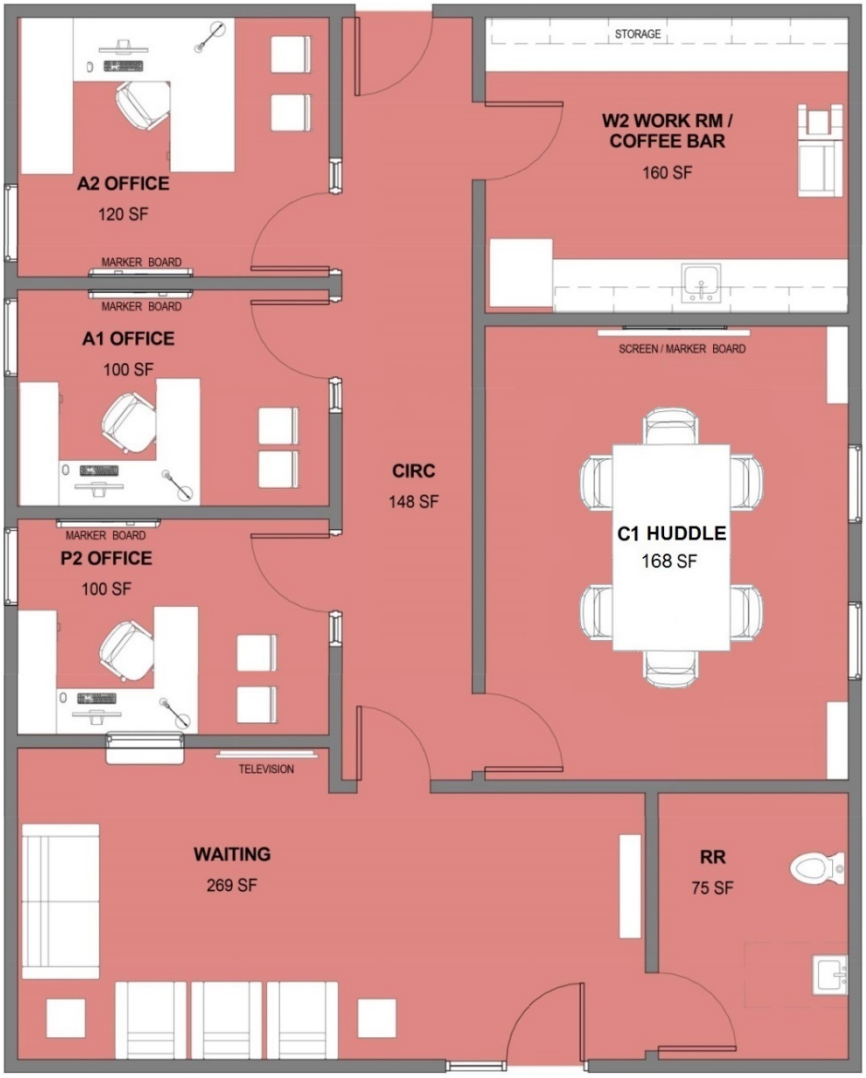


Figure 6-4 ADC Notional Floor Plan



6-2 CLSV SPECIAL VICTIMS' COUNSEL (SVC) OFFICES

6-2.1 Function and Adjacency

SVCs represent victims of sexual assault during reporting, military investigations, and military proceedings, in both trial and post-trial matters. They advocate to protect victims' rights by removing barriers to victim participation in the military justice process and assisting victims in obtaining available services and resources. SVCs are located at bases throughout the Air Force, yet represent clients through an independent chain of command in AFLOA. Eligibility for representation and the scope of representation is a vital and expanding Air Force mission.

Programming sheet: Figure 6-5

Special requirements:

- Due to client intake and interviewing responsibilities, the Special Victims' Paralegal (SVP) is entitled to a P2 office.
- Larger waiting area, including a play area for children.

6-2.2 Site Location

The privacy and dignity of a sexual assault victim is paramount when considering SVC facilities. SVC offices may be stand-alone facilities (preferable) or secondary tenants in buildings that serve another primary function. The preferred location is one that provides discreet 24/7 entry and direct access to and from a parking lot. Provide a secondary exit for added security. Preferred adjacencies include:

- Installation chaplain's office
- Installation clinic/hospital
- SARC office
- Equal Opportunity office

It is imperative that SVC facilities be separate from the following:

- ADC office
- Installation legal office
- Security Forces office
- AFOSI office
- IG office

Figure 6-5 SVC Programming Sheet

(This programming sheet is notional, in that it reflects the space requirements for the SVC legal office depicted in Figures 6-6 through 6-8. However, it can be used for all offices of the same type, using the formulas listed in the comments.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Special Victims Counsel Office (SVC)							
Offices:							
A1: General Office	1	0	1	100	100	9.29	1,10
A2: Attorney	1	0	1	120	120	11.148	1,10
A3: Deputy SJA	1	0	0	150	0	0	1,10
A4: SJA	1	0	0	216	0	0	1,10
Paralegal Work Spaces:							
P1: Open	1	0	0	64	0	0	2,10
P2: Standard	1	0	1	100	100	9.29	2,10
P3: MAJCOM Functional Manager	1	0	0	120	0	0	2,10
Conference Rooms:							
C1: Huddle Room	6	0	1	168	168	15.6072	3,10
C2: Small	15	0	0	304	0	0	3,10
C3: Medium	30	0	0	450	0	0	3,10
C4: Large	45	0	0	600	0	0	3,10
Work Rooms:							
W1: Open Work Area	0	0	0	60	0	0	4,10
W2: Work Room	0	0	1	120	120	11.148	4,10
W3: Work Room	0	0	0	200	0	0	4,10
Break Rooms:							
B1: Coffee Bar	0	0	1	60	60	5.574	5,10
B2: Break Room	0	0	0	120	0	0	5,10
B3: Break Room	0	0	0	252	0	0	5,10
B4: Break Room	0	0	0	399	0	0	5,10
Storage:							
S1: Open Storage Area	0	0	1	60	60	5.574	6,10
S2: Closed Secured Storage	0	0	0	0	0	0	6,10
S4: Special Storage	0	0	0	0	0	0	7,10
Other:							
Waiting/Reception Area	5	0	1	385	385	35.7665	8,10
Total Facility Net Floor Area					1113	103.40	
Net to Gross	15.00%				167	15.51	
Total Facility Gross Area					1280	118.91	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	2				2	9
Clients	2				2	9
Total Number of Parking Spaces					4	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A2 - for SVCs, as authorized on UMD; A1 - 1, for visiting attorney.
2. Paralegal Work Spaces: P2 - for SVPs, as authorized on UMD.
3. Conference Rooms: C1.
4. Work Room: W2.
5. Break Room: B1.
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: As required (e.g., safe or SCIF).
8. Waiting/Reception Area: # authorized SVCs x 2, with additional space for children's play area.
9. Parking spaces (basic requirement): # authorized SVCs x 3, plus # authorized SVPs.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

Figure 6-6 (Not Used)

Figure 6-7 SVC Adjacency Diagram

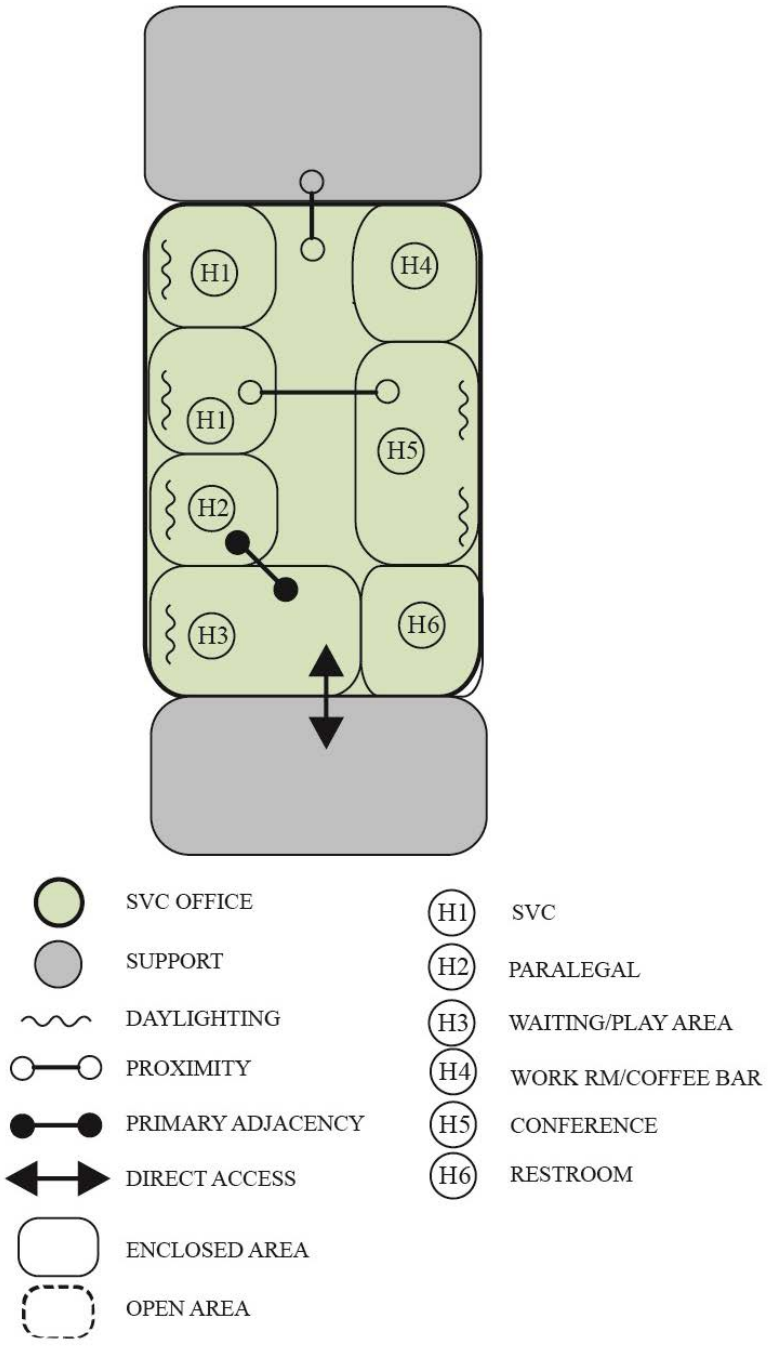
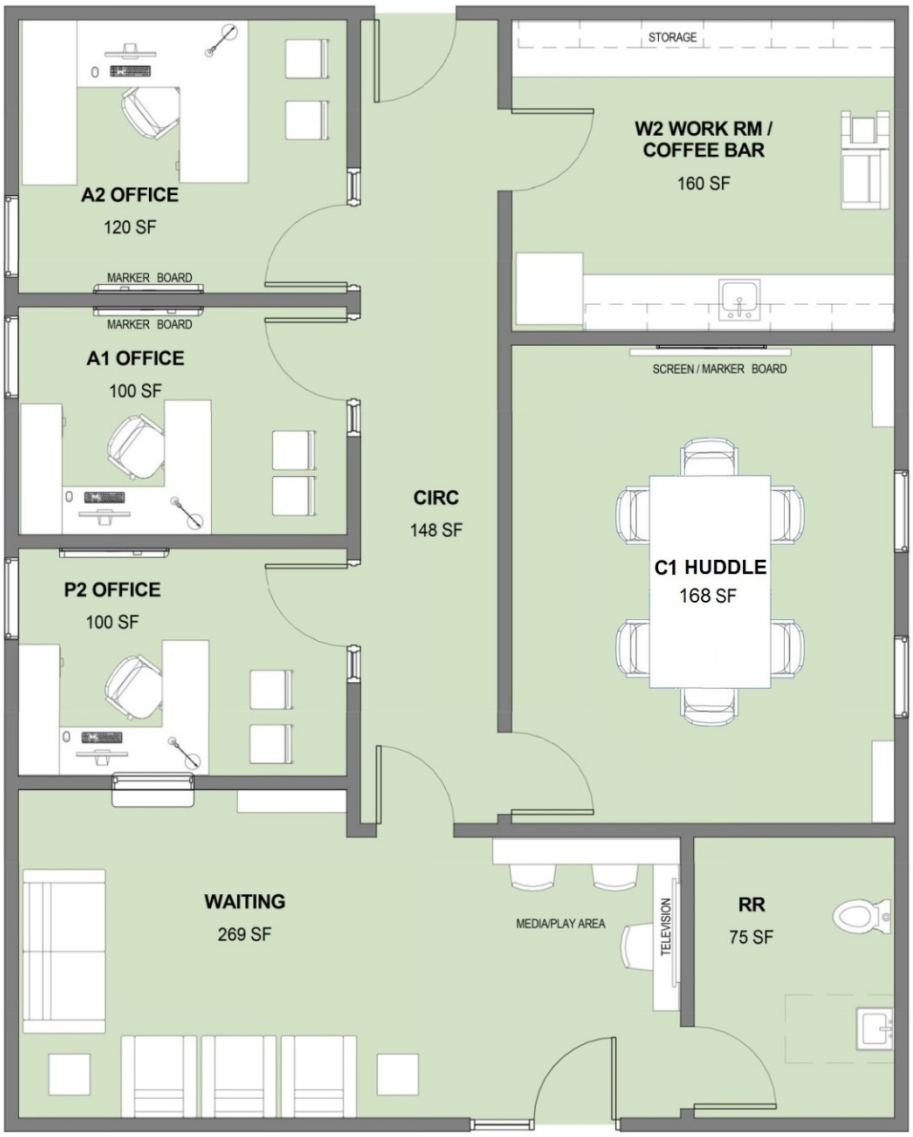


Figure 6-8 SVC Notional Floor Plan



6-3 CLSA OFFICE OF AIRMAN'S COUNSEL (OAC)

6-3.1 Function and Adjacency

The OAC represents Airmen involved in the Disability Evaluation System (DES). OAC attorneys and paralegals provide legal assistance to help Airmen reach their desired medical evaluation outcome. As the Airmen progress through the system, the OAC provides more specific advice, ultimately representing them if they choose to appear before the Formal Physical Evaluation Board (FPEB). The OAC also represents Airmen in appeals to the Secretary of the Air Force Personnel Council (SAFPC) and the Veterans Administration (VA). The OAC has unique privacy and security concerns because it routinely handles Health Insurance Portability and Accountability Act (HIPAA) and Privacy Act documents. Typically, four to five clients report to the FPEB each day, are in-briefed by OAC paralegals, and meet with assigned attorneys to prepare for FPEB hearings. Frequently, clients bring family members and/or medical escorts to assist them, as well as witnesses to testify on their behalf.

Programming sheet: Figure 6-9

Special requirements:

- Chief's office: A4
- Deputy chief's office: A3
- Handicap accessibility
- Waiting area with seating for 15, including space for three to four wheelchairs
- Records viewing room: Seating for 2 at each computer workstation
- Conference Room: C3
- Work room: W3
- Closed/secure storage area: Locked file cabinet, with 12 linear feet of storage for HIPAA and Privacy Act documents
- Break area: B2, B1
- IDS alarm at front and back doors
- Duress alarms in all offices and workstations

6-3.2 Site Selection

The OAC is a unique, specialized legal representation group, presently located at JBSA-Randolph. It could be situated in a stand-alone facility, but currently is a secondary tenant in another building. The preferred location for the office is one readily accessible on base, with direct access to and from a parking lot. Additionally, because many OAC clients have disabilities that make it difficult for them to ambulate, wheelchair and handicap accessibility is vital.

Figure 6-9 OAC Programming Sheet

(This programming sheet is notional, in that it reflects the space requirements for the OAC legal office depicted in Figures 6-10 and 6-11.)

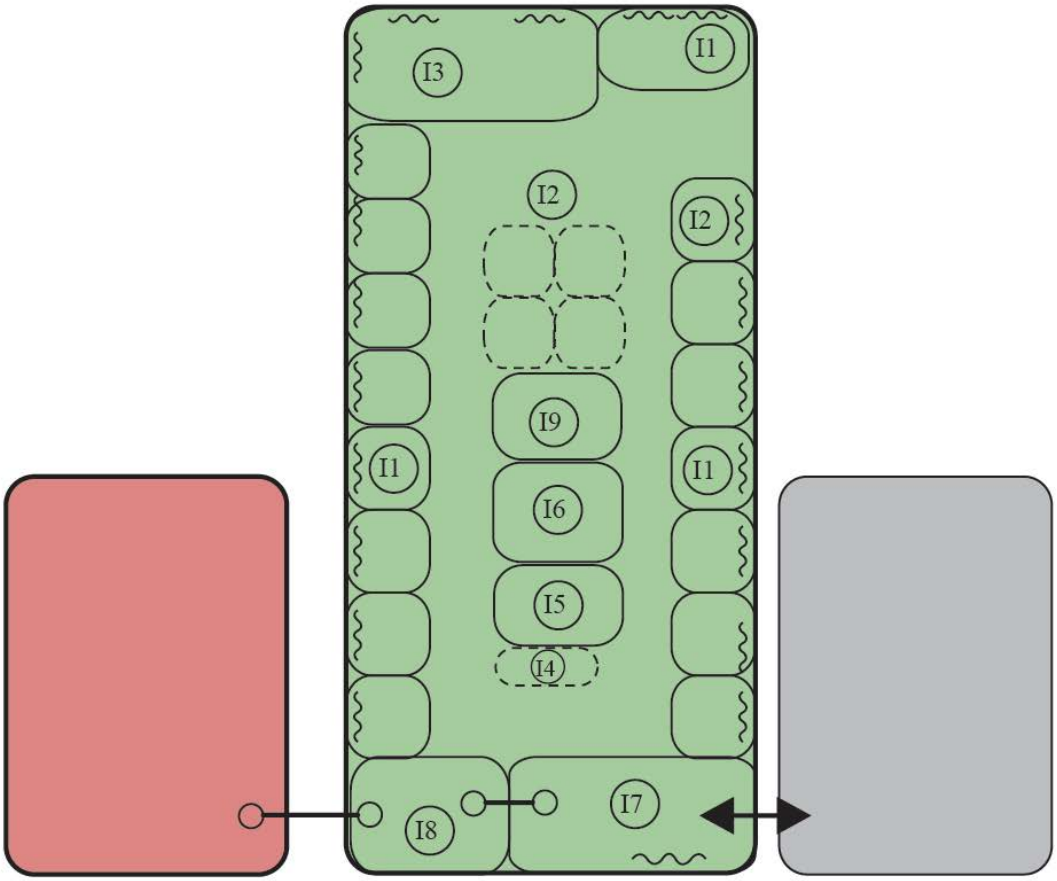
AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Office of Airmans Counsel (OAC)							
Offices:							
A1: General Office/Visiting Attorney	1	0	2	100	200	18.58	1,10
A2: Attorney	1	0	11	120	1320	122.628	1,10
A3: Deputy Chief	1	0	1	150	150	13.935	1,10
A4: Chief	1	0	1	216	216	20.0664	1,10
Paralegal Work Spaces:							
P1: Open	1	0	4	64	256	23.7824	2,10
P2: Standard/LOS	1	0	1	100	100	9.29	2,10
P3: MAJCOM Functional Manager	1	0	0	120	0	0	2,10
Conference Rooms:							
C1: Huddle Room	6	0	0	168	0	0	3,10
C2: Small	15	0	0	304	0	0	3,10
C3: Medium	30	0	1	450	450	41.805	3,10
C4: Large	45	0	0	600	0	0	3,10
Work Rooms:							
W1: Open Work Area	0	0	0	60	0	0	4,10
W2: Work Room	0	0	0	120	0	0	4,10
W3: Work Room	0	0	1	200	200	18.58	4,10
Break Rooms:							
B1: Coffee Bar	0	0	1	60	60	5.574	5,10
B2: Break Room	0	0	1	120	120	11.148	5,10
B3: Break Room	0	0	0	252	0	0	5,10
B4: Break Room	0	0	0	399	0	0	5,10
Storage:							
S1: Open Storage Area	0	0	0	0	0	0	6,10
S2: Closed/Secured Area	0	0	1	210	210	19.509	6,10
S3: Special Storage	0	0	0	0	0	0	7,10
Other:							
Waiting/Reception Area	15	0	1	536	536	49.7944	8,10
Record Review	8	0	1	455	455	42.2695	10
	0	0	0	0	0	0	
	0	0	0	0	0	0	
Total Facility Net Floor Area					4273	396.96	
Net to Gross	15.00%				641	59.54	
Total Facility Gross Area					4914	456.51	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	18				18	9
Clients	10				10	9
Total Number of Parking Spaces					28	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A4 - 1, for Chief; A3 - 1, for Deputy Chief; A2 - for other attorneys, as authorized on UMD, and VA Counselor; A1 - 2, for visiting attorneys.
2. Paralegal Work Spaces: P2 - 1, for LOS; P1, for other paralegals, as authorized on UMD.
3. Conference Room: C3.
4. Work Room: W3.
5. Break Room: B2 (for staff), B1 (for clients).
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: As required (e.g., safe or SCIF).
8. Waiting/Reception Area: 15, to include support personnel for disabled members.
9. Parking spaces (basic requirement): # authorized on UMD + 10.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

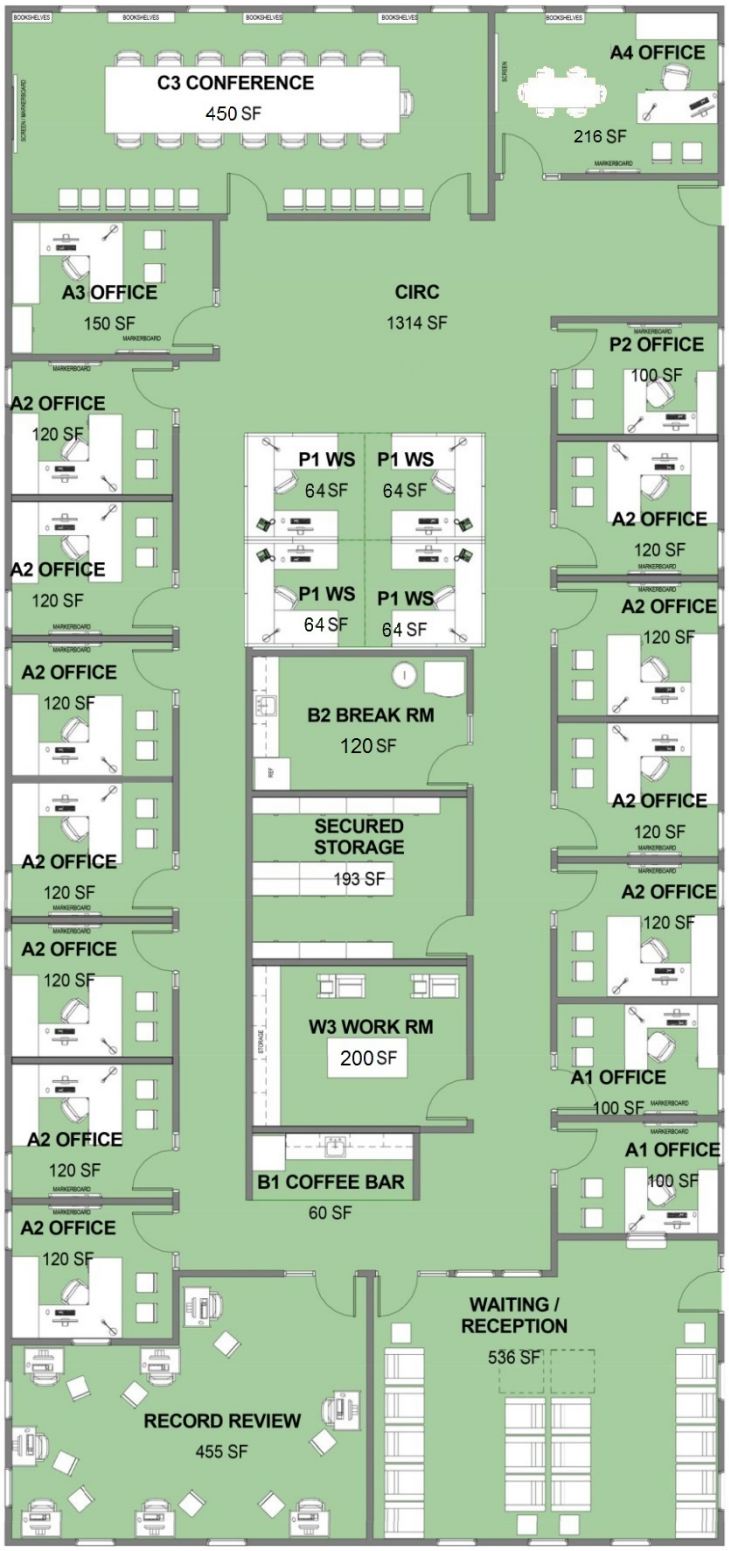
Figure 6-10 OAC Office Adjacency Diagram



OAC
ADC
PARKING
DAYLIGHTING
PROXIMITY
PRIMARY ADJACENCY
DIRECT ACCESS
ENCLOSED AREA
OPEN AREA

I1 ATTORNEY
I2 PARALEGAL
I3 CONFERENCE
I4 COFFEE BAR
I5 WORK RM
I6 STORAGE
I7 WAITING/RECEPTION
I8 RECORD REVIEW
I9 BREAK RM

Figure 6-11 OAC Office Notional Floor Plan



6-4 FIELD SUPPORT CENTERS (FSC)

6-4.1 Function and Adjacency

In addition to AFLOA/JACC's offices in the Jones Building, it also staffs five satellite FSCs:

- Air Force Claims Service Center (AFCSC)
- Environmental Law Field Support Center (ELFSC)
- Medical Cost Reimbursement Program (MCRP)
- Medical Law Field Support Center (MLFSC)
- Utility Law Field Support Center (ULFSC)

6-4.2 Air Force Claims Service Center (AFCSC)

The AFCSC processes permanent change of station (PCS) claims by service members and other claims against the government.

Programming sheet: Figure 6-12

Special requirements:

- Server room: 200 square feet, secured and climate controlled, with four server racks
- Chief's office: A3
- Conference room: C3
- Work area: W1
- Closed/secure storage: 300 square feet, with 144 linear feet of storage for claims files and financial payment documents
- Break room: B2

6-4.3 Environmental Law Field Support Center (ELFSC)

The ELFSC provides a broad range of environmental law support to the MAJCOMs, and the Air Force Installation and Mission Support Center (AFIMSC) and its subordinate units.

Programming sheet: Figure 6-12

Special requirements:

- Chief's office: A4
- Deputy Chief's office: A3
- Conference room: C3
- Classified workstation/storage area: 260 square feet
- Open storage: 1,195 linear feet of high-density storage
- Work area: W1
- Break area: B1
- Waiting/reception area: Two seats, in leadership suite

6-4.4 Medical Cost Reimbursement Program (MCRP)

The MCRP pursues third-party liability claims to reimburse the Air Force for medical care provided to Air Force active-duty members, retirees, and dependents. It is dispersed in eight regional, CONUS-based offices.

Programming sheet: Figure 6-12

Special requirements for each regional office:

- Paralegals require P2 offices because of the confidential nature of frequent discussions regarding third-party liability claims.
- Conference room: C1 or C2, sized for total authorized on UMD
- Work area: W1
- Closed/secure storage: 240 to 400 linear feet of storage, depending on regional office requirement for retaining third-party liability claim records
- Break area: B1
- Client waiting/reception area: 2 seats

6-4.5 Medical Law Field Support Center (MLFSC)

The MLFSC embeds medical law consultants (MLC) and paralegals at regional medical treatment facilities (MTF) to provide medical-legal advice directly to the MTF/CC and staff, as well as other MTFs in the region. MLCs also provide reachback support to base

legal offices within their regions. The MLFSC is dispersed at nine regional CONUS offices and one OCONUS office.

Programming sheet: Figure 6-12

Special requirements: All support spaces (e.g., conference room, storage area, safe, waiting area, visiting attorney office, work room, break room, restrooms, and parking) are shared with other building occupants.

6-4.6 Utility Law Field Support Center (ULFSC)

As the largest consumer of energy in the federal government, the Air Force works with many of the nation's power utilities to purchase electrical power. The ULFSC represents the Air Force before state public service commissions in utility rate negotiations.

Programming sheet: Figure 6-12

Special requirements:

- Conference room: C1
- Work area: W1

Figure 6-12 Field Support Center Standard Programming Sheet

(Items marked “TBD” will be determined according to the notes at the bottom of the programming sheet.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Field Support Centers Offices (FSCs)							
Attorney Offices:							
A1: General Office	1	0	TBD	100	TBD	TBD	1,10
A2: Attorney	1	0	TBD	120	TBD	TBD	1,10
A3: Deputy SJA	1	0	TBD	150	TBD	TBD	1,10
A4: SJA	1	0	TBD	216	TBD	TBD	1,10
Paralegal Work Spaces:							
P1: Open	1	0	TBD	64	TBD	TBD	2,10
P2: Standard Paralegal	1	0	TBD	100	TBD	TBD	2,10
P3: Command Paralegal	1	0	0	120	0	0	2,10
P4: Large Workstation	1	0	0	100	0	0	2,10
Conference Rooms:							
C1: Huddle Room	6	0	TBD	168	TBD	TBD	3,10
C2: Small	15	0	TBD	304	TBD	TBD	3,10
C3: Medium	30	0	TBD	450	TBD	TBD	3,10
C4: Large	45	0	TBD	600	TBD	TBD	3,10
Work Rooms:							
W1: Open Work Area	0	0	TBD	60	TBD	TBD	4,10
W2: Work Room	0	0	TBD	120	TBD	TBD	4,10
W3: Work Room	0	0	TBD	200	TBD	TBD	4,10
Break Rooms:							
B1: Coffee Bar	0	0	TBD	60	TBD	TBD	5,10
B2: Break Room	0	0	TBD	120	TBD	TBD	5,10
B3: Break Room	0	0	TBD	252	TBD	TBD	5,10
B4: Break Room	0	0	TBD	399	TBD	TBD	5,10
Storage:							
S1: Open Storage Area	0	0	TBD	TBD	TBD	TBD	6,10
S2: Closed/Secured Area	0	0	TBD	TBD	TBD	TBD	6,10
S3: Special Storage	0	0	TBD	TBD	TBD	TBD	7,10
Other:							
Waiting/Reception Area	TBD	0	TBD	TBD	TBD	TBD	8,10
	0	0	0	0	0	0	
	0	0	0	0	0	0	
	0	0	0	0	0	0	
Total Facility Net Floor Area					TBD	TBD	
Net to Gross	15.00%				TBD	TBD	
Total Facility Gross Area					TBD	TBD	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	TBD				TBD	9
Clients	TBD				TBD	9
Total Number of Parking Spaces					TBD	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A2 - for attorneys, as authorized on UMD.
2. Paralegal/Administrative Work Spaces: P2 - 1, for LOS; P1 - other paralegal/administrative personnel, as authorized on UMD.
3. Conference Room: As required.
4. Work Room: As required.
5. Break Room: As required.
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: As required (e.g., safe or SCIF).
8. Waiting/Reception Area: As required.
9. Parking (basic requirement): # authorized on UMD + avg. # clients.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

6-5 OTHER AFLOA FIELD OFFICES

6-5.1 Function and Adjacency/Site Location

In addition to the AFLOA offices covered above, JAQK, JACE, the ELFSC, the LLFSC, and JAS have small satellite offices outside the National Capital Region (NCR) at various U.S. locations to forward station personnel to help execute the AFLOA mission. The standard programming sheet for these offices is Figure 6-12.

6-6 TRIAL JUDICIAL CIRCUITS

6-6.1 Function and Adjacency

The AFJAGC has five trial judicial circuits, three CONUS and two OCONUS. Each circuit office includes at least two military judges (AF/JAT), two senior trial counsel (AFLOA/JAJG), two senior defense counsel (AFLOA/JAJD), one defense paralegal manager (AFLOA/JAJD), a senior special victims' counsel (AFLOA/CLSV), and an enlisted court reporter (AFLOA/JAJ). CONUS-based circuits will have additional military judges, senior trial counsel, senior defense counsel, and enlisted court reporters. Collocating these senior military justice practitioners enhances their operational impact individually and collectively, both within their specialized military justice role, as well as across specializations. Offices should be configured with shared common space so that there is easy access between functional groups.

Programming sheet: Figure 6-13

Special requirements:

- Conference room: C1
- Work area: W1
- Break room: B1, for overseas circuits; B2, for CONUS circuits

6-6.2 Site Location

The trial judicial circuit offices will be typically secondary tenants in buildings that serve another primary function. The offices will be located at JB Langley-Eustis, JB San Antonio-Randolph, Travis AFB, Kadena AB, and Ramstein AB.

Figure 6-13 Trial Judicial Circuit Offices Standard Programming Sheet

(Items marked “TBD” will be determined according to the notes at the bottom of the programming sheet.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Trial Judicial Circuit Offices (JAT)							
Attorney Offices:							
A1: General Office/Visiting Attorney	1	0	0	100	0	0	1,10
A2: Attorney	1	0	TBD	120	TBD	TBD	1,10
A3: Chief Judge/Chief Senior Defense Counsel	1	0	TBD	150	TBD	TBD	1,10
A4: SJA	1	0	0	216	0	0	1,10
Paralegal Work Spaces:							
P1: Open	1	0	TBD	64	TBD	TBD	2,10
P2: Standard	1	0	TBD	100	TBD	TBD	2,10
P3: MAJCOM Functional Manager	1	0	0	120	0	0	2,10
Conference Rooms:							
C1: Huddle Room	6	0	1	168	168	15.6072	3,10
C2: Small	15	0	0	304	0	0	3,10
C3: Medium	30	0	0	450	0	0	3,10
C4: Large	45	0	0	600	0	0	3,10
Work Rooms:							
W1: Open Work Area	0	0	1	60	60	5.574	4,10
W2: Work Room	0	0	0	120	0	0	4,10
W3: Work Room	0	0	0	200	0	0	4,10
Break Rooms:							
B1: Coffee Bar	0	0	TBD	60	TBD	TBD	5,10
B2: Break Room	0	0	TBD	120	TBD	TBD	5,10
B3: Break Room	0	0	0	252	0	0	5,10
B4: Break Room	0	0	0	399	0	0	5,10
Storage:							
S1: Open Storage Area	0	0	TBD	TBD	TBD	TBD	6,10
S2: Closeed Secured	0	0	TBD	TBD	TBD	TBD	6,10
S3: Special Storage	0	0	0	0	0	0	7,10
Other:							
Waiting/Reception Area	0	0	0	80	80	7.432	8,10
Total Facility Net Floor Area					TBD	TBD	
Net to Gross	15.00%				TBD	TBD	
Total Facility Gross Area					TBD	TBD	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	TBD				TBD	9
Total Number of Parking Spaces					TBD	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A3 - Chief Judge and Chief Senior Defense Counsel, as authorized on UMD; A2 - for other attorneys, as authorized on UMD.
2. Paralegal/Administrative Work Spaces: P2 - Defense Paralegal Manager and enlisted court reporters, as authorized on UMD; P1 - other paralegals/administrative personnel, as authorized on UMD.
3. Conference Rooms: C1.
4. Work Room: W1.
5. Break Room: B1, for overseas circuits; B2, for CONUS circuits.
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: None.
8. Waiting/Reception Area: None.
9. Parking (basic requirement): # authorized on UMD.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

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CHAPTER 7 AIR FORCE JUDGE ADVOCATE GENERAL'S SCHOOL (AFJAGS)

7-1 FUNCTION AND ADJACENCY

AFJAGS serves as the primary Air Force legal education and training site. The school is responsible for legal education courses for judge advocates, enlisted paralegals, and civilian attorneys. It has seven divisions:

- Military Justice Division
- Civil Law Division
- Operations and International Law Division
- Professional Outreach Division
- Paralegal Development Division
- Accreditation, Curriculum and Evaluations Division
- Administrative Division

It also publishes several major publications, including the *Air Force Law Review*, *The Reporter*, *Military Commander and the Law*, and *Air Force Operations and the Law*.

7-1.1 Site Location

The school is housed in the Dickinson Law Center, which is part of the larger Air University campus, located on Maxwell AFB, Alabama. The facility was built in 1993; there is no planned move in the near future.

7-1.2 Facility Components

AFJAGS is a two-story, 56,000-square-foot facility that includes a leadership suite, two auditoriums (with adjoining control rooms with VBrick systems), 15 seminar rooms, two courtrooms, a library, an executive conference room, an adjoining small conference room, an AFJAGC heritage room, a computer training room, a remote learning production room, a classified storage room, 52 faculty offices, administrative offices, instructor and student lounges, a distinguished visitor (DV) suite, an extended lobby, a mail/supply room, a server room, and restrooms. Under consideration is expansion of the heritage room and addition of a food service.

Within the school there are six main types of learning spaces: auditoriums, seminar rooms, conference rooms, computer lab, a library, and practice courtrooms. Additionally, there are student support spaces, including a large lounge area and restrooms on the first floor. The second floor contains instructor and administrative offices, a professional development suite, and building support spaces, including

restrooms. The general layout of the building is depicted in Figures 7-2 and 7-3. The programming sheet for the facility is Figure 7-1.

7-1.3 AFJAG Leadership Suite

Special requirements:

- VTC capability in Commandant's office
- Reception/waiting area: Alcove, with seating for three
- Unisex restroom

Figure 7-1 AFJAGS Programming Sheet

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
AFJAG School Facility							
Offices:							
A1: General Office/Visiting Attorney	1	0	0	100	0	0	1,10
A2: Attorney	1	0	47	120	5640	523.956	1,10
A3: Deputy Commandant	1	0	1	150	150	13.935	1,10
A7: Commandant	1	0	1	200	200	18.58	1,10
Paralegal Work Spaces:							
P1: Paralegals/Administrative Personnel	1	0	13	64	832	77.2928	2,10
P2: LOS/Paralegal Instructors	1	0	18	100	1800	167.22	2,10
P3: Superintendent	1	0	1	120	120	11.148	2,10
Conference Rooms:							
C1: Huddle Room	6	0	4	168	672	62.4288	3,10
C2: Small	15	0	0	304	0	0	3,10
C3: Medium	30	0	1	450	450	41.805	3,10
C4: Large	45	0	0	600	0	0	3,10
Work Rooms:							
W1: Open Work Area	0	0	0	60	0	0	4,10
W2: Workroom	0	0	0	120	0	0	4,10
W3: Workroom	0	0	1	200	200	18.58	4,10
Break Rooms:							
B1: Coffee Bar	0	0	1	60	60	5.574	5,10
B2: Breakroom	0	0	0	120	0	0	5,10
B3: Breakroom	0	0	1	252	252	23.4108	5,10
B4: Breakroom	0	0	1	399	399	37.0671	5,10
Storage:							
S1: Open Storage Area	0	0	1	120	120	11.148	6,10
S2: Closed/Secure Area	0	0	1	240	240	22.296	6,10
S4: Special Storage	0	0	1	20	20	1.858	7,10
Other:							
Misc Building Support Spaces	0	0	1	14,500	14,500	1347.05	10
Waiting/Reception Area	9	0	2	120	240	22.296	8,10
Seminar Rooms	20	0	15	600	9000	836.1	10
Auditorium 1	65	0	1	2200	2200	204.38	10
Auditorium 2	150	0	1	3500	3500	325.15	10
Practice Court Rooms	150	0	2	1800	3600	334.44	10
Heritage Room	10	0	1	200	200	18.58	10
Professional Development	6	0	1	2250	2250	209.025	10
Classified Reading Room	1	0	1	120	120	11.148	10
Extended Lobby Area	TBD	0	1	1000	1000	92.9	10
Total Facility Net Floor Area					47765	4437.37	
Net to Gross	**15.00%**				7165	665.61	
Total Facility Gross Area					54930	5102.97	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	222				222	9
Total Number of Parking Spaces	222				222	9

the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A7 - 1, for Commandant; A3 - 1, for Deputy Commandant; A2 - for attorney instructors and other attorneys, as authorized on UMD.
2. Paralegal Work Spaces: P3 - 1, for Superintendent; P2 - for LOS and paralegal instructors, as authorized on UMD; P1 - for other paralegals and administrative personnel, as authorized on UMD.
3. Conference Rooms: C3 Executive Conference Room (details in Figure 7-1.5); 4 C1 conference rooms.
4. Workroom: W2.
5. Break Rooms: B1, B3 (Instructor Lounge), and B4 (Student Lounge).
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: Classified Reading Room.
8. Waiting/Reception Area: 3-seat alcove, for Leadership Suite; 6-seat waiting area, for Curriculum Development Suite.
9. Parking spaces: 218 (3 for handicapped) in adjacent parking lot; 4 near loading dock.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

Figure 7-2 AFJAGS Adjacency Diagram - First Floor

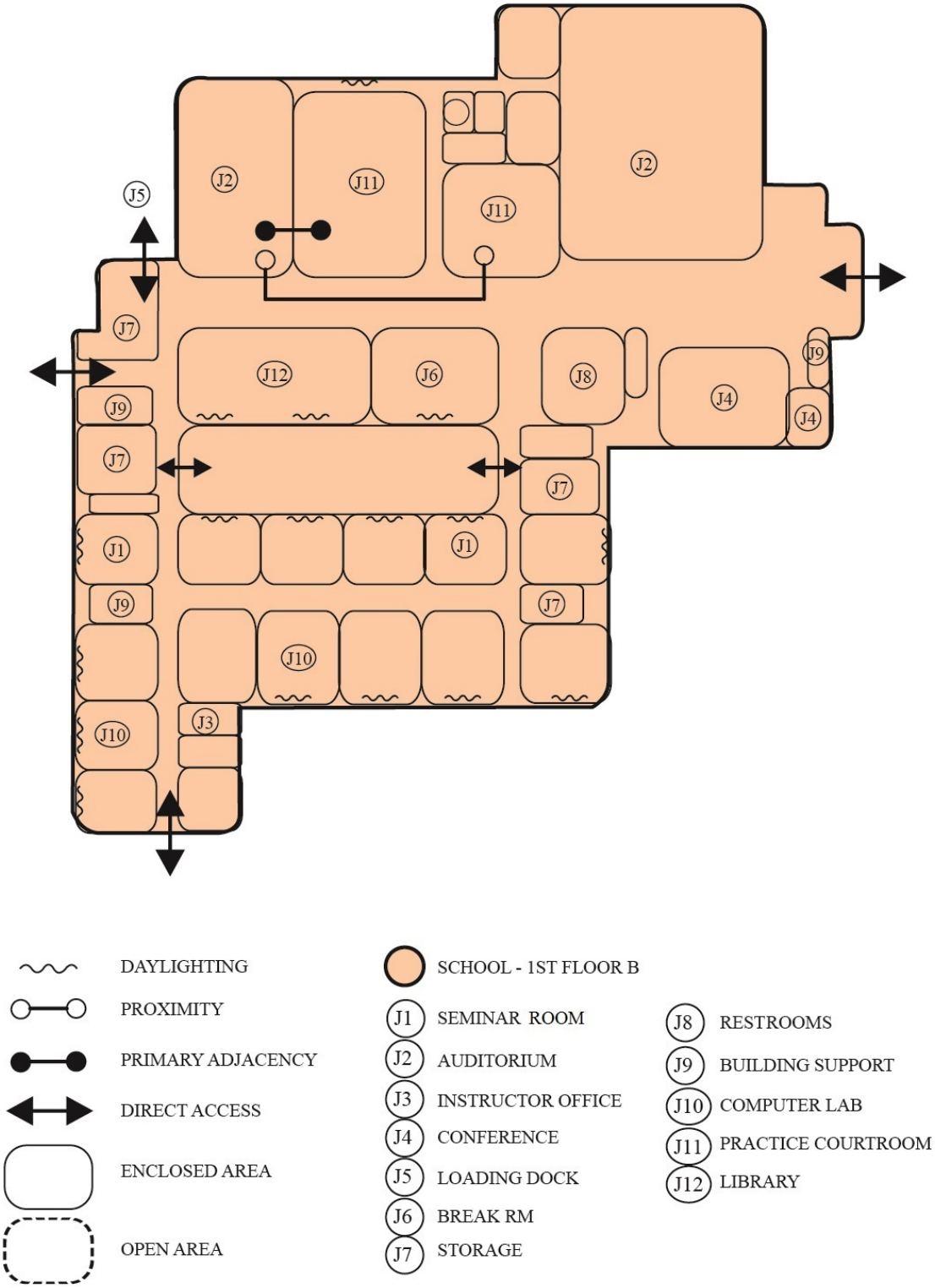
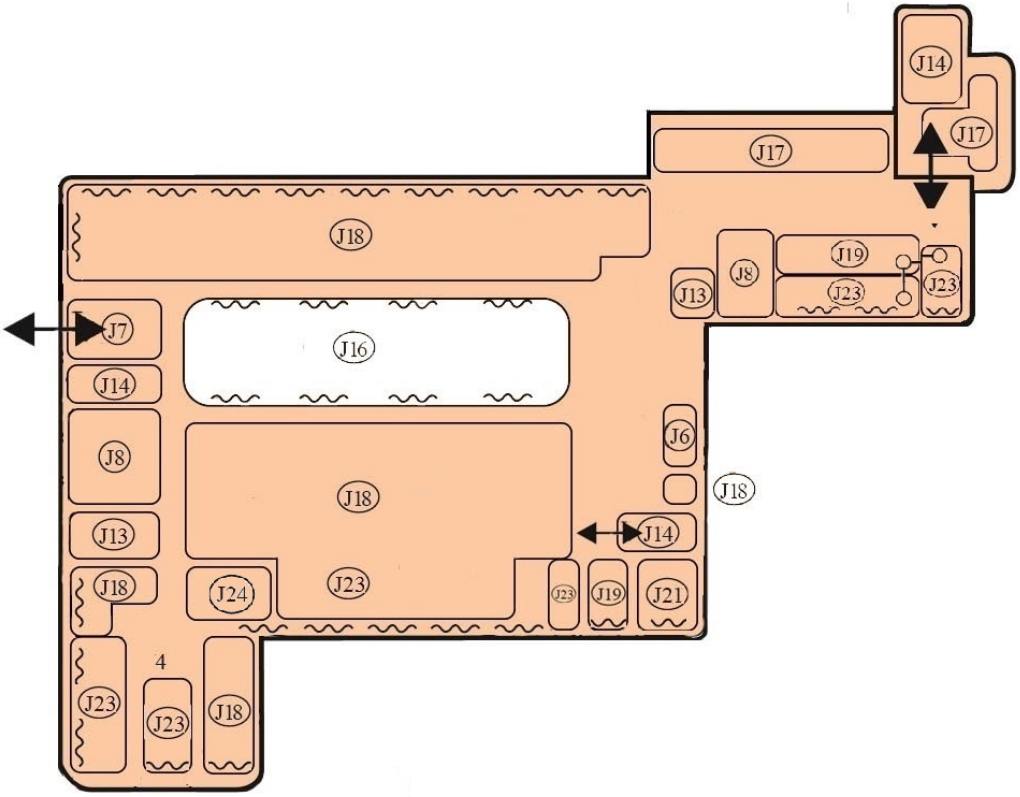


Figure 7-3 AFJAGS Adjacency Diagram - Second Floor



DAYLIGHTING
PROXIMITY
PRIMARY ADJACENCY
DIRECT ACCESS

SCHOOL - 2ND FLOOR

J6 BREAK ROOM
J7 STORAGE ROOM
J8 RESTROOMS
J13 MECHANICAL
J14 STAIRWELL
J16 COURTYARD
J17 ATRIUM
J18 INSTRUCTOR OFFICES
J19 WAITING AREA
J20 DIRECTOR
J21 CURRICULUM DIRECTOR
J23 PRIVATE OFFICES
J24 COMPUTER SERVER ROOM

7-1.4 AFJAGS Room Data Sheets

Figure 7-4 Administrative Leadership Suite Room Data Sheet

Description/Usage		A private office for the Commandant, whose duties include frequent consultations with staff instructors and other personnel.
Ceiling Height		9'-0" minimum
Windows		Exterior glazing, AT compliant
Doors	**Type**	Solid wood, 3 x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Side-view panel
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		None
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Yes
	Data	NIPR, SIPR
	CCTV	N/A
	CATV	User justified
	Security	Duress alarm
Acoustics		Floors, partitions, and ceilings meet or exceed the STC 50 requirement. Windows and door meet the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		Provide wood 6' executive desk, credenza, leather executive swivel chair, four swivel leather chairs, two straight upholstered chairs, 4' round wood table, and a TV.
Special Requirements		N/A

Figure 7-5 Executive Conference Room Data Sheet

Description/Usage		Meeting space (about 1,200 square feet) that serves both school staff and students.
Ceiling Height		9’-0” minimum
Windows		Exterior insulated, AT compliant
Doors	**Type**	Wood, 3’ x 7’
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	Yes
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		One 6’ x 3’ head table, two 18’ x 3’ tables, wall-mounted video monitor, VTC capable, 15 swivel chairs at tables, 22 seats along walls, bookshelves, and storage for students’ bags.
Special Requirements		N/A

Figure 7-6 Courtroom Room Data Sheet

Description/Usage		Two courtrooms are used to conduct mock judicial proceedings. Judge's bench, court reporter station, and witness stand are designated areas. Other spaces include the jury member area, and trial and defense counsel areas. Gallery in each seats 25 to 30 spectators.
Ceiling Height		12'-0"
Windows		Clearstory or none
Doors	**Type**	Solid wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	None
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		None
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Receptacles for all equipment at court reporter stand, per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	Yes. Include amplification and recording system, microphones for judge, witness, counsel, and members.
	Data	NIPR
	CCTV	Yes
	CATV	N/A
	Security	N/A
Acoustics		Floors, partitions, and ceilings meet or exceed the STC 50 requirement. Doors and windows meet or exceed the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		Provide one high-back leather swivel chair, 15 swivel chairs, and one straight upholstered chair. Theater-style or individual chairs for gallery, with movable rail to separate gallery from proceedings. Two 3'-6" x 7' counsel tables, and three straight upholstered chairs. Integrated bench/workstation for judge, jury members, court reporter, and witnesses.
Special Requirements		Elevate judge's bench 18" from finished floor. Elevate witness stand and court reporter station 8" from finished floor. Jury member area to be double-tiered raised platform.

Figure 7-7 Auditorium Room Data Sheet

Description/Usage		Two large, column-free auditoriums, one sized for 150 people, and a smaller one sized for 65 people. Includes equipment storage and control room for entire school.
Ceiling Height		Varies
Windows		N/A
Doors	**Type**	Wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	None
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		None
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	Yes, in control booth
	Data	NIPR
	CCTV	Yes
	CATV	N/A
	Security	N/A
Acoustics		Floors, partitions and ceilings meet or exceed the STC 50 requirement. Doors and windows meet or exceed the STC 45 requirement.
Furnishings Fixtures & Equipment (FF&E), Casework		Provide straight upholstered swivel chairs, with integrated lecture tables with data connections, front stem wall at each seat location, and tiered seating. Include rear projection screens.
Special Requirements		Elevate stage 18" above ground floor, with ABA access to stage area. Provide shared control room in rear for both auditoriums. Include two P1 workstations and necessary equipment that controls all school rooms (via audio and video) through hard-wired VBrick system.

Figure 7-8 Computer Lab Room Data Sheet

Description/Usage		Meeting space for school staff, and students that require computer access.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 1
	Floor	Level 1
	Base	Level 1
	Ceiling	Level 1
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	N/A
	Data	NIPR
	CCTV	Yes
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Computer tables with integrated power and data connection for 20 students, and stacking chairs.
Special Requirements		N/A

Figure 7-9 Library Room Data Sheet

Description/Usage		Library space for school staff and students. Also serves as a work room.
Ceiling Height		9'-0" minimum
Windows		Exterior insulated, AT compliant
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 2
	Floor	Level 2
	Base	Level 2
	Ceiling	Level 2
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	N/A
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Provide ten 3' x 8' rectangle library tables, with six stackable chairs per table. Include work area, similar to work room, with upper and lower cabinets with Formica work surface. Include book shelves, storage for student bags, and computer workstations.
Special Requirements		N/A

Figure 7-10 Seminar Room Data Sheet

Description/Usage		Meeting space for school staff and students, suitable for group discussions.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 1
	Floor	Level 1
	Base	Level 1
	Ceiling	Level 1
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	N/A
	Data	NIPR
	CCTV	Yes
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Provide 60" x 30" seminar tables, with integrated power and data connection for 20 students, and stacking chairs. Include storage cubes or lockers for student bags.
Special Requirements		N/A

Figure 7-11 Heritage Room Data Sheet

Description/Usage		Space for displaying AFJAGC history and school memorabilia.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Solid wood, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 3
	Floor	Level 3
	Base	Level 3
	Ceiling	Level 3
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Provide custom display cabinets and lighting for Air Force and school memorabilia.
Special Requirements		Provide direct access from main school lobby. Expansion under consideration.

Figure 7-12 Professional Outreach Division (POD) Room Data Sheet

Description/Usage		Provides digital support for all AFJAGS courses, produces publications for the school, hosts webcasts, and assists faculty with class program/course setup.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 2
	Floor	Level 2
	Base	Level 2
	Ceiling	Level 2
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	Yes
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Provide green room capabilities for video productions and webcast recording.
Special Requirements		Provide access from instructor offices.

Figure 7-13 Extended Lobby Area Room Data Sheet

Description/Usage			Extended lobby space that serves as a display area for AFJAGC history and school memorabilia and pre-function space for courtrooms and auditoriums. Also used as a seating area for catered events.
Ceiling Height			Varies
Windows			N/A
Doors	**Type**		Double solid wood, 3’ x 7’
	Security/ Hardware		Keyed lock set
	View Panels/ Kick-Plates		N/A
Finishes	**Walls**		Level 3
	Floor		Level 3
	Base		Level 3
	Ceiling		Level 3
Plumbing			N/A
HVAC			Per UFC 3-410-01
Fire Protection			Wet or dry pipe sprinkler system, per UFC 3-600-01
Power			Per UFC 3-520-01
Lighting			Per UFC 3-530-01
Communication		**Telephone**	N/A
		Data	N/A
		CCTV	N/A
		CATV	N/A
		Security	IDS
Acoustics			Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)			Provide custom display cabinets and lighting for Air Force and school memorabilia.
Special Requirements			Provide direct access from main lobby.

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CHAPTER 8 LEGAL INFORMATION SERVICES DIRECTORATE (JAS)

8-1 FUNCTION AND ADJACENCY

JAS is the AFJAGC information technology (IT) directorate, managing JA IT systems and fulfilling a DoD executive agency for legal research. Its mission is to provide responsive and secure, legal-specific IT solutions for the AFJAGC and other DoD legal communities. JAS has six divisions:

- System Operations and Development Division
- Applications Development Division
- Legal Division
- Information Assurance Division
- Plans/Requirements/Testing and Training Division
- Resource/Personnel Division

8-1.1 Site Location

In 1993, JAS moved from Colorado to the second story of AFJAGS at Maxwell AFB, Alabama. In 2008, due to growth in the school faculty, JAS moved to an older building nearby on base. The data center that supports JAS is still located in the AFJAGS facility. Additionally, a small cadre of JAS programmers is located with the AFCSC at Wright-Patterson AFB, Ohio.

8-1.2 JAS Leadership Suite

Programming sheet: Figure 8-1

Special requirements: VTC capability in director’s office

8-1.3 Other JAS Offices

Programming sheet: Figure 8-1

Special requirements:

- Testing/training room
- Computer work space/storage
- Data center (in AFJAGS): Raised flooring

Figure 8-1 JAS Programming Sheet

(This programming sheet is notional, in that it reflects the space requirements for the JAS legal office depicted in Figures 8-2 and 8-3.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
JAS Office							
Offices:							
A1: Visiting Attorney	1	0	1	100	100	9.29	1,10
A2: Attorney	1	0	5	120	600	55.74	1,10
A3: Deputy Director	1	0	1	150	150	13.935	1,10
A7: Director	1	0	1	200	200	18.58	1,10
Paralegal Work Spaces:							
P1: Open	1	0	9	64	576	53.5104	2,10
P2: LOS/Division Chiefs	1	0	4	100	400	37.16	2,10
P3: MAJCOM Functional Manager	1	0	0	120	0	0	2,10
P4: Large Workstation	1	0	20	100	2000	185.8	2,10
Conference Rooms:							
C1: Huddle Room	6	0	2	168	336	31.2144	3,10
C2: Small	15	0	0	304	0	0	3,10
C3: Medium	30	0	0	450	0	0	3,10
C4: Large	45	0	1	600	600	55.74	3,10
Work Rooms:							
W1: Open Work Area	0	0	0	60	0	0	4,10
W2: Work Room	0	0	1	120	120	11.148	4,10
W3: Work Room	0	0	1	200	200	18.58	4,10
Break Rooms:							
B1: Coffee Bar	0	0	0	60	0	0	5,10
B2: Break Room	0	0	0	120	0	0	5,10
B3: Break Room	0	0	1	252	252	23.4108	5,10
B4: Break Room	0	0	0	399	0	0	5,10
Storage:							
S1: Open Storage Area	0	0	0	0	0	0	6,10
S2: Closed/Secured Area	0	0	2	225	450	41.805	6,10
S3: Special Storage	0	0	1	12	12	1.1148	7,10
Other:							
Waiting/Reception Area	2	20	1	100	100	9.29	10
Computer Data Center	0	0	1	1300	1300	120.77	10
Testing and Training Center	0	0	1	400	400	37.16	10
Computer Work Room	0	0	1	365	365	33.9085	10
Total Facility Net Floor Area					8161	758.16	
Net to Gross	15.00%				1224	113.72	
Total Facility Gross Area					9385	871.88	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	40				40	9
Total Number of Parking Spaces					40	9

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A7 - 1, for Director; A3 - 1, for Deputy Director; A2- for other attorneys, as authorized on UMD; A1 - 1, for visiting attorney.
2. IT/Paralegal/Administrative Work Spaces: P2 - for LOS and non-attorney division chiefs, as authorized on UMD; P1 or P4 - for IT, paralegal, and administrative personnel, as authorized on UMD (P4s necessary due to extra IT equipment required in workstations).
3. Conference Room: 2 C1s, C4. 150 sq. ft. added for speaker, per AFMAN 32-1084, Table 6.4.
4. Work Rooms: W2 and W3.
5. Break Room: B3.
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: Safe.
8. Waiting/Reception Area: 2, in leadership suite (20 sq. ft. per person).
9. Parking spaces (basic requirement): # authorized personnel on UMD.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

Figure 8-2 JAS Adjacency Diagram

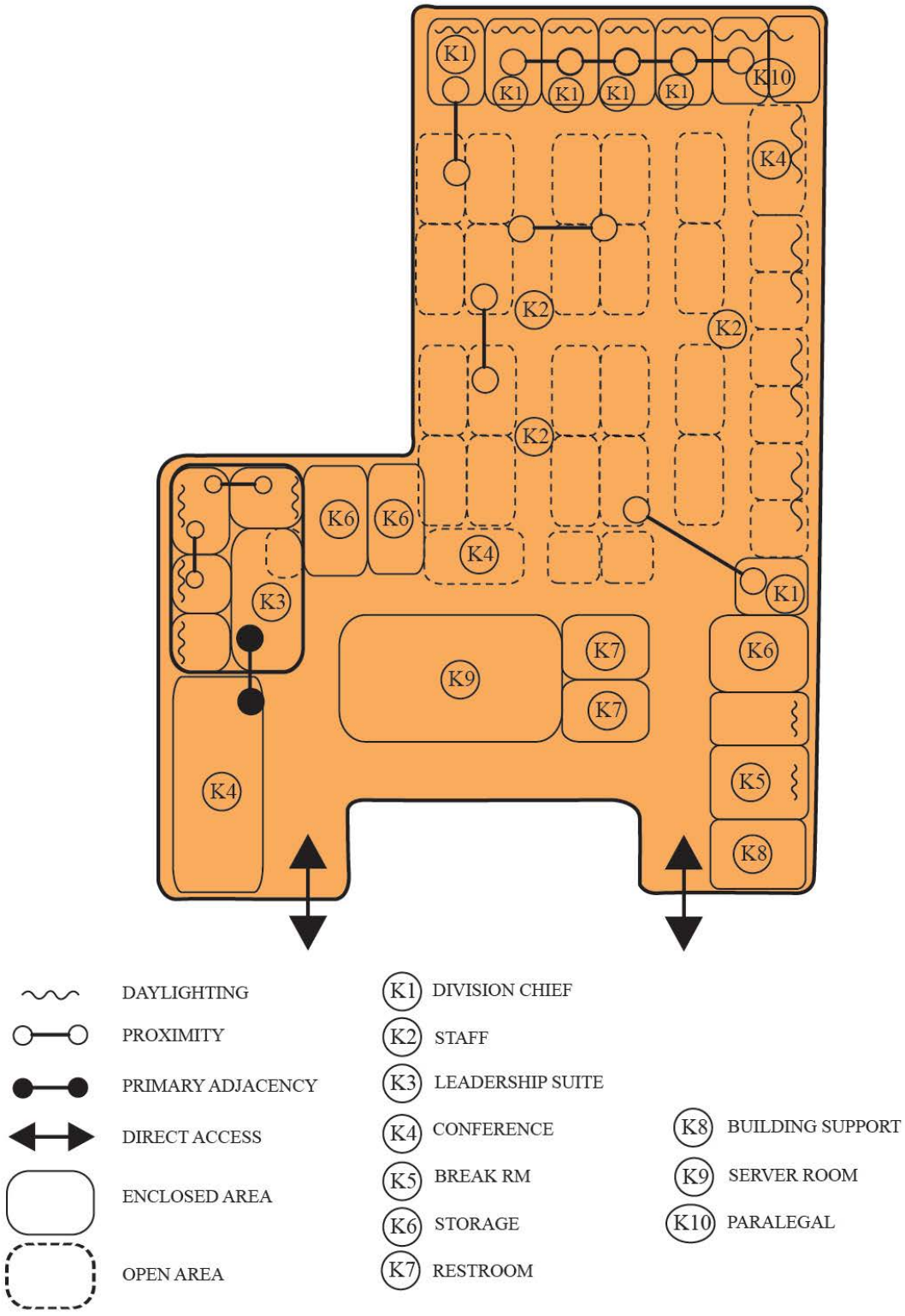
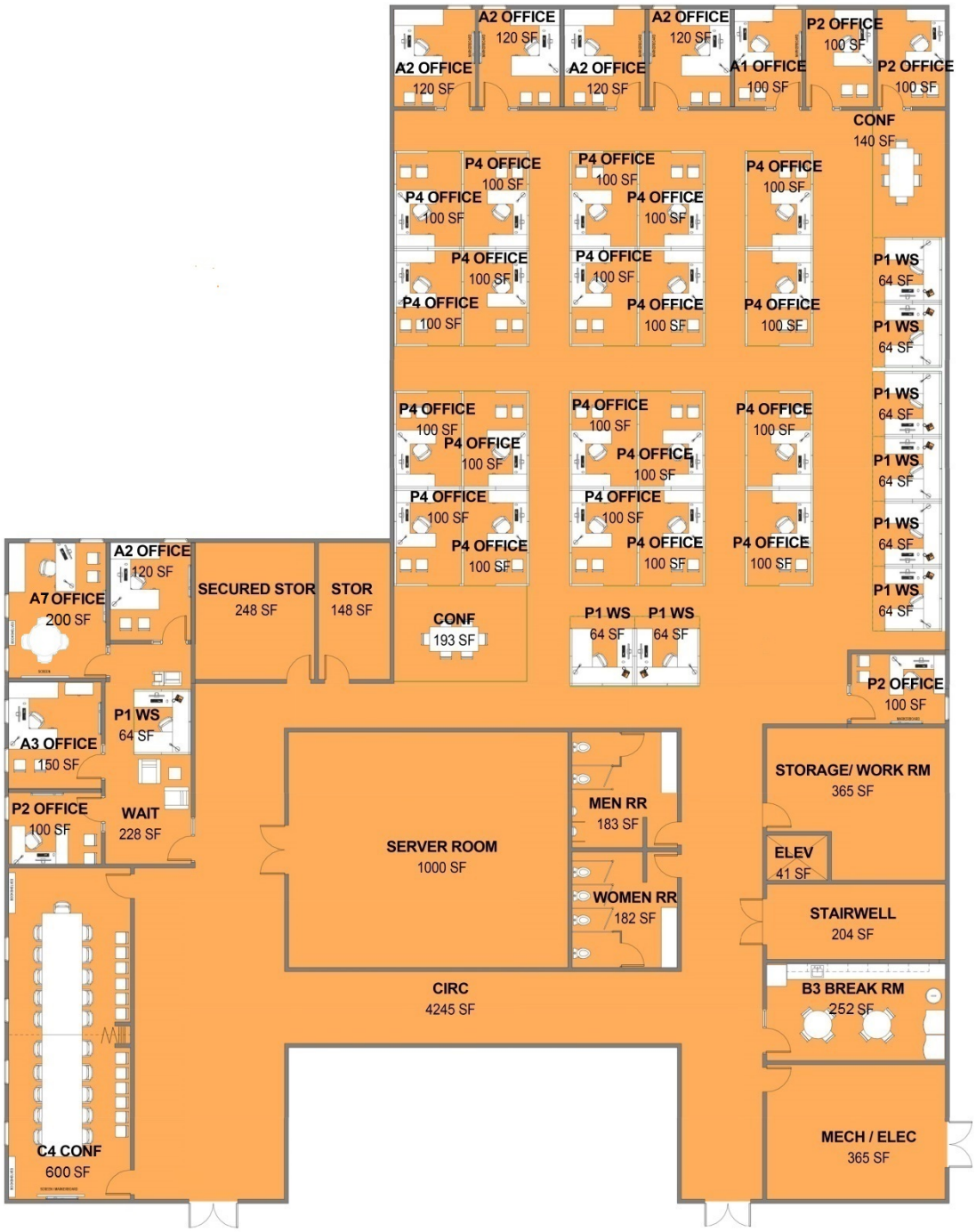


Figure 8-3 JAS Notional Floor Plan



8-1.4 JAS Room Data Sheets

Figure 8-4 IT Work Room Data Sheet

Description/Usage		Two work rooms to receive, refurbish, and store JA computers and VTCs.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 1
	Floor	Level 1
	Base	Level 1
	Ceiling	Level 1
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Telephone**	One per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Include storage cabinets and work tables.
Special Requirements		Provide non-static flooring.

Figure 8-5 Server Room Data Sheet

Description/Usage		Secured room to house computer systems and associated components
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, 3' x 7'
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 1
	Floor	Level 1
	Base	Level 1
	Ceiling	Level 1
Plumbing		N/A
HVAC		Per UFC 3-410-01, include a 480V, 3-phase circuit for computer room air conditioning (CRAC) unit, and 120V, single-phase circuit for controls.
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	One per desk
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Server racks to house JAS servers, along with a CRAC unit to provide supplemental power.
Special Requirements		Raised flooring for access to computer racks and CRAC unit.

Figure 8-6 Testing and Training Room Data Sheet

Description/Usage		Classroom setting for testing and training in current software programs
Ceiling Height		9’-0” minimum
Windows		N/A
Doors	**Type**	Double hollow metal, 3’ x 7’
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Level 1
	Floor	Level 1
	Base	Level 1
	Ceiling	Level 1
Plumbing		N/A
HVAC		Per UFC 3-410-01
Fire Protection		Wet or dry pipe sprinkler system, per UFC 3-600-01
Power		Per UFC 3-520-01
Lighting		Per UFC 3-530-01
Communication	**Tele.**	One, wall mounted
	Data	NIPR
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustics		Per UFC 3-450-01, for noise control
Furnishings Fixtures & Equipment (FF&E)		Provide computer tables, with associated floor plugs and data jacks, sufficient to serve the number of students in the room.
Special Requirements		N/A

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CHAPTER 9 OTHER FIELD OPERATING AGENCIES (FOA)

9-1 FUNCTION AND ADJACENCY/SITE LOCATION

FOAs are commands subordinate to Air Staff directors that perform specialized missions. The FOAs, other than AFLOA, with legal offices are:

- Air Force Inspection Agency (AFIA)
- Air Force Office of Special Investigations (AFOSI)
- Air Force Personnel Center (AFPC)
- Air Force Safety Center (AFSEC)
- National Air and Space Intelligence Center (NASIC)

9-1.1 Air Force Inspection Agency (AFIA)

AFIA provides independent inspection, evaluation, and analysis to advance the continuous improvement of mission effectiveness at all levels in the Air Force. Its mission set includes nuclear surety, healthcare, management inspections of organizations above wing level, unit effectiveness inspections of FOAs and DRUs, directed inspections of programs of significant interest to Air Force leadership, and oversight of all aspects of the Air Force Inspection System. AFIA/JA is located at Kirtland AFB, New Mexico.

Programming sheet: Figure 9-1

Special requirements: Support spaces (e.g., conference room, work room, break room, and restrooms) are shared with other building occupants.

9-1.2 Air Force Office of Special Investigations (AFOSI)

AFOSI is a federal law enforcement agency, with responsibility for conducting independent criminal investigations, counterintelligence activities, and specialized investigative and force protection support for the Air Force worldwide. AFOSI/JA is located at Marine Corps Base Quantico, Virginia.

Programming sheet: Figure 9-1

Special requirements:

- Legal office is sited in a SCIF
- Support spaces (e.g., conference room, work room, break room, and restrooms) are shared with other building occupants

- Visiting attorney office: A1

9-1.3 Air Force Personnel Center (AFPC)

AFPC executes personnel programs covering the entire life cycle of Air Force military and civilian personnel, from accession through retirement. AFPC/JA is located at JB San Antonio - Randolph, Texas.

Programming sheet: Figure 9-1

Special requirements:

- Conference room: C2
- Open storage/library: 525 square feet
- Work area: W1
- Break area: B1
- Reception/waiting area: 6 seats
- Visiting attorney office: A1

9-1.4 Air Force Safety Center (AFSEC)

AFSEC develops, implements, executes, and evaluates Air Force aviation, ground, weapons, space, and system mishap prevention, and nuclear surety programs and policy. AFSEC/JA is located at Kirtland AFB, New Mexico.

Programming sheet: Figure 9-1

Special requirements:

- AFSEC records library: Secure 1,800-square-foot storage room, with 1,054 linear feet of storage for privileged safety investigation reports for review and analysis
- Work area: W1
- Break area: B1
- Visiting attorney office: A1

9-1.5 National Air and Space Intelligence Center (NASIC)

NASIC analyzes intelligence on foreign air and space forces, weapons, and systems. NASIC assessments of aerospace performance characteristics, capabilities, and

vulnerabilities are used to shape national security and defense policies and support weapons treaty negotiations and verification. NASIC/JA is located at Wright-Patterson AFB, Ohio.

Programming sheet: Figure 9-1

Special requirements:

- Legal office is sited in a SCIF
- Support spaces (e.g., conference room, work room, break room, and restrooms) are shared with other building occupants
- Visiting attorney office: A1

Figure 9-1 FOA Offices (Other than AFLOA) Standard Programming Sheet

(Items marked "TBD" will be determined according to the notes at the bottom of the programming sheet.)

AREA	NO. OCCUPANTS	S.F. PER USER	NO. OF ROOMS REQUIRED	STANDARD ROOM REQUIREMENTS	NET USER REQUIREMENTS		COMMENTS
				SF	SF	SM	
Field Operating Agency Offices (FOAs) (Other than AFLOA)							
Attorney Offices:							
A1: General Office/Visiting Attorney	1	0	TBD	100	TBD	TBD	1,10
A2: Attorney	1	0	TBD	120	TBD	TBD	1,10
A3: Deputy SJA	1	0	TBD	150	TBD	TBD	1,10
A4: SJA	1	0	TBD	216	TBD	TBD	1,10
Paralegal Work Spaces:							
P1: Open	1	0	TBD	64	TBD	TBD	2,10
P2: LOS/Standard	1	0	TBD	100	TBD	TBD	2,10
P3: MAJCOM Functional Manager	1	0	0	120	0	0	2,10
Conference Rooms:							
C1: Huddle Room	6	0	TBD	168	TBD	TBD	3,10
C2: Small	15	0	TBD	304	TBD	TBD	3,10
C3: Medium	30	0	0	450	0	0	3,10
C4: Large	45	0	0	600	0	0	3,10
Work Rooms:							
W1: Open Work Area	0	0	TBD	60	TBD	TBD	4,10
W2: Work Room	0	0	0	120	0	0	4,10
W3: Work Room	0	0	0	200	0	0	4,10
Break Rooms:							
B1: Coffee Bar	0	0	TBD	60	TBD	TBD	5,10
B2: Break Room	0	0	0	120	0	0	5,10
B3: Break Room	0	0	0	252	0	0	5,10
B4: Break Room	0	0	0	399	0	0	5,10
Storage:							
S1: Open Storage Area	0	0	TBD	TBD	TBD	TBD	6,10
S2: Closed Secured	0	0	TBD	TBD	TBD	TBD	6,10
S3: Special Area	0	0	TBD	TBD	TBD	TBD	7,10
Other:							
Waiting/Reception Area	0	0	TBD	630	TBD	TBD	8,10
Total Facility Net Floor Area					TBD	TBD	
Net to Gross	15.00%				TBD	TBD	
Total Facility Gross Area					TBD	TBD	

AREA	NO. OCCUPANTS				NO. OF PARKING SPACES	COMMENTS
Parking:						
UMD	TBD				TBD	9
Clients	TBD				TBD	9
Total Number of Parking Spaces					TBD	

To the extent the information in this manual differs from that in Chapter 6 of AFMAN 32-1084, this information supersedes. Other applicable information not included in this manual can be found in AFMAN 32-1084, Chapter 6, Tables 6.3 and 6.4.

1. Attorney Offices: A4 - 1, for SJA; A3 - 1, for DSJA, if authorized; A2 - for other attorneys, as authorized on UMD; A1 - for visiting attorney, as required.
2. Paralegal/Administrative Work Spaces: P2 - 1, for LOS, if authorized; P1 - other paralegals and administrative personnel, as authorized on UMD.
3. Conference Room: As required.
4. Work Room: W1.
5. Break Room: B1.
6. Total storage requirements: 30 linear ft. + (# authorized on UMD X 10) linear ft. Includes open area storage (outside individual offices and workstations) and closed/secure area storage (in separate, locked area). Distribution of open and closed storage depends on specific legal office requirements.
7. Special Storage: As required (e.g., safe or SCIF).
8. Waiting/Reception Area: As required.
9. Parking (basic requirement): # authorized on UMD + avg. # clients.
10. Administrative areas include circulation factor of 10%, per AFMAN 32-1084.

CHAPTER 10 ENGINEERING/TECHNICAL CRITERIA

10-1 ACOUSTICAL PERFORMANCE

10-1.1 Acoustical Design

For any given critical legal space, it is important that speech from the activity within not be audible in adjacent spaces, and vice-versa. Special attention should be paid at the earliest stages of planning to ensure that noise-producing spaces (e.g., building systems equipment rooms, restrooms, circulation space, public lobbies) are not located directly adjacent (vertically or horizontally) to noise-sensitive spaces.

Include an acoustic consultant during project development, whether new construction or remodeling, to determine the appropriate information needed for the design of attorney offices, courtrooms, and auditoriums, so that sound/vibration issues are properly addressed. Internal partitions must be of a construction determined to achieve an appropriate level of airborne sound isolation, as measured per ASTM E90-09. All facade elements (e.g., walls, glazing, roofs, flooring) must be designed to provide appropriate sound isolation.

The following list of STC ratings for privacy levels, discussed in the various room data sheets, are required in courtrooms, auditoriums, command and leadership suites, and rated attorney offices. The STC ratings fall into three categories. These categories are listed below, along with typical examples of interior partition construction that provides the appropriate acoustic isolation:

STC of 40-45: One layer of 12.7-millimeter (0.5-inch) gypsum wallboard on each side of the steel studs to the underside of the structure, with acoustic sealant at top and bottom. Include an acoustic break along the base of the walls.

STC of 50: One layer of 15.9-millimeter (0.625-inch) gypsum wallboard on each side of the steel studs, plus an additional layer on one side, to the underside of the structure, with acoustic sealant at top and bottom. (Install 69.8-millimeter [2.75-inch] glass fiber insulation in the wall cavity.)

STC of 55: One layer of 6.3-millimeter (0.25-inch) and 15.9-millimeter (0.625-inch) gypsum wallboard on each side of the steel studs to the underside of the structure, with acoustic sealant at top and bottom. (Install 69.8-millimeter [2.75-inch] glass fiber insulation in the wall cavity.)

10-1.2 HVAC Acoustic Performance

HVAC acoustic performance must be a major consideration regarding the selection of equipment for both courtrooms and legal offices. Systems serving the courtrooms, legal offices, and auxiliary spaces must be designed with sound attenuation to provide consistent and acceptable sound levels. This is particularly critical in any court facilities, auditoriums, and conference rooms that require extensive use of sound and A/V or VTC equipment for recording and presentations. Regulate noise during all modes of

operation and for all load conditions by providing an HVAC system with one or more of the following:

- Sound traps and acoustic lining in the duct work
- Low-velocity, low-static pressure fan systems
- Special low noise diffusers

If air is returned by the ceiling plenum, special attention must be given to the location of any partitions extending to the floor structure above and to the acoustical treatment of the required penetration of these partitions for return air.

Locate all HVAC equipment, including air-handling units (AHU) and variable air volume (VAV) boxes, away from courtrooms, jury rooms, judge's chambers, and designated spaces. The minimum distance between AHUs and critical facilities must be 7.6 meters (25 feet). Provide the appropriate treatment of mechanical supply/return ducts to minimize sound and voice transfer from courtroom facilities, conference rooms, or legal offices to surrounding areas. Noise criteria (NC) define the limits that the octave band spectrum of the noise source must not exceed, and must range from 25 to 30 in facilities. For sound level maintenance, courtrooms or other designated spaces need to be served by constant volume air supply. Air ducts serving courtrooms, trial jury deliberation rooms, auditoriums, and critical conference rooms must be lined with 50 millimeters (2 inches) of acoustical absorption material for a length of at least 3700 millimeters (12 feet) from the diffuser or return air intake to minimize sound transmission.

APPENDIX A REFERENCES

AIR FORCE

AFI 32-9010, *Management and Reporting Of Air Force Space and Building Services in OSD Assigned Facilities and in the Washington DC Area*, http://www.e-publishing.af.mil/

AFI 51-110, *Professional Responsibility Program*, http://www.e-publishing.af.mil/

AFMAN 32-1084, *Facility Requirements*, http://www.e-publishing.af.mil/

Air Force Corporate Facility Standards (AFCFS), http://afcfs.wbdg.org/index.html

Air Force Sustainable Design and Development (SDD) Implementing Guidance, http://www.wbdg.org/ccb/AF/POLICY/af_sdd_impl_guidance.pdf

ACCESS BOARD

ABA Accessibility Standard for Department of Defense Facilities, http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/aba-standards

FED-STD-795, *Uniform Federal Accessibility Standards*, http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/ufas

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS

ASHRAE 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, https://www.ashrae.org/resources--publications/bookstore/standard-90-1

ASTM INTERNATIONAL

ASTM E90-09, *Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements*, http://www.astm.org/Standards/E90.htm

ENERGY POLICY ACT

EPACT, http://energy.gov/sites/prod/files/2013/10/f3/epact_2005.pdf

INTERNATIONAL CODE COUNCIL

International Building Code (IBC), http://publicecodes.cyberregs.com/icod/ibc/index.htm

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

IEEE C2, *National Electrical Safety Code*,
http://standards.ieee.org/findstds/standard/C2-2012.html

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA

IESNA, *The Lighting Handbook*, http://www.ies.org/handbook/

DEPARTMENT OF DEFENSE

MIL-HDBK 1013/1A, *Design Guidelines for Physical Security of Facilities*,
http://www.wbdg.org/ccb/browse_doc.php?d=2813

UFC 1-200-01, *General Building Requirements*,
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 1-200-02, *High Performance and Sustainability Building Requirements*,
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-101-01, *Architecture*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-120-10, *Interior Design*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-410-01*, Heating, Ventilating, and Air Conditioning Systems*,
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-420-01, *Plumbing Systems*,
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-450-01, *Noise and Vibration Control*,
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-501-01, *Electrical Engineering*,
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-520-01, *Interior Electrical Systems*,
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls*,
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-550-01, *Exterior Electrical Power Distribution,*
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-600-01, *Fire Protection Engineering for Facilities*,
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*, http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 4-010-05, *Sensitive Compartmented Information Facilities Planning, Design, and Construction*, https://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

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APPENDIX B BEST PRACTICES

B-1 PROGRAMMING SHEET LINK

For the active programming sheets**,** go to:

http://www.wbdg.org/references/afbim_tools.php

B-2 BIM AND PDF DRAWING LINK

For the BIM & PDF versions of the drawings, go to:

http://www.wbdg.org/references/afbim_tools.php

B-3 AIR FORCE MILCON SUSTAINABILITY REQUIREMENTS SCORE SHEETS LINK.

For the interactive sustainability requirements score sheets, go to:

http://www.wbdg.org/ccb/browse_cat.php?c=265

B-3.1 AIR FORCE MILCON SUSTAINABILITY REQUIREMENTS SCORE SHEETS

Air Force MILCON Sustainability Requirements Scoresheet

version LEED® 2009 (Updated September 2013)

* required entry

General Information		INCOMPLETE	
SURVEY INCOMPLETE		Project ID (e.g. ABCD12345)	*
		Real Property Unique ID (RPUID)	*
		Building Name	*
		Project Type	*
		Installation	*
		City	*
		State	*
		CONUS	*
		MAJCOM	*
		PM Name	*
		PA ($k)	*
		Building Size (SF)	*
		Program Year (FY#####)	*
		Project Phase	*
		Design Started (FY#####)	*
		BOD (MM/DD/YY)	*
		Pursuing formal LEED® Certification	*
		Date Project Registered (MM/DD/YY)	
		Date Project Certified by GBCI (MM/DD/YY)	
		LEED Points Awarded by GBCI (e.g. 42)	
		LEED Energy and Water Points Awarded by GBCI	
		[Select] LEED Certification Level Awarded by GBCI	
		Fees ($) Registration / Certification	
	LEED® 2009	LEED® Rating System	
	0	LEED® Points Status	
	Prerequisites Not Achieved	LEED® Certification Level Status	
		LEED® Energy and Water Points Status	
	0%	HPSB Compliant	
	0%	Energy Efficiency Achieved (% below ANSI/ASHRAE/IESNA Standard 90.1-2010)	
		Date Scoresheet Completed or Revised	*
	2013_V0	Scoresheet version	

Color Coding: See Instructions Tab for more detail	
Drop-Down Box	Recommended (not required)
No Entry Required	Yes or N/A
Custom Entry	Maybe
LEED Prerequisite	No

* required entry

Federal Requirements for High Performance and Sustainable Buildings (HPSB) & UFC 1-200-02					
HPSB I: Employ Integrated Design Principles (UFC 1-200-02 para 2-2)					
Total Points	0	INCOMPLETE	Possible Points	2	
	HPSB I.1	Integrated Design		1	*
	HPSB I.2	Commissioning		1	*
UFC 1-200-02 para 2-3. Promote Sustainable Location and Site Development					
Total Points	0	INCOMPLETE	Possible Points (HPSB only)	1	
	UFC para 2-3.1	Site selection		1	*
	UFC para 2-3.2	Mitigation of Heat Island Effect		1	*
	UFC para 2-3.3	Reduction of Light Pollution		1	*
	HPSB III.3-4	Stormwater Management		1	*
HPSB II: Optimize Energy Performance (UFC 1-200-02 para 2-4)					
Total Points	0	INCOMPLETE	Possible Points	4	
	HPSB II.1	Energy Efficiency		1	
		Reduce energy use 30% below ANSI/ASHRAE/IESNA Standard 90.1-2010 or if not - achieve maximum energy efficiency that is lifecycle cost effective			*
		Insert percentage below ANSI/ASHRAE/IESNA Standard 90.1-2010 in terms of energy use (e.g. 32)			*
		Insert building energy intensity (kBtu/yr-sqft) calculated IAW 10 CFR 433			*
	HPSB II.2	On-site Renewable Energy - Solar Hot Water Heater System		1	

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* required entry

		Installed solar hot water heater system or found installation not lifecycle cost effective		*
		Insert generation capacity (MMBtu/yr)		
		Insert percentage of demand		
	HPSB II.3	**On-site Renewable Energy**	1	
		Installed renewable energy elements or projects were not lifecycle cost effective		*
		Renewable energy types (check below)		
		☐ Solar PV ☐ Geothermal ☐ Hydro ☐ Waste to Energy ☐ Solar CP ☐ GSHP ☐ Wind ☐ Renewables were not ☐ Solar Thermal Electric		
		Insert generation capacity (kW)		
		Insert percentage of total building		
	HPSB II.4	**Measurement and Verification**	1	
		Water Metering: Select N/A if no service		*
		Electric Metering: Select N/A if no service		*
		Natural Gas Metering: Select N/A if no service		*
		Steam Metering: Select N/A if no service		
HPSB III: Protect and Conserve Water (UFC 1-200-02 para 2-5)				
Total Points 0		INCOMPLETE	Possible Points	3
	HPSB III.1	**Indoor Water**	1	*
	HPSB III.2	**Outdoor Water**	1	*
	HPSB III.4	**Water used for heating and cooling**	1	
		Water efficient measures were implemented with heating and cooling equipment when life cycle effective		*
HPSB IV: Enhance Indoor Environmental Quality (UFC 1-200-02 para 2-6)				
Total Points 0		INCOMPLETE	Possible Points	6
	HPSB IV.1	**Thermal Comfort**	1	*
	HPSB IV.2	**Ventilation**	1	*
	HPSB IV.3	**Moisture Control**	1	*
	HPSB IV.4	**Daylighting**	1	*
	HPSB IV.5	**Low Emitting Materials**	1	*
	HPSB IV.6	**Protect Indoor Air Quality during Construction**	1	*
Yes	HPSB IV.7	**Environmental Tobacco Smoke**		
HPSB V: Reduce Environmental Impact of Materials (UFC 1-200-02 para 2-6)				
Total Points 0		INCOMPLETE	Possible Points	6
	HPSB V.1	**Recycled Content**	1	*
	HPSB V.2	**Biologically-based Products**	1	*
	HPSB V.3	**Environmentally Preferable Products**	1	*
	HPSB V.4	**Waste and Materials Management - Recycling**	1	*
	HPSB V.5	**Waste and Materials Management - Divert 50% from Disposal**	1	
		Insert percentage diverted from landfill		*
		Data element is not applicable		*
	HPSB V.6	**Ozone Depleting Substances**	1	*
HPSB Totals			Possible Points	22
0	**Federal Requirements - Yes or N/A**			
0	**Federal Requirements - Maybe**			
0	**Federal Requirements - No**			
0%	**Percentage of Federal Requirements Met**			

LEED® 2009 Checklist

LEED® Credits and/or Prerequisites that meet HPSB/UFC Requirements
LEED® Credits and/or Prerequisites that align closely with HPSB/UFC Requirements
LEED® Credits that meet USAF Energy & Water Criteria (may depend on technologies & strategies)

Sustainable Sites				
Achievable Points 0		Sustainable Sites	Possible Points	26
	Prereq 1	Construction Activity Pollution Prevention (HPSB GP3)		Required
	Credit 1	**Site Selection**		1
	Credit 2	**Development Density & Community Connectivity**		5
	Credit 3	**Brownfield Redevelopment**		1
	Credit 4.1	**Alternative Transportation** - Public Transportation Access		6
	Credit 4.2	**Alternative Transportation** - Bicycle Storage & Changing Rooms		1
	Credit 4.3	**Alternative Transportation** - Low-Emitting & Fuel Efficient Vehicles		3
	Credit 4.4	**Alternative Transportation** - Parking Capacity		2
	Credit 5.1	**Site Development** - Protect or Restore Habitat		1
	Credit 5.2	**Site Development** - Maximize Open Space		1
	Credit 6.1	**Stormwater Design - Quantity Control (HPSB GP3)**		1
	Credit 6.2	**Stormwater Design - Quality Control (HPSB GP3)**		1
	Credit 7.1	Heat Island Effect - Non-Roof (UFC)		1

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	Credit 7.2	Heat Island Effect - Roof (UFC)		1
	Credit 8	Light Pollution Reduction		1
			Select which LEED® Interior Lighting Option was used	
Water Efficiency				
Achievable Points	0		Possible Points	10
	Prereq 1	Water Use Reduction - 20% Reduction (HPSB GP3)		Required
	Credit 1	Water Efficient Landscaping (HPSB GP3)		2 to 4
		2	Reduce Potable Water Use by 50% (HPSB GP3)	2
		4	No Potable Use or Irrigation (HPSB GP3)	2
	Credit 2	Innovative Wastewater Technologies		2
	Credit 3	Water Use Reduction (HPSB GP3)		2 to 4
		2	30% Reduction (HPSB GP3)	2
		3	35% Reduction (HPSB GP3)	1
		4	40% Reduction (HPSB GP3)	1
Energy & Atmosphere				
Achievable Points	0		Possible Points	35
	Prereq 1	Fundamental Commissioning of the Building Energy Systems (HPSB GP1)		Required
	Prereq 2	Minimum Energy Performance (HPSB GP2)		Required
	Prereq 3	Fundamental Refrigerant Management (HPSB GP5)		Required
	Credit 1	Optimize Energy Performance (HPSB GP2)		1 to 19
		1	12% for New Buildings/8% for Existing Building Renovations	1
		2	14% for New Buildings/10% for Existing Building Renovations	1
		3	16% for New Buildings/12% for Existing Building Renovations	1
		4	18% for New Buildings/14% for Existing Building Renovations	1
		5	20% for New Buildings/16% for Existing Building Renovations	1
		6	22% for New Buildings/18% for Existing Building Renovations	1
		7	24% for New Buildings/20% for Existing Building Renovations	1
		8	26% for New Buildings/22% for Existing Building Renovations	1
		9	28% for New Buildings/24% for Existing Building Renovations	1
		10	30% for New Buildings/26% for Existing Building Renovations	1
		11	32% for New Buildings/28% for Existing Building Renovations	1
		12	34% for New Buildings/30% for Existing Building Renovations	1
		13	36% for New Buildings/32% for Existing Building Renovations	1
		14	38% for New Buildings/34% for Existing Building Renovations	1
		15	40% for New Buildings/36% for Existing Building Renovations	1
		16	42% for New Buildings/38% for Existing Building Renovations	1
		17	44% for New Buildings/40% for Existing Building Renovations	1
		18	46% for New Buildings/42% for Existing Building Renovations	1
		19	48%+ for New Buildings/44%+ for Existing Building Renovations	1
	Credit 2	On-Site Renewable Energy (HPSB GP2)		1 to 7
		1	On-site 1%	1
		2	On-site 3%	1
		3	On-site 5%	1
		4	On-site 7%	1
		5	On-site 9%	1
		6	On-site 11%	1
		7	On-site 13%	1
	Credit 3	Enhanced Commissioning (HPSB GP1)		2
	Credit 4	Enhanced Refrigerant Management (HPSB GP5)		2
	Credit 5	Measurement & Verification (HPSB GP2)		3
	Credit 6	Green Power		2
Materials & Resources				
Achievable Points	0		Possible Points	14
	Prereq 1	Storage & Collection of Recyclables (HPSB GP5)		Required
	Credit 1.1	Building Reuse - Maintain Existing Walls Floors & Roof		1 to 3
		1	Maintain 55% of Existing Walls Floors & Roof	1
		2	Maintain 75% of Existing Walls Floors & Roof	1
		3	Maintain 95% of Existing Walls Floors & Roof	1
	Credit 1.2	Building Reuse - Maintain 50% of Interior Non-Structural Elements		1
	Credit 2	Construction Waste Management (HPSB GP5)		1 to 2
		1	50% Recycled or Salvaged	1
		2	75% Recycled or Salvaged	1
	Credit 3	Materials Reuse		1 to 2
		1	5% of value of material reused content	1
		2	10% of value of material reused content	1
	Credit 4	Recycled Content (HPSB GP5)		1 to 2
		1	10% of value of material recycled content	1
		2	20% of value of material reused content	1
	Credit 5	Regional Materials		1 to 2
		1	10% Extracted, Processed & Manufactured	1
		2	20% Extracted, Processed & Manufactured	1
	Credit 6	Rapidly Renewable Materials (HPSB GP5)		1
	Credit 7	Certified Wood (HPSB GP5)		1
Indoor Environmental Quality				
Achievable Points	0		Possible Points	15
	Prereq 1	Minimum IAQ Performance (HPSB GP4)		Required

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* required entry

	Prereq 2	Environmental Tobacco Smoke (ETS) Control (HPSB GP4)	Required
	Credit 1	Outside Air Delivery Monitoring	1
	Credit 2	Increased Ventilation	1
	Credit 3.1	Construction IAQ Management Plan, During Construction (HPSB GP4)	1
	Credit 3.2	Construction IAQ Management Plan, Before Occupancy (HPSB GP4)	1
	Credit 4.1	Low Emitting Materials, Adhesives & Sealants (HPSB GP4)	1
	Credit 4.2	Low Emitting Materials, Paints & Coatings (HPSB GP4)	1
	Credit 4.3	Low Emitting Materials, Flooring Systems (HPSB GP4)	1
	Credit 4.4	Low Emitting Materials, Composite Wood & Agrifiber Products (HPSB GP4)	1
	Credit 5	Indoor Chemical & Pollutant Source Control	1
	Credit 6.1	Controllability of Systems, Lighting (HPSB GP4)	1
	Credit 6.2	Controllability of Systems, Thermal Comfort	1
	Credit 7.1	Thermal Comfort, Design (HPSB GP4)	1
	Credit 7.2	Thermal Comfort, Verification	1
	Credit 8.1	Daylight & Views - Daylight 75% of Spaces (HPSB GP4)	1
	Credit 8.2	Daylight & Views - Views for 90% of Spaces	1
Innovation & Design Process			
Achievable Points	0	Possible Points	6
	Credit 1.1	Innovation in Design 1.1	1
		Select if ID 1.1 was for energy and/or water	
	Credit 1.2	Innovation in Design 1.2	1
		Select if ID 1.2 was for energy and/or water	
	Credit 1.3	Innovation in Design 1.3	1
		Select if ID 1.3 was for energy and/or water	
	Credit 1.4	Innovation in Design 1.4	1
		Select if ID 1.4 was for energy and/or water	
	Credit 1.5	Innovation in Design 1.5	1
		Select if ID 1.5 was for energy and/or water	
	Credit 2	LEED® Accredited Professional	1
Regional Priority Credits			
Achievable Points	0	Possible Points	4
	Credit 1.1	Regional Priority 1.1	1
		Select if RP 1.1 was for energy and/or water	
	Credit 1.2	Regional Priority 1.2	1
		Select if RP 1.2 was for energy and/or water	
	Credit 1.3	Regional Priority 1.3	1
		Select if RP 1.3 was for energy and/or water	
	Credit 1.4	Regional Priority 1.4	1
		Select if RP 1.4 was for energy and/or water	
LEED Project Totals	(pre-certification estimates)	Possible Points	110
0	Total LEED® Yes Points		
0	Total LEED® Maybe Points		
0	Total LEED® No Points		
	Total LEED® Energy and Water Related Points		
Prerequisites Not Achieved	LEED® Certification Status		
N/A	LEED® Horizontal Benchmark Level		
N/A	LEED® Utility Benchmark Level		
N/A	LEED® Industrial Benchmark Level		

LEED®: Certified: 40-49 points, Silver: 50-59 points, Gold: 60-79 points, Platinum: 80-110

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APPENDIX C GLOSSARY

A/V	Audiovisual
ABA	Architectural Barriers Act
ADA	Americans with Disabilities Act
ADC	Area Defense Counsel
ADP	Area Development Plan
A-E	Architect-Engineer
AFB	Air Force Base
AFCCA	Air Force Court of Criminal Appeals
AFCFS	Air Force Corporate Facilities Standards
AFCSC	Air Force Claims Service Center
AFDW	Air Force District of Washington
AFH	Air Force Handbook
AFI	Air Force Instruction
AFIA	Air Force Inspection Agency
AFJAG	Air Force Judge Advocate General
AFJAGC	Air Force Judge Advocate General's Corps
AFJAGS	Air Force Judge Advocate General's School
AFLOA	Air Force Legal Operations Agency
AFMAN	Air Force Manual
AFMC	Air Force Materiel Command
AFOSI	Air Force Office of Special Investigations
AFOTEC	Air Force Operations Test and Evaluation Center
AFPC	Air Force Personnel Center
AFSEC	Air Force Safety Center

AHU	Air Handling Unit
AIB	Accident Investigation Board
AIBFSC	Accident Investigation Board Field Support Center
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning
AT	Antiterrorism
BIM	Building Information Modeling
CAAF	Court of Appeals for the Armed Forces
CATV	Cable Television
CCTV	Closed Caption Television
CLFSC	Commercial Litigation Field Support Center
CLS	Community Legal Services
CLSA	Office of Airman's Counsel
CLSL	Legal Assistance Division
CLSV	Special Victims' Counsel Division
CONUS	Continental United States
CRAC	Computer Room Air Conditioning
CSAF	Chief of Staff for the Air Force
DoD	Department of Defense
DRU	Direct Reporting Unit
ELFSC	Environmental Law Field Support Center
FC	Facilities Criteria
FOA	Field Operating Agency
FOIA	Freedom of Information Act
FPEB	Formal Physical Evaluation Board
FSC	Field Support Center

GAIB	Ground Accident Investigation Board
GAO	Government Accountability Office
HIPAA	Health Insurance Portability and Accountability Act
HQ	Headquarters
HVAC	Heating, Ventilation, and Air Conditioning
IDP	Installation Development Plan
IDS	Intrusion Detection System
IG	Inspector General
IT	Information Technology
JA	Judge Advocate
JAC	Civil Law and Litigation Directorate
JACC	Claims and Tort Litigation Division
JACE	Environmental Law and Litigation Division
JACL	General Litigation Division
JAG	Judge Advocate
JAH	Air Force Court of Criminal Appeals
JAJ	Air Force Judiciary
JAJA	Appellate Defense Division
JAJD	Trial Defense Division
JAJG	Government Trial and Appellate Counsel Division
JAJM	Military Justice Division
JAJR	Clemency, Corrections and Officer Review Division
JAQ	Commercial Law and Litigation Directorate
JAQC	Commercial Litigation Field Support Center
JAQK	Contract Law Field Support Center

JAS	Legal Information Services Directorate
JAT	Air Force Trial Judiciary
JB	Joint Base
KLFSC	Contract Law Field Support Center
LLFSC	Labor Law Field Support Center
LOS	Law Office Superintendent
MAJCOM	Major Command
MCRP	Medical Cost Recovery Program
MIRT	Multidisciplinary Independent Review Team
MLFSC	Medical Law Field Support Center
N/A	Not Applicable
NAF	Numbered Air Force
NASIC	National Air and Space Intelligence Center
NIPR	Non-Classified Internet Protocol Router Network
OAC	Office of Airmen’s Counsel
OCONUS	Outside Continental United States
PDF	Portable Document Format
POV	Privately Owned Vehicle
RR	Restroom
SARC	Special Assault Response Coordinator
SCIF	Sensitive Compartmented Information Facility
SecAF	Secretary of the Air Force
SF	Square Footage
SIPR	Secret Internet Protocol Router Network
SJA	Staff Judge Advocate

SM	Square Meters
STC	Sound Transmission Class
SVC	Special Victims' Counsel
TJAG	The Judge Advocate General
UFC	Unified Facilities Criteria
ULFSC	Utility Law Field Support Center
UMD	Unit Manning Document
USAFA	United States Air Force Academy
V	Volt
VTC	Video Teleconference

UFC 4-711-01
10 August 2018
Change 2, 14 February 2024

UNIFIED FACILITIES CRITERIA (UFC)

FAMILY HOUSING



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UNIFIED FACILITIES CRITERIA (UFC)

FAMILY HOUSING

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location
1	01-08-2024	Deleted “2015” reference for IECC in “Revision Summary Sheet” and updated IECC reference in Appendix A as requested by CP Panel dated 12-13-2023. Also updated WBDG web page link and incorporated CCR’s #6766, #7028, #8590, #10036, #10048, #11476, and a few grammar related changes.
2	02-14-2024	Revised paragraph 4-6.7.2 Window Fall Prevention; removed paragraph B4-8.6.1 along with image; and updated Reference Appendix.

This UFC supersedes UFC 4-711-01 dated 13 July 2006.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide website **\1** https://www.wbdg.org **/1/.**

Refer to UFC 1-200-01, *DoD Building Code (General Building Requirements)*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Document: UFC 4-711-01,

Superseding: 2006 version of UFC 4-711-01, *DESIGN: FAMILY HOUSING*

Description: This is a Joint-Service document that supersedes and updates the 2006 version of the same UFC.

Reasons for Document: The UFC 4-711-01, *FAMILY HOUSING* represents another step in the joint Services effort to bring uniformity to the planning, design and construction of military Family Housing. This revision updates the 2006 UFC in accordance with the following:

- Alignment with the latest model codes, standards, and practices governing quality residential construction.
- Update housing unit design to better reflect off-post market equivalents and privatized housing.
- Elimination of two bedroom units.
- Incorporation of minimum areas for critical dwelling unit spaces.
- Requirement for 2-car garages.
- Stringent window fall prevention requirements (exceeds the Code minimum)
- Minor revisions to the neighborhood features section to broaden the amenities.
- Removal of the requirement for EPA ENERGY STAR® Home Certification. Note that individual ***products*** are still required to be ENERGY STAR certified.
- Addition of Best Practices and Lessons Learned appendix.
- Incorporation of resiliency.

Impact: The following impacts will result from this update of UFC 4-711-01:

- Energy savings through compliance with Energy performance requirements of the **\1\ /1/** International Energy Conservation Code (IECC) – estimated to be 32% average savings over the 2006 UFC.
- Increased usability through increasing reliance on mature industry codes and standards.
- Safer and more resilient housing through incorporation of cost effective resiliency practices and increased window fall prevention measures.

Unification Issues

- Army requires LEED certification for housing projects, Navy and Air Force do not.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

This UFC originated as a guidance document to ensure the construction of high quality housing to support Military families.

1-2 PURPOSE AND SCOPE.

1-2.1 Purpose.

This UFC provides guidance for the design, construction, and **\1** alterations **/1/** of Department of Defense (DoD) family housing facilities in the United States, its possessions, and foreign countries. It is intended, when used in combination with applicable building codes and standards which this UFC supplements, to define minimum standards consistent with high quality, energy efficient, sustainable family housing equivalent to off-post market offerings.

It is not within the scope of this UFC to specify the content of design deliverables and construction documentation for housing projects. Refer to the Design agency for the applicable specifications.

1-2.2 Goal and Objectives.

The Military Family Housing Goal Statement defines the ideal end-state for military communities and housing. It is not intended to be static, but responsive to the dynamics of military family housing needs. The Military Family Housing Goal is:

- To provide quality-housing neighborhoods and dwellings to contribute to a strong force of skilled people who provide the readiness of our Military Forces.

Military family housing objectives support the family housing goal. These objectives are:

- To bring the existing required housing inventory up to contemporary housing standards (i.e. life safety, convenience, quality, livability, maintainability) to the extent practicable through repair, **\1** alterations **/1/** and replacement.
- To reduce energy consumption per Executive Order (EO) 13834, which establishes a variety of annual energy reduction, renewable energy, water conservation, and waste management goals.

Military family housing facility programs should use a “whole house revitalization” and “whole neighborhood” approach for **\1** alterations **/1/**, replacement, and repair of existing family housing units and neighborhoods pursuant to elevating the overall quality of housing. Whole neighborhood/house revitalization should generally follow the following prioritization schedule:

- Restore housing units to structural soundness.
- Extend the useful life of facilities and infrastructure by at least 25 years.
- Achieve high energy performance and sustainability.
- Increase quality of life and convenience.
- Provide utility repair and replacement.
- Provide street repair and replacement.
- Provide, enhance, and repair streetscapes.
- Provide, enhance community amenities.

1-3 APPLICABILITY.

This UFC applies to all Service elements and contractors involved in the planning, design, or construction of family housing projects.

1-4 GENERAL BUILDING REQUIREMENTS.

1-4.1 General.

This UFC shall not be construed to preclude application of, and adherence to, other governing DoD and Service specific regulations and policies. Also, no apparent omission in this UFC shall be construed to imply waiver authority to deviate from the minimum requirements of applicable building Codes and standards.

1-4.2 Building Code Criteria.

The DoD adopts the International Code Council (ICC) ***International Building Code*® (IBC)** (per UFC 1-200-01 DoD Building Code) and ***International Residential Code* (IRC)** as the primary voluntary consensus standard for DoD Family Housing. Except as augmented or modified in this UFC, design, construct new, and improve Family Housing in accordance with the following:

- Detached one- and two-family dwellings and multiple attached single-family dwellings (townhouses) not more than three stories above grade plane in height with a separate means of egress and their accessory structures shall comply with all sections of the ***International Residential Code (IRC)*** and referenced codes and standards.
- All other housing types shall comply with UFC 1-200-01 *DoD Building Code (General Building Requirements*), which augments the ***International Building Code (IBC)***. This includes primarily multifamily (i.e. apartment style) housing.

1-4.2.1 Definitions.

The following terms used throughout this document shall be defined as follows:

Code(s) – IRC, IBC, ABA, or other applicable code in accordance with the context.

Improvement(s), Improvement work, Improvement construction – blanket terms to encompass either repair, renovation, alteration, or reconstruction as defined specifically by ***ICC***.

*IBC Building - Building types subject to the **IBC** in accordance with 1-4.2*

*IRC Building - Building types subject to the **IRC** in accordance with 1-4.2*

Multifamily [dwellings] – Housing type with three or more dwelling units sharing common entry, circulation elements, mechanical service, and other supporting elements. Note that this definition excludes *Townhouses* which are defined as multiple attached single family dwellings. Multifamily housing is classified in IBC as R-2 and may be stand-alone or as part of a mixed occupancy/use building.

1-4.3 Supplemental Criteria.

Current supplemental criteria listed below provide service-specific operations, maintenance, planning, programming, design and construction guidance; provision of this list does not limit the services from publishing additional direction related to Family Housing.

- ARMY: Army Regulation AR 420-1 - Army Facilities Management. In addition, at the earliest phase of programming Family Housing projects, planners must consult with the USACE Center of Standardization (COS), Norfolk District, to assist in a thorough and comprehensive review prior to finalizing scope and 3086 costs. The COS also provides other resources including additional Army required technical criteria, template DD Form 1391, and template Design/Build Statement of Work.
- AIR FORCE: Air Force Family Housing Guide for Planning, Programming, Design, and Construction.
- MARINE CORPS: MCO P11000.22 – Marine Corps Housing Management Manual.

1-4.4 \1\ Alterations /1/ Based on Criteria.

Current criteria shall be used to the extent that it corrects or remedies any health and safety, structural, and major livability deficiencies. Projects should not be created for the sole purpose of meeting this UFC.

1-4.5 Accessibility.

1-4.5.1 Architectural Barriers Act (ABA) Standards.

DoD has adopted the Architectural Barriers Act (ABA) Standards. These Accessibility Standards include building and site accessibility requirements for Military Family Housing new construction, alterations, and leases to be applied at all project locations

that are subject to US law and DoD criteria. Projects in other locations may still be subject to local accessibility standards.

Refer to the US Access Board and the October 31, 2008 DoD Memo *Access for People with Disabilities* for additional information such as waiver requirements, applicability to projects outside the United States and its possessions, and host funded projects. These standards supersede the ICC codes for accessibility. Additional housing specific interpretive guidance provided in the following subparagraphs.

1-4.5.1.1 New Construction.

ABA requires that new housing projects include a percentage of units with mobility features (5%, with an accessible route) and communication features (2%). For the purpose of determining number of accessible units required, a *military installation* is defined as the area of responsibility of the Housing Office. It is not the ABA intent to require that a new housing project provide more than the required percentage in order to satisfy a current deficit of accessible Installation housing stock.

1-4.5.1.2 ABA Unit Dispersion.

For the purposes of accessible unit *dispersion*, housing *type* as indicated in the ABA should be defined in accordance with the variability of the particular military installation housing stock. For example, housing type may be differentiated by bedroom number (i.e. 3, 4, or 5 bedrooms units), by unit configuration (i.e. single family or duplex), or by other meaningful differentiator. It is not the ABA intent that each housing *type* adhere strictly to the percentage thresholds of the ABA (i.e. 5% of duplexes, 5% of apartments, etc.); these percentages apply to overall housing stock. Generally, accessible units shall be single story ground level units, although accessible apartments units may also be feasible.

1-4.5.1.3 \1\ Alteration /1/ Scope.

The planner/designer shall be aware of ABA standard scope triggers regarding **\1** alterations ***/1/***; for example, the requirement that dwelling units which include substantial alteration of a kitchen or bath, in combination with alteration of one other room, must incorporate mobility features and/or communication features throughout the unit pursuant to the satisfaction of the installation's overall percentage requirement. Normal maintenance, reroofing, painting or wallpapering, or changes to mechanical and electrical systems are not alterations unless they affect the usability of the building or facility. As an example, replacement of kitchen cabinets in-kind is not an alteration, but reconfiguring kitchen and dining areas while installing new cabinets is an alteration.

1-4.5.1.4 Mixed Use Buildings.

IBC buildings, especially multi-use mid-rise and high-rise, have additional accessibility requirements such as accessibility to building shared amenities, functional areas, public

bathrooms and others outside the scope of the dwelling unit. Refer to the ABA accessibility standards.

1-4.6 Antiterrorism and Security.

Antiterrorism standards are generally applicable only to residential buildings exceeding 12 units. Refer to UFC 4-01-01 *DoD Minimum Antiterrorism Standards for Buildings* for requirements for this housing type.

Locations outside the United States, its territories and possessions, locations subject to elevated threat, and/or housing associated with High Risk Personnel may require additional AT or protection measures. Consult with the Installation Antiterrorism Officer (ATO) and Security Officer to confirm requirements.

1-4.6.1 Housing for High Risk Personnel (HRP) Housing associated with HRP may require additional AT and protection measures. Determining the level of protection and associated protection measures for a HRP is the responsibility of the Protection-Providing Organization (PPO). Refer to UFC 4-010-03, Security Engineering Physical Security Measures for High Risk Personnel.

1-4.7 Historic Construction Criteria.

The National Historic Preservation Act of 1966, and subsequent Executive Orders, require the Federal Government to take into account historic housing facilities listed on, or are eligible for listing on, the National Register of Historic Places. Responsibility for the majority of preservation duties falls to each installation. Maintenance, **\1** alterations **/1/**, or repair of historic quarters, must comply with applicable DoD Directives and Instructions (see References). Coordinate work planned for historically significant quarters with State Historic Preservation Office (SHPO), Installation Cultural Resources personnel, and with local historic preservation officials.

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CHAPTER 2 RESIDENTIAL COMMUNITY PLANNING

2-1 GENERAL.

Planners and designers must ensure that lot and site designs conform to standards or requirements stated in installation and family housing master plans. The goal of neighborhood design for military family housing is to develop and sustain a residential environment that responds to the military family, and reinforces the connection between families and community. Design neighborhoods to accommodate the widest range of residents and modes of transport.

In designing or improving a neighborhood, an important planning element is to create a sense of community and understand the nature of the housing area—the relationship of each dwelling unit to a cluster of units, neighborhood, and community as a whole. Housing areas should be planned so that community members can identify "their own" place in the overall neighborhood, while at the same time fostering social interaction vital to the military family support structure. Plan the site so that housing units are clustered into mini- or sub-neighborhoods, or are organized around a central element, such as a cul-de-sac, recreation area, community center, or other common amenity with attention to consistent architectural proportion among units. Consider the accommodation of multiple users– residents, motorists, and pedestrians alike - in establishing a hierarchy of safe and convenient passage with appropriate scale, vistas, and overall experience.

Promote, protect, and enhance the unique environment, character, and natural site features as much as possible. Consider the local history of the particular site and how to retain, and interpret that history in the architecture of the site.[1]

2-1.1 Site Selection

Plan to ensure that construction avoids, to the maximum extent practicable, wetlands, coastal and shoreline zones, and natural habitats when making neighborhood improvements or executing construction projects. These projects must undergo environmental impact analyses in compliance with the 1969 *National Environmental Policy Act (NEPA)* as implemented by Council on Environmental Quality regulations found at 40 CFR 1500-1508. Objectives of site development are to:

- Plan and provide adequate infrastructure.
- Use residential building blocks to create neighborhood identity.
- Orient buildings and paved surfaces to optimize solar control and minimize heat-island effects.

[1] For additional guidance on creating great neighborhoods, refer to https://www.planning.org/greatplaces/neighborhoods/characteristics.htm

- Ensure adequate and consistent unit setbacks from the street to limit street parking and to maintain sidewalks clear of driveway-parked vehicle intrusions.
- Strengthen the neighborhood with efficient traffic patterns for motorists, cyclists (consider cycling lanes), joggers, and pedestrians.
- Provide or create access to a full range of private and shared recreational facilities and associated parking.
- Use sustainable landscape design to minimize impact on the environment and reduce water consumption.

2-1.1.1 Flood Hazard Areas.

Do not locate Housing units in a Special Flood Hazard Area (SFHA) as determined by FEMA Flood Insurance Rate Maps (FIRM).

2-1.1.2 Compatible Use Zones.

New housing must be located in compatible areas with respect to aircraft noise, as established in DoDINST 4165.57 (1977, updated 12 March 2015), *Air Installation Compatible Use Zone* (AICUZ). Military Family Housing sites should have a maximum Day-Night Average Level (DNL) rating of less than 65. These standards also apply to housing sites near heavily traveled highways or other noise generating facilities. New Military Family Housing will not be located within any runway Clear Zone or Accident Potential Zone (APZ I or APZ II).

Site preparation and site improvements, required exclusively for support of a housing project, should be included in the design and be included in total project cost. Site preparation work includes demolition of existing structures, correction of drainage problems and unsuitable subsurface conditions, clearing, grubbing, and rough grading as applicable. Site improvements include utility systems, roads, streets, curbs and gutters, walks, driveways, off-street parking, recreation areas, bike and jogging paths, lawns, landscaping, low impact development, and finish grading as required to support function and livability of housing. Site improvements may require incorporation of a future ACP, refer to UFC 4-010-01.

2-2 NEIGHBORHOOD AND DENSITY.

Densities for family housing projects, expressed in units per acre, are listed in Table 2-2a. Density ranges represent guidelines intended to assist the master planner and designer in generating a housing type mix that results in the desired neighborhood density. The program benchmark density should be the median value.

Table 2-2a. Site Densities

Density Factors – Number of Units per Acre		
Low [1]	**Medium [2]**	**High [3]**
4-6	7-10	11-15

1. Suburban, moderately developed, and rural areas.
2. Developed urban areas, not included under "High" location.
3. Dense metropolitan areas and most overseas locations where land is not available to meet at least medium density. Only in exceptional cases will high-rise building density of up to 40 units per acre or 100 units per building be programmed.

2-2.1 Housing Types.

Refer to the table below for permitted dwelling unit types.

Table 2-2b. Permitted Units by Building Type and Grade

Unit Type	Apartment	Townhouse	Duplex[1]	Detached
O6-O7+	NP	NP	NP	P
E9, W4/5, & O4-O5 - 3-4 BR	NP	NP	P	P
W1/3, O1-O3 - 3-5 BR	P	P	P	P
E7-E8 - 4-5 BR	P	P	P	P
E7-E8 - 3 BR	P	P	P	NP
E1-E6 - 4-5 BR	P	P	P	NP
E1-E6 - 3 BR	P	P	P	NP

P =Permitted. NP = Not permitted
Table excludes foreign mid-rise and high-rise construction. This table does not apply to Air Force, which do not rank differentiate housing; Individual Services may have requirements that vary from these recommendations.

Note 1. 'over-under' style Duplex is not permitted.

2-3 NEIGHBORHOOD RECREATION.

Outside of the immediate yard areas of each dwelling unit, provide each neighborhood housing cluster a minimum of 2 acres per 100 population, but no less than two acres, of open area to support safe and convenient neighborhood recreation. These areas shall encompass age-appropriate play lots, common open areas, landscaped areas, dog parks, picnic areas, sitting areas, walking, biking and jogging paths as indicated below. Recreation areas shall have a maximum service area of 1/4 mile distance from the housing units they serve. New recreational areas are required to comply with chapter 10 of the ABA Accessibility Standards. Playground design, and equipment and surfaces shall comply with CPSC Publication No. 325 –*Public Playground Safety Handbook.* Avoid bare metal surfaces in playground equipment.

Locate recreational site amenities with appropriate adjacency compatibility. For example, tot lots should be located carefully with regard to playing fields for safety reasons, yet should have wide viewsheds from other park locations for security reasons; consider separating bike traffic from slower pedestrian traffic; dog parks shall be fenced and separate from play areas; consider consolidating 'hardscape' play areas like tennis and basketball, with appropriate sound buffers. Installation should determine the need for any supporting facilities.

Provide site amenities and recreational facilities as specified in Table 2-3, based on number of family housing units in the neighborhood. These areas need not be co-located, but may be dispersed in accordance with the masterplan and good neighborhood design practice. Design all site amenities in accordance with national, local, or installation design standards and guidelines.

Table 2-3. Site Recreation

ITEM	QUANTITY OF AMENITIES	REMARKS
Outdoor Spaces		
Tot lot (2-5 year olds)	Min 1 per neighborhood	
Play lot (6-10 year olds)	Min 1 per neighborhood	
Fenced Dog Park	Min 1 per neighborhood	Accommodate waste disposal
Picnic area	Min 1 per neighborhood	Provide min 2 tables per area. Preference is for shaded locations.

Common open areas	Min 1 per neighborhood	Leisure area for Frisbee, community events, etc. consider co-location with natural landscaped area.
Skate Board Park (optional)		
Natural landscaped areas (optional)	1 per neighborhood	
Basketball courts (optional)	1 per neighborhood, or 1 per 100 housing units.	
Tennis courts (optional)	1 pair per neighborhood	
Open athletic fields (optional)	1 acre per 100-200 housing units	Installation preference: ballfields, soccer, etc.
Outdoor structures		
School bus stop enclosures	Min 1 per 100 housing units, more as required.	
Benches	Min 2 per tot lot, play lot, rec. court, and playfield.	Distribute throughout neighborhood, along walkways/trails
Bike paths	1 per neighborhood	May be combined, and connected to existing paths.
Jogging paths	1 per neighborhood	
Walkways	1 per neighborhood	

2-4 SUPPORT FACILITIES.

Concurrent with the planning of new or improvement housing projects, consider the need for support facilities such as housing management offices (aka Housing Service Center), housing maintenance facilities, and community service centers. These facilities are typically based on Installation population and/or housing development density. Consult the Installation masterplanner to determine requirements. When such support facilities are required, those facilities located in the project area should be

architecturally compatible with the housing unit design and installation architectural standards to provide a coherent neighborhood.

CHAPTER 3 SITE ENGINEERING

3-1 NEIGHBORHOOD VEHICULAR AND PEDESTRIAN CIRCULATION.

3-1.1 General.

Vehicular and pedestrian circulation systems should provide convenient and safe access and circulation within the housing area and neighborhood.

3-1.2 Roads and Streets.

Street systems should minimize through-traffic in housing areas. Roads and streets must be adequate to accommodate occupant traffic, service vehicles (including maintenance, trash removal, buses, moving vans, curbside parking, firefighting equipment), bicycles, and snow removal equipment where applicable. The development of improved vehicular circulation systems is one of the best ways to strengthen identity of neighborhoods. Although the street system should provide safe, convenient access to housing units to and from the neighborhood, it must not play a dominant role with respect to the overall housing area environment. Additionally, the street system must address the need for motorist visibility for the safety of pedestrians, particularly as children may be present and obstructed by parked vehicles.

Residential streets and collector streets shall accommodate bicycle travel lanes in accordance with AASHTO. Design street systems in accordance with the AASHTO *Roadside Design Guide*, and AASHTO *Guide for the Development of Bicycle Facilities*, or local requirements if more stringent. These and the following criteria may require modification at locations outside of the Unites States and its possessions and territories, especially for higher density urban environments.

3-1.3 Residential Street.

Residential streets should be designed with target speeds of no greater than 25 mph, and have a target minimum width in accordance with the accommodation of bidirectional traffic, curbside parking, and cyclists. A residential street carries low volumes of traffic and functions as access to each housing cluster. Consider ‘gateway features’ that inform drivers they are entering a residential neighborhood. Provide for flexibility in accommodating diverse modes of travel and those with individual mobility challenges. Useful guidance for successful streets and streetscapes can be found in Institute of Transportation Engineers (ITE) *Designing Avenues and Streets in Residential Areas.*

3-1.4 Collector Streets.

Collector streets handle traffic from a group of clusters and residential streets and shall be sized in accordance with applicable criteria. Do not locate housing units on collector streets or the arterial streets into which they discharge.

3-1.5 Curb, Gutter, and Sidewalk.

Curbs and gutters should generally be provided on all new streets. Sidewalks are required on at least one side of each street. A "greenbelt" space should separate sidewalk and curb for pedestrian safety. Depress standing curbs at driveways, intersection corners, cross walks, and wheelchair accessibility ramps.

3-1.6 Dwelling Unit Setbacks.

For each dwelling unit, provide front, rear, and side setbacks in accordance with the Installation Design guide or Area Development Plan. Setbacks may also be governed by fire separation requirement and/or the Emergency Services. If these, or similar local practice guidance is unavailable, provide sufficient setbacks to ensure adequate light infiltration, health and safety, and privacy through the following minimums which shall not be reduced[2]:

- 30 feet front yard setback (measured from back of curb)
- 10 foot side yard setback (building to 'lot line'); single family and duplex.
- 30 feet rear yard setback (building to lot line)

3-1.7 Driveways.

Driveways shall accommodate 2 car widths with a minimum of 18 ft. (5.5 m). The minimum length for driveways utilized for off-street parking shall be 24 ft. (7.3 m), measured from back edge of sidewalk to the garage door or as necessary to ensure that vehicles do not encroach over the sidewalk. Driveways shall have a minimum of 2% positive slope away from the housing unit.

3-1.8 Pedestrian Circulation.

Provide pedestrian-oriented circulation systems. Pave sidewalks and walks, and provide appropriate surfaces for jogging, exercise, and bikes. Walkways should provide pedestrian access to and from housing units, public sidewalks, and other common use areas. Walkways should be a minimum of 4 ft. (1.2 m) wide, and jogging paths should be a minimum of 6 ft. (1.8 m) wide, and may be combined with bicycle paths. Pedestrian circulation shall be separated from vehicular circulation as much as possible. Walks must conform to ABA Accessibility Standards.

3-1.9 Signage and Lighting.

Provide street signs and markings according to Federal Highway Administration (FHWA) *Manual on Uniform Traffic Control Devices* (MUTCD), and applicable individual Military Service Sign Standards. Guidance for minimum lighting of walkways, streets, and parking areas is available from the Illuminating Engineering Society of North

[2] Excerpted from *US Air Force Family Housing Guide, 2004.*

America (IESNA). Foreign locations must also adhere to Host Nation standards for street signs and markings.

3-2 PARKING.

3-2.1 Private Parking.

Each unit in CONUS new construction should have three off-street parking spaces to accommodate residents and guests. Projects outside the United States and its territories shall have a minimum of 2 spaces. Indented, 90-degree, and gang parking are not desirable except where necessary in high density urban housing. Each parking space provided in a garage, carport, or driveway counts as a parking space.

3-3 STORM WATER MANAGEMENT.

3-3.1 General.

Develop a storm water management system in accordance with UFC 3-210-10 *Low Impact Developmen*t. Incorporate the natural features as much as feasible into the neighborhood planning to protect natural resource systems and reduce infrastructure costs. Ensure child safety is integrated into the design and construction of storm water systems and structures.

3-3.2 Storm Water Runoff.

Areas should be designed for positive drainage away from housing units. Finish grade around perimeter of each housing unit should slope a minimum of 5% for 10 feet to carry surface water away from foundation walls. Where lot lines, walls, slopes, or other physical barriers make this infeasible, drains or swales should be provided to ensure drainage away from the structure.

3-3.3 Foundation Drains.

Drains should be provided in accordance with applicable codes and standards.

3-4 UTILITIES.

Provide utility services in accordance with applicable codes and standards.

3-4.1 Meters.

For new construction and renovations, provide advanced meters in accordance with DoDI 4170.11 metering policy[3] for referenced utilities. For large multi-family buildings, the configuration may be a master meter with sub-meters for each Unit, depending upon the established utility charge structure. Confirm with the local **\1** BO/AHJ **/1/** or

[3] As amended by DOD Utilities Meter Policy, 16 April 2013.

privatized utility for specific requirements and protocols related to Energy Management Control System (EMCS), meter installation and integration.

3-4.1.1 Meter Location.

New meters should not be located on the front of the dwelling units. Consider a corner or side location, outside of any fenced yard area if feasible.

3-4.2 Utility Distribution.

Utility distribution in new construction shall be underground. Direct bury of electrical feed is not permitted in new projects. Where feasible, and acceptable to local utility supplier or servicing agency, use common trenches for two or more utilities and applicable underground utility marking protocol. However, a minimum of 10 feet horizontal separation shall be maintained between water and sewer lines to prevent cross contamination.

3-4.3 Corrosion Control.

Protect all ferrous materials in underground utility systems from corrosion. Comply with applicable recommendations of UFC 3-570-01 *Cathodic Protection*, and National Association of Corrosion Engineers (NACE) *Standard Practice: Control of External Corrosion on Underground or Submerged Metallic Piping Systems*.

CHAPTER 4 FAMILY HOUSING SIZE AND FEATURE STANDARDS

4-1 FAMILY HOUSING SIZE STANDARDS.

Provide new housing units in accordance with Table 4-1 which establishes the family housing unit size limitations by rank and bedroom count. Note that 2 bedroom units are prohibited in new construction projects.

Programming Benchmarks (with allowable increases per footnotes below) represent the maximum unit size to be programmed in new housing projects, and shall not be exceeded. *Construction Minimum* represents the livability threshold for new and existing housing unit construction, and *Construction Maximum* represents the absolute ceiling. This range is provided to address constraints associated with improvement projects, and also to address square footage variations associated with Design/Build 'Best Value' acquisitions. Refer to the COS for 'planning factor' guidance associated with circulation and building support elements of multifamily (apartment) buildings.

Table 4-1. Unit Floor Area Gross Square Footage (GSF)

Rank and Number of Bedrooms	Programming Benchmark [1,2]		Construction Minimum	Construction Maximum
	(GSF)	GSM (m^2)	(GSF)	(GSF)
O7 and above - 4BR	**3330**	309	2600	4060
O6 - 4BR	**2520**	234	2110	2920
O4-O5 - 4BR	**2310**	215	1920	2700
O4-O5 - 3BR	**2020**	188	1740	2300
E9 & W4/5 - 4BR	**2310**	215	1920	2700
E9 & W4/5 - 3BR	**2020**	188	1740	2300
E7/8-W1/3-O3 - 5BR	**2510**	233	1920	3090
E7/8-W1/3-O3 - 4BR	**2150**	200	1800	2500
E7/8-W1/3-O3 - 3BR	**1860**	173	1670	2050
E1-E6 - 5BR	**2300**	214	1920	2670
E1-E6 - 4BR	**1950**	181	1670	2220
E1-E6 - 3BR	**1630**	151	1490	1760

1. Add up to 27.9 m^2 (300 ft^2) for harsh climates. Harsh climates are defined as having more than 7,500 Heating Degree-Days (HDD), annually, or 5,500 Cooling Degree-Days (CDD), annually, using a 65 deg F reference temperature.
2. Gross floor area may be increased by 10% for housing units for an officer holding a special command position, for the Sergeant major of the Army and special command sergeant major positions, for the commanding officer of a military installation, and for the senior non-commissioned officer of a military installation. Refer to AR 420-1 for approved special command and special command sergeant major positions.

4-1.1 Unit Floor Area Calculation.

Unit Gross Square Footage for all unit types[4] shall be defined as, and calculated in accordance with, the *Finished Area*[5] of the *American National Standard for Single-Family Residential Buildings, Square Footage-Method for Calculating*: ANSI Z765, with the following modifications:

- Only 6 in (15 cm) of exterior wall thickness shall be **included** in the dwelling unit GSF, measured outward from the inside finished face of the wall.
- Sunrooms, even if defined in ICC as *uninhabitable* and even though excluded in ANSI finished area, shall be **included** in the dwelling unit GSF.
- Shared common spaces outside of the dwelling unit in multifamily (apartment-style) buildings shall be **excluded** from the dwelling unit GSF.

4-2 UNIT DESIGN – INTERIOR SPACES.

4-2.1 General.

Several 'Best Practices' floor plan layouts are provided in Appendix B for information only and not intended as requirements. Generally, centrally locate and arrange circulation space to serve as many functional areas as possible without the need for extended hallways. Consider multiple furniture placement layouts in determining location of windows and doors, electrical outlets and switches, and HVAC supply and return outlets (or radiators located underneath windows as commonly used in foreign construction).

4-2.2 Main Entry.

Design main entries to provide a sense of identity for each individual unit. Visual impact from the street is extremely important. Avoid a common entry to several units. Each unit should have an appropriate number or letter designation. Provide each front entrance with a door chime and door knocker. Provide overhead weather protection and a slip-resistant finish for porch surfaces.

4-2.3 Entrance Foyer.

Provide each housing unit with a lighted foyer and nearby coat closet. Locate entrance adjacent to living room, but avoid undifferentiated main entrance into the middle of a living space. Provide access to other areas without passing directly through the living room, unless accommodating width for circulation is provided. Foyers should have a

[4] Strictly speaking, the ANSI standard is not intended for apartments. However, it can be applied to apartments with little to no modification.
[5] ANSI defines finished area as ". enclosed area in a house that is suitable for year-round use, embodying walls, floors, and ceilings that are similar to the rest of the house"

minimum dimension of 4 ft. (1.2 m) deep. For **\1** alterations **/1/** consider entrance foyer requirement whenever it is economically feasible.

4-2.4 Circulation.

Provide hallways, stairways, and stairwells as required. Particular attention should be given to these areas to minimize floor space lost to circulation. Proper placement of door openings can produce more usable floor space. Design circulation areas to permit movement of a queen size box spring. Minimum hallway width of 3 ft. 6 in (1.1 m) is recommended.

4-2.5 Dining Room.

The primary eating area may be a separate dining room, or combined dining and living room (Great room), or dining and kitchen in accordance with an open plan concept. Dining room shall accommodate a family table and chairs, and china cabinet or buffet and a minimum area[6] of 90, 110, 140 ft^2 (8.3, 10.2, 13.0 $m^{2)}$ for three bedroom, four and five bedroom, and O6+ units. The dining room should not have bathroom doors within direct sight, if possible. . Units for O7+ shall maintain a separate formal dining room.

4-2.6 Living Room.

Units shall be provided with a living room. Minimum dimension of living room should be 11 ft. 8 in (3.6 m) and a minimum area[7] of 150 ft^2 (13.9 m^2) Living room may be combined with Dining Room to create a single Great Room. Great Room (see exception above) shall be able to accommodate multiple furniture arrangements associated with spaces that are combined. The benefits of such arrangements are that the combined space can be used more efficiently.

4-2.7 Family Room.

Units should be provided with a family room in addition to a living room with a minimum area[7] of 90 ft^2 (8.3 m^2) Include at least one wall that has a minimum length of 10 ft. (3 m) to accommodate a sofa and end tables.

4-2.8 Kitchen Area.

Locate kitchen adjacent to dining room and family room, with direct access to each. Provide a visual separation between kitchen and formal living areas. Convenient access from kitchen to a covered parking area, and to interior utility and exterior service areas, is desirable. Kitchens shall be sized and designed in accordance with *National Kitchen and Bath Association (NKBA) Space Planning Guidelines* and accommodate a minimum of double bowl sink and disposer, under-counter mounted dishwasher, full height standard refrigerator, stovetop/oven, and countertop appliances. Provide kitchen storage capacity in accordance with NKBA *small* (three bedroom units)*, medium* (four

[6] Excludes circulation path.

and five bedroom units*),* and *large* (O6+ units). Kitchens will generally be a minimum of 100 ft^2 (9.3 m^2). Provide ducted range hood with exterior discharge. Ductless recirculating systems are not permitted.

4-2.9 Secondary Eating Area (Breakfast Area).

A secondary eating area may be provided in the form of an oversized kitchen, breakfast bar, or family room and dining area. This secondary eating area may be in direct sight of food preparation areas.

4-2.10 Laundry/Utility Room.

Provide a minimum 64 ft^2 (5.9 m^2) enclosed laundry/utility room to accommodate side-by-side washing machine and dryer, plus shelving and cabinets for storing laundry supplies, located out of sight of entry, entertainment, and eating areas. Locate the laundry/utility room within conditioned space, and not within a bedroom, bathroom, or kitchen. Utility areas can do double duty as secondary access to/from the garage, in which case the square footage should be increased to accommodate the coat hooks and 'landing' space. Exhaust from moisture-producing equipment (e.g. clothes dryers) must be vented to the exterior, with provisions to disallow bird nests and rodents. Vent-less (internally circulating) clothes dryers are prohibited.

4-2.11 Bathrooms.

Provide a minimum of 2 full bathrooms and 1 half-bath in all units with 3 to 4 bedrooms, and 3 full bathrooms and 1 half-bath in 5 bedroom units. Locate full bathrooms near bedrooms and out of sight of other areas of the house. In two-story units, the half-bath should be provided to serve the first floor with access to both guests and family activities without passage through an intervening room. The master bedroom shall have a private full bathroom, accessible only from the master bedroom, with the remaining full bathrooms to serve the remaining bedrooms. Provide exterior exhaust ventilation for all bathrooms containing shower or tub fixtures, and consider exhaust for half-baths as well. Design all bathrooms in accordance with the *National Kitchen and Bath Association (NKBA) Space Planning Guidelines.*

4-2.12 Bedrooms.

Family housing units must include a master bedroom, plus two or more additional bedrooms. Separate these sleeping areas from all other functional areas of the house, and conveniently located near bathrooms. Provide access to bathrooms from halls serving bedrooms, without passage through other rooms of the house. For new construction master bedrooms shall be a minimum of 150 ft^2 (13.9 m^2) to accommodate a king size bed, flanking nightstands, dressers and adequate circulation. One bedroom shall be a minimum of 120 ft^2 (11.1 m^2) to accommodate a full size bed, and the remaining bedrooms shall be a minimum of 100 ft^2 (9.3 m^2) to accommodate a full size bed. In new construction, units for the rank of O7+ should have a bedroom located on

ground floor adjacent to public areas with a private full bath. In new construction, bedrooms shall not be located adjacent to the mechanical room.

4-2.13 Interior Storage and Closets.

Provide storage areas in the form of clothes closets, linen closets, and bulk storage in the housing unit for seasonal and personal effects:

- Foyer/entry: coat closet minimum 2 ft 4in (0.7 m) deep, 4 ft (1.2 m) wide.
- Bedrooms: wardrobe closet minimum 2 ft (0.6 m) deep, 4 lineal ft. (1.2 m) per occupant.
- Master bedroom: at least 1 walk-in closet is preferred, of approximately 24 ft^2 (2.2 m^2) minimum area per occupant.
- Interior bulk storage: minimum 32 ft^2 (2.9 m^2).

4-3 UNIT DESIGN - OUTDOOR SPACES.

4-3.1 General.

Each family dwelling unit should have an adjoining private or semi-private outdoor space, partially or completely surrounded by privacy screening, unless such space is considered impracticable because of density or location.

4-3.2 Balconies.

Each living unit located entirely above ground floor should have a balcony with no dimension less than 6 ft. (1.8 m). Construct balconies using solid decks with an impervious surface, sloped to drain to the outer edge. Provide direct access from balcony to living room, dining room, or family room.

4-3.3 Patios and Decks.

Screen patios and decks from streets, common areas, and adjacent living units. Provide direct access from patios and decks to living room, dining room, or family room areas. For each living unit that opens to the exterior at ground level, provide a minimum patio area of 120 ft^2 (11.2 m^2) with a minimum dimension of 8 ft. (2.4 m). An acceptable alternative is a raised deck of the same size, constructed of weather-resistant materials.

4-3.4 Lawns.

Provide sufficient lawn space of durable native grass species for each dwelling unit for use by the Unit occupants. Consider the need for screening or fencing for privacy, pets, and for supervision of children.

4-4 UNIT DESIGN – SERVICE AND SUPPORT.

4-4.1 Garages and Carports.

For new construction, provide a two-car garage for each single family detached and duplex units, and for townhouse units when feasible. For **\1** alterations **/1/** projects, garages or carports should be provided as the site allows. Enclosed bulk storage may be included in the garage or carport. Garages should be attached to the housing unit they serve. If garages cannot be attached, locate them as close as possible to kitchen and the service area of the house. For ABA units, garages must be on an accessible route from within the unit. Design garages to compliment architectural features, materials, and roof slopes of the house. In addition, provide light switches and duplex convenience outlets in each garage. Garage floor surface must be a minimum of 4 in. (10.2 cm) lower than finished floor of the attached housing unit; slope floor to drain liquids away from walls. Design and construct any attached garages so as to prevent infiltration of air-borne contaminants into housing units.

4-4.2 Mechanical Space.

Provide indoor acoustically insulated mechanical space as needed, with exterior access for Base Operations and Maintenance personnel. Locate the space either at grade level or in the basement. Mechanical equipment shall not be located in confined spaces such as crawlspace and attics. Do not locate mechanical room adjacent to bedrooms. For space savings, consider co-locating mechanical/plumbing equipment with unit fire suppression sprinkler equipment if feasible to optimize clearance requirements, drains, cleanouts and other support elements. Fire suppression equipment shall be located within conditioned space.

4-4.3 Electrical and Communication Space.

Locate electrical load centers in accordance with Code and as close to the meter as possible, preferably close to heavy load centers such as kitchen, laundry, and mechanical spaces for efficiency and to minimize cable runs. Do not locate panels in storage or moist spaces.

4-4.4 Exterior Storage.

For each unit, provide exterior storage space wide enough to accommodate lawn mowers and typical lawn tools. For new construction, this space is best located attached to the garage (often abutting the back or side), with the service door opening to outdoor living and lawn areas, and a paved access path to/from the nearest door of the unit. Where attachment to the unit is not possible - for example in existing work - the space may be a freestanding structure located in the back yard. Provide a switch-controlled light at outside service door. Recommended exterior storage space is 40 ft^2 (3.7 m^2) for three bedroom units, and 50 ft^2 (4.6 m^2) for four and five bedroom units. Note that this space is not exempt from accessibility requirements for accessible dwelling units. In **\1** alterations **/1/** projects where site is limited, a consolidated exterior storage may co-

locate several units' storage, provided it is partitioned by unit, with separate securable access provided.

4-4.5 Trash Enclosure.

For IRC buildings, provide each living unit with a paved pad area large enough for a minimum of two standard 96-gallon roll-type containers, plus any recycling containers required by the installation. Locate pad near trash pickup to the side, but not the front of the house, and provide paved access for occupant access. If visible from the street, common area, or from other living units, provide semi-transparent trash enclosure screening using a combination of fencing and landscaping material (ex; hinged gate fence in front, fence to the side, landscaping in the back). Alternatively, garages may be designed to provide adequate space for containers.

For IBC buildings, trash containerization is typically centralized, with outside dumpsters. In these cases, a 3-side landscaped masonry screen wall with operable double gate access is appropriate. Do not use 'chain-link' fencing for container screening. Use aesthetically and architecturally appropriate picket/slat or similar style system of durable prefinished non-wood materials.

4-4.6 Exterior Stairs.

Design code compliant non-skid (i.e. broom finish or similar) stairs to permit safe occupant passage as well as conveyance of a queen-size bed box spring and any other unit furniture items. Exterior stairways serving multiple units should be sheltered from wind and precipitation. Stairs should have a minimum width of 3 ft. 6 in (1.1 m), or greater as required by code, and be of durable, non-wood construction. Provide factory finished aluminum or steel handrails, pickets, and guards as required. Open risers are not permitted.

4-4.7 Entrance Ramps.

Entrance Ramps for new ABA accessible units shall be of durable permanent materials. Wood-based exterior ramps are prohibited in new construction.

4-4.8 Lifts and Elevators.

Platform or stairway lifts will not ordinarily be needed for new accessible units, as these will normally be single story units. Refer to ABA standards if they are required. Refer to code and ABA standards when elevators are required in multifamily (apartment) units. For mid-rise and high-rise housing, 1 passenger elevator should be provided for every 70 to 100 dwelling units, plus a freight elevator. Stair lifts shall not be used in new dwelling units.

4-5 UNIT INTERIOR DESIGN, FINISHES AND FEATURES.

Interior design, and materials and finish selection for a housing project shall consider life safety, quality of life, economies of scale, local labor expertise and acquisition, and to the extent practicable should be a natural extension of the site/architectural context of the housing area development plan. Refer to applicable guidance in UFC 3-120-10 *Interior Design* for the preparation of interior design submittals. Design interior systems in accordance with Codes and standards, and as augmented in this section.

4-5.1 Sound Attenuation.

Attenuate sound transmission between units of multi-family buildings, and within the unit spaces to achieve suitable privacy and speech intelligibility for occupants to carry out day-to-day functions. Refer to Mechanical systems chapter for additional requirements related to acceptable background noise levels.

For **\1** alterations **/1/** projects, replace unrated assemblies with acoustically rated assemblies – wall, ceiling, doors as applicable – to the extent that the assembly replacement is within the scope or collateral to it (example; if drywall removal is required for plumbing reconfiguration, acoustically insulate the wall where it adjoins adjacent living spaces(s).

4-5.1.1 Interior Acoustics, Airborne Sound.

Design unit separation assemblies with an STC50 as required by code in order to achieve a field tested minimum STC 45 between units and between units and public spaces. Within units, design assemblies in accordance with the following STC ratings:

- **\1** STC45 – between bathroom/powder, mechanical room and non-bedroom habitable spaces of the unit. **/1/**

4-5.1.2 Exterior Sources.

Refer to the Noise control section of UFC 3-101-01 *Architecture* for required composite Outdoor Indoor Transmission Class (OITC) values for the building envelope.

4-5.2 Interior Finishes.

Select environmentally sustainable materials and finishes to achieve a balance between occupant convenience, satisfaction, appearance, durability, and life cycle cost. Refer to chapter 7 for environmental requirements for material selection. Paint shall be based on Master Painters Institute's (MPI's) standards and specifications. Finishes and coatings shall should have vapor permeance characteristics in accordance with the intended vapor and moisture management strategy.

In **\1** alterations **/1/** projects involving material replacements, use contemporary approximations rather than customization. For example, non-custom moldings may often be compounded to achieve the required profile, avoiding the high cost of custom

knifing setups. Consult with the Installation Cultural Resources personnel and/or local SHPO.

4-5.2.1 Flooring.

Provide finishes providing some slip resistance. Carefully consider the appropriate application for carpet. Generally, carpet should be limited to bedrooms, and shall not be installed in kitchens, baths, laundry areas, utility areas, storage rooms, entryways, patios, porches, and areas exposed to weather elements. Consider alternatives to carpet for living rooms. If considering carpet for living rooms, ensure it is appropriately durable and stain-resistant. Do not install hardwood flooring in kitchens, bathrooms, or utility/laundry rooms.

4-5.2.2 Walls.

Provide Gypsum board finished to level 4 or 5 as appropriate for all living and sleeping spaces. Provide tile wall surfaces and/or moisture resistant gypsum board with mold/mildew resistant paint in high moisture spaces. Avoid vinyl wallcoverings, as these tend to trap and conceal moisture within the walls.

4-5.2.3 Ceilings and Ceiling Height.

At a minimum, provide gypsum board finished ceilings for all interior spaces and all other spaces as required by code for fire separation/barrier purposes. Suspended acoustical tile ceiling systems – typically of mineral fiber or fiberglass – is prohibited in dwelling units. Comply with code as applicable for minimum ceiling heights of interior spaces. For garages, coordinate ceiling height with the garage door manufacturers required clearances, which are usually 12 to 16 inches of vertical clearance above the (typical 7 or 8 ft high) door opening of a torsional spring, motor operated system.

4-5.2.4 Woodwork and Trim.

Running trim shall be low-maintenance, easily cleanable standard round-over-type residential profiles, in compliance with Architectural Wood Institute (AWI) Woodwork standards. Avoid excessive architectural ornamentation except as authorized and required for historical authenticity.

4-5.3 Interior Doors, Frames and Hardware.

Within dwelling units, provide dimensionally stable, interior flush or paneled wood doors to accommodate occupant passage/egress, maneuvering (i.e. furniture), acoustical privacy, and passive ventilation as required. Comply with AWI custom grade performance specification for all wood doors. Ensure the doors, especially bedroom closet doors, provide for adequate flanking wall space for furniture items, light switches, and other anticipated décor items, as well as accommodate movement of large bedroom furniture including boxspring. Avoid Lauan doors except at closets and unit

storage rooms not subject to humid conditions. Avoid pocket doors generally. Bi-fold and sliding bypass doors shall have both top and bottom tracks

For **\1** alterations **/1/** projects that include door replacement, the priority shall be to meeting code egress width requirements, followed by material durability upgrades.

4-5.3.1 Door Dimensions.

Ensure that doors are sufficiently wide to allow passage of people and furniture;

- For apartment units accessed from an interior corridor, unit main entrance doors shall be a minimum of 36 inch x 78 inches side-swinging doors made of either solid core wood or – in areas outside the US and its territories - an equivalently durable alternative material.
- In all housing types, Bedroom doors shall be a minimum 32 inches wide.
- No door within the unit intended for passage shall provide for less than 30 inches clear opening width, or greater as required when located on an accessible route pursuant to ABA compliance.

4-5.3.2 Acoustics.

Door acoustic STC ratings should match that of the walls.

4-5.3.3 Hardware.

Provide BHMA compliant hardware in accordance with industry standards for the function; passage (ex; hallways), privacy (ex; bedrooms, bathrooms), and storage. Provide door stops to protect adjacent wall surfaces from door swing.

4-5.4 Window Treatments.

Provide glass door and window treatments for occupant privacy. Comply with ANSI/WCMA A100-1, except that new window treatments shall not be the corded type nor have a hazardous loop configuration.

4-5.5 Casework, Counters, and Cabinets.

All casework shall be in accordance with AWI Custom Grade, except that hardwood plywood shall be used in lieu of MDF in moist environments like bathrooms and kitchens. Cabinets and countertop underlayment must comply with ANSI A208.2 or ANSI/HPVA HP-1 standards for low formaldehyde emissions.

Simple built-ins – such as open shelving within an alcove, a ‘command’ station in the kitchen, etc. - may be a cost effective way to ‘capture’ otherwise underutilized interior space and elevate the quality of the unit’s interior. If provided, do so strategically, sparingly, and without excessive customization or hardware.

4-5.6 Furniture and Equipment.

If the procurement is included in the contract, designer shall specify ENERGY STAR certified fixtures and appliances[7] that are safe, easily maintainable, and have the least amount of operational complexity. Refer to ABA standards for required appliance features for accessible dwelling units. Provide utility connections for all appliances and accommodate in the space with due regard for operation and maintainability. Typical Government-Furnished Government Installed equipment includes a refrigerator, and stove/range. Typical Contractor-furnished contractor-Installed equipment includes a disposer and dishwasher. Typical tenant supplied items include washer, dryer, and microwave. For safety reasons, all equipment must be installed in a way that precludes tip-over. This may require additional securement.

4-6 UNIT GENERAL CONSTRUCTION.

4-6.1 General.

Comply with Code and all referenced standards and criteria except as augmented by this UFC.

4-6.2 Structural Criteria.

Comply with code as applicable to the Building type. For IBC buildings, comply with UFC 3-301-01 *Structural Engineering* which includes modifications, alterations, and additions to the IBC.

4-6.2.1 Limitations.

Log Structures are not permitted.

4-6.3 Resiliency.

Achieve resiliency to the extent that is Life cycle cost effective. Whereas building and life safety codes are designed for life safety, the intent of resiliency standards is to minimize residential property losses and occupant displacement resulting from severe storm events. Resiliency is achieved by adherence to construction standards of a nationally recognized resiliency standard such as the “FORTIFIED Home” program of the Insurance Institute for Business & Home Safety (IBHS), or to more stringent local resiliency standards. IBHS standards are designed for new and existing single family wood framed detached housing in CONUS and US OCONUS locations, but can be adapted to other housing types, locations and construction. These construction standards will meet and in some aspects exceed those of model building codes. Application of the IBHS standards is dependent on the specific project location. IBHS categorizes each US region and its territories as either Hurricane-prone or High Wind-prone, applying a set of storm-specific measures in an incremental tiered approach -

[7] https://www.energystar.gov/products/appliances

"Bronze", "silver", and "Gold"– commensurate with increasing resiliency. Note that non-compliance with a model national resiliency standard shall not be construed to be a Building or Life Safety Code violation, nor authorization in itself for an **\1** alterations **/1/** project.

4-6.3.1 Certification.

Designation and independent certification is not required unless otherwise required by SOFA or host-nation agreement. However, consider documentation attesting to adherence to the construction standards for quality assurance. Label all resiliency features on drawings and specifications.

4-6.3.2 Resiliency Standards.

Other recognized resiliency standards besides IBHS FORTIFIED Home may be applied, provided these effect equivalent overall resiliency performance. Resiliency standards should focus on the following construction areas:

- Enhanced Roof Cover, roof deck, and attic ventilation systems and installation (1st level; IBHS "Bronze")
- Additional detail consideration at gables (additional framing and bracing), chimney lateral bracing, ancillary attached structures, overhangs, openings and similar vulnerable locations (2nd level; IBHS "Silver")
- Continuous load path from foundation to roof (3rd level; IBHS "Gold") with (typically) metal straps and anchors, and based on documented engineering analysis.

4-6.4 Hurricane and Tornado Storm Shelters (aka "Safe Rooms").

Residential or Community Storm Shelters are authorized if required by Local Codes. These shall be programmed in the DD form 1391 with supporting justification. The installation of any safe room should be coordinated with the Base **\1** BO/AHJ **/1/** and local emergency management and law enforcement to ensure its use during extreme wind events is not a violation of Base, Local or State evacuation plans.

If a shelter is required in new construction, the preference in single-family, two-family (duplexes) and multiple single family attached (townhouse) units is to construct the storage Room, utility room, closet, or bathroom as the shelter, or else a prefabricated unit in the garage, adding little or no additional Unit square footage. A basement location may also be feasible in non-flood prone areas. In multi-family housing (apartments), a shared Community Shelter serving multiple dwelling units may be more appropriate. Note that Community Shelters – those designed for more than 16 occupants - have more stringent criteria including but not limited to ventilation, sanitation, and fire separation. Safe room location and construction features shall be identified on the drawings in accordance with ICC/NSSA. In the absence of more location-specific criteria, comply with the following in accordance with the type of shelter required. In case of conflict, apply the more stringent:

- FEMA P-320 *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*. This publication provides prescriptive safe room solutions (drawings and construction details) and planning guidance for shelters serving up to 16 persons.
- FEMA P-361 *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms.* This publication contains the technical design criteria, including location and sizing criteria, used to develop the prescriptive solutions of P-320 and applicable to shelters of various sizes.
- ICC/NSSA *Standard for the Design and Construction of Storm Shelters (ICC 500).* Applicable to both Residential and Community Storm Shelters.
- UFC 4-023-10 *Safe havens* (as applicable).

4-6.5 Foundations, Crawl Spaces, and Basements.

Comply with code except as modified herein. Refer to UFC 3-301-01 for snow loading and frost penetration depths at locations outside the United States. For IRC buildings in US Coastal areas, comply also with the guidance of FEMA P-550 *Recommended Residential Construction for Coastal Areas; Building on Strong and Safe Foundations,* except where more stringent local codes exist.

4-6.5.1 Wood Foundation Systems.

Wood foundation systems are not permitted.

4-6.5.2 Crawl Spaces.

Exposed grade in under-floor (crawl) spaces, even if a vented crawlspace, shall be covered with a continuous Class I vapor retarder installed in accordance with the IRC for unvented crawlspaces. Consider a crawlspace drainage system if warranted by local conditions and/or required by Code. All crawlspaces shall have a low-maintenance hinged access door on the exterior or basement wall to access the crawlspace.

4-6.5.3 Termite Prevention.

Provide termite protection for new housing and ancillary structures in areas subject to damage from termites as determined by IBC/IRC probability maps or by State, Base, and/or local authorities. When termite protection is required, and for all types of construction, it shall at a minimum consist of Soil treatment during construction in accordance with UFGS Specification *31 31 16.13 Chemical Treatment Control* with EPA and locally approved chemical termiticides.

4-6.5.3.1 Protection shall also consist of additional measures or methods recommended or required by State, Base, housing management, and/or local authorities.

4-6.5.4 Basements.

Full or partial Basements in new housing may be provided if life cycle cost effective considering energy efficiency, operations and maintenance, life safety/egress, ABA accessibility requirements, fire prevention, shelter requirements, site constraints, and whether it will contain *habitable* space. Appropriate adjustments in unit size should be made if a basement is constructed, due to the loss of square footage from the addition of a stairwell and an increase in square footage if the water heater and HVAC systems are relocated to the basement. Refer to paragraph 7-1.4.2 for Radon mitigation. Other considerations include:

4-6.5.4.1 Unit Basement access should be provided from within the dwelling unit.

4-6.5.4.2 At a minimum, Incorporation of a basement shall assume full (new construction) Code compliance consistent with *useable* space with provisions for the light and ventilation needs of *habitable space*. However, if intended to be habitable space, then it shall be designed and constructed accordingly.

4-6.6 Exterior Wall Construction.

Comply with applicable criteria and local practices.

4-6.6.1 Wall System Limitations.

Structural Insulated Panel (SIP) Construction is permitted provided it is life cycle cost effective considering operations and maintenance, available labor expertise, cladding and roofing considerations/limitations, configurability/flexibility, construction timeline as well as first cost. If SIPs are used, comply with the IBC/IRC and the Structural Insulated Panel Association recommendations and guidelines.

4-6.6.2 Thermal and Moisture Control.

Provide a comprehensive thermal and moisture control strategy. Of particular concern is the control of air transported moisture by infiltration which accounts for considerably more moisture migration than vapor diffusion.

4-6.6.2.1 Water Resistant Barriers (WRB).

Required in all wall systems. Approved materials are those meeting the requirements of the International Code Council Evaluation Service (ICC-ES)

4-6.6.2.2 Air Barrier Systems.

Use systems with 3rd party certifications, such as by the Air Barrier Association of America (ABAA) or equivalent. Air barrier construction is often the work of multiple trades, depending on the air barrier plane location and configuration. Therefore it is important that construction documents clearly identify and properly detail the air barrier.

Comply with additional guidance from Department of Energy's *Building Technologies Program; Air Leakage Guide*.

4-6.6.2.3 Vapor Retarders.

Determine the need for, and permeance characteristics of vapor retarders. Not all climates will require them. Codes and standards will generally require warm-in-winter side vapor retarders for cold (i.e. heating climates) and portions of mixed regions, with exceptions to the class I or II vapor retarder requirement (allowing class III instead) when the cladding is vented and the wall continuously sheathed with insulation which mitigates the potential for trapped moisture and condensation within the wall system. Outside of the mixed and cold regions, confirm through ASHRAE dew point analysis supplemented by local best practices whether conditions warrant a vapor retarder. Often, incorrect location of a vapor retarder causes more damage than its omission would otherwise cause.

4-6.6.2.4 Insulation.

In colder regions, consider distributing some of the insulation as insulated sheathing outboard of the wall framing, which help to not only reduce thermal bridging, but also in maintaining sheathing surface temperatures above the dew point temperature, thus eliminating air leakage based condensation. This is especially critical for cold formed metal framed assemblies. Refer to the guidelines of CRREL Cold Regions Research and Engineering Laboratory for practical application.

4-6.6.3 Cladding Systems.

Use sustainable, low maintenance, color-fast finish materials, such as brick, integrally-colored concrete masonry, integrally colored stucco, vinyl siding, fiber-cement siding, engineered wood siding, and drainable exterior insulation and finish systems. Avoid materials requiring field finishing. For all cladding types, and in the absence of other codes or standards, Include an air gap rain screen of 3/8" inch (or larger in wetter climates) at the sheathing/siding interface. Alternatively, provide either an approved integrated moisture management system or an analysis demonstrating sufficient moisture barrier properties as determined by IRC's modified ASTM E331 procedures.

Aluminum siding, and wood shakes and shingles are not permitted.

4-6.6.3.1 EIFS and Stucco.

Refer to UFC 3-101-01 for LCCA-based consideration of Exterior Insulation and Finish Systems (EIFS), and Exterior Residential Stucco systems. These exterior systems are applicable to low-rise residential construction only. Stucco systems shall comply with both the Stucco Manufacturer's Association (SMA) recommendations and the IBC. EIFS shall comply with the IBC/IRC as applicable to the unit type. Additional requirements are as follows:

4-6.6.3.1.1 All EIFS and Stucco systems, regardless of substrate, must incorporate a drainage plane.

4-6.6.3.1.2 Maintain the lowest finished edge at least 8 in (200mm) from finished grade to provide protection from mowers, string trimmers, etc. Increase this clearance where snow accumulation conditions warrant.

4-6.6.3.1.3 At all areas subject to abuse or abnormal stress, provide high impact or Ultra-high impact EIFS (as classified by ASTM E2468). At a minimum, these areas include walls adjoining sidewalks and lawns up to at least water table height, but may also include wall locations vulnerable to door swing impacts, vehicles/bikes, and ball play activities.

4-6.6.3.1.4 Use solid or sheathing backed Stucco systems only. Do not install Stucco directly onto plastic-based polyolefin water-resistive barriers (WRB) which are vulnerable to surfactants in the cement.

4-6.6.3.2 Wood Siding.

Wood siding is prohibited, due to its maintenance costs. Engineered wood siding is permitted and should comply with ANSI/APA performance criteria. Use only USGBC approved (or equivalent) no formaldehyde, treated, pre-finished siding bearing third party certification.

4-6.7 Exterior Windows and Doors.

Comply with code which prescribes independent testing, labelling, performance and construction requirements for exterior windows, doors, and fenestration and their installation.

4-6.7.1 Material Selection.

For all housing types, provide energy efficient manufactured windows and doors that are ENERGY STAR Certified (or FEMP-designated) for the particular project location, if Life Cycle Cost Effective. Refer also to UFC 1-200-02. Site-built windows and doors are not permitted. Provide low maintenance clad pre-finished insulated hinged exterior doors for all exterior doors. Choose materials and finishes consistent with the specific environmental context including salt exposure, ambient noise exposure, residential scale and aesthetic, and similar considerations. Clad doors, rather than un-faced wood doors, are generally preferred for durability in all environments. True divided lite windows should be avoided unless historical authenticity requires it. Skylights should generally be avoided.

4-6.7.2 Window Fall Prevention.

\2 Operable windows with an opening sill height less than 42 inches (106.7 cm) above finish floor and greater than 72 inches (182.9 cm) above the adjacent surface, and with

an opening large enough for a 4 in. (10.1 cm) sphere to pass through, must be provided with window fall prevention devices that comply with ASTM F 2090 or ASTM F 2006, as applicable. Note that as of October 2019, Title 10 USC 2857 limits the definition of acceptable window fall prevention devices to include only fall protection screens and guards. Window Opening control devices – which work by limiting the window opening to 4 inches (10.1 cm) or less - are not acceptable.

Regardless of improvement scope, Improvement projects shall provide window fall prevention devices for all operable windows, in accordance with the new construction requirement described above and any other applicable fire and life safety requirements. ***/2/***

4-6.7.3 Resiliency.

Comply with the “Silver” level of IBHS “Fortified Housing” impact resistance and opening protection requirements if life cycle cost effective. Note this may require impact rated glazed assemblies or opening protection systems. Where opening protection systems are selected, choose systems that do not require manual removal/retrieval and storage, which are less likely to be deployed in conditions that require them. Instead, select architecturally compatible hinged shutters or similar.

4-6.7.4 Door and Window Operation.

Provide thermally insulated, securable windows. Tilt-in windows are recommended to facilitate cleaning by occupants. Window screens shall be provided for operable windows in habitable rooms and spaces, and must be removable for window cleaning and (if applicable) emergency egress without the use of any special tools. Removable window guards or child safety locks may be provided in lieu of reinforced window screens. For IRC buildings, Doors shall generally be swing type. Automatic sliding doors may be permitted in IBC multifamily mid-and high-rise buildings.

4-6.7.5 Garage Door Operation.

Provide automatic garage door openers for each garage door, listed and labeled by UL 325.

4-6.7.6 Door and Window Hardware.

Exterior doors leading into the house shall have a BHMA/ANSI minimum grade 2 keyed entry lockset and deadbolt. These may be provided as a combination unit. Provide wide-angle door viewers unless a sidelight is provided that provides viewing opportunity. Keyless systems are not recommended due to safety concerns.

4-6.7.6 Other Considerations.

Protect the main entry door with a minimum 2 ft. (0.6 m) overhang, or covered porch, for weather protection and decreased operations and maintenance burden associated with flooring maintenance. For rear exterior doors, consider glass storm door with operable panel to facilitate backyard activity supervision for families. Provide interior and exterior lighting at each main entrance.

4-6.8 Roofing.

Provide roof systems with a service life of 25 years or greater. For low-slope roofing, and for IBC housing generally, comply with UFC 3-110-03 *Roofing,* which incorporates National Roofing Contractors Association (NRCA) and the IBC with modifications. For steep slope roofing systems, comply with the IRC at a minimum, and additionally with applicable NRCA recommendations. Roofing materials should comply with ENERGY STAR recommendations provided all other performance standards are satisfied. Design roof drainage systems in accordance with SMACNA.

4-6.8.1 Roof Slopes and Overhangs.

Roofs with slopes greater than 4/12 have improved maintainability and a more residential scale and are encouraged. Roofs should generally have eave overhangs of 12 inches or more, and gable overhangs of 6 inches or more. For steep slope asphalt shingle roofing systems, provide a minimum 4/12 roof slope for housing units, and a minimum 3/12 roof slope for unconditioned detached accessory structures.

4-6.8.2 Roof System Limitations

4-6.8.2.1 Wood shingles and shakes, and roll roofing are prohibited. Photovoltaic shingles may be used if Life cycle Cost Effective and approved by the **\1** BO/AHJ **/1/**. Avoid Fire retardant-treated plywood roof systems above unconditioned attics which prematurely degrade with exposure to high temperatures and humidity.

4-6.8.2.2 For steep slope roof systems over conditioned spaces in areas with mean January temperatures below 30F (corresponding approximately to ASHRAE climate zones 5+), provide ice barrier protection complying equivalent to ASTM D1970 (aka ice and water shield) at eaves and rakes. Install in accordance with NRCA recommendations except that membrane shall extend horizontally a minimum of 36 inches from the inside face of the exterior wall, or further if warranted by known ice conditions.

4-6.8.2.3 Where IRC or local practices permit self-adhering membranes to be used as underlayment for full shingle roof system coverage, include a bond break (equivalent to type I underlayment) between the membrane and shingles to prevent shingle bond.

4-6.8.3 Steep Slope Roof Drainage.

4-6.8.3.1 Pre-finished Roof edge gutters are generally required for edge draining roof systems and must discharge rainwater at least 5 feet from the home to reduce the chances of saturating the soil around the foundation. Gutters are not necessary in dry climates provided a sufficiently wide overhang and positive ground slope can maintain the occasional rainwater (or snowmelt) away from the structure. Gutters shall be sloped, with sections joined with rivets and sealant, welded, or soldered. Vinyl gutters and downspouts are not prohibited. Gutter profile should be selected for drainage performance while adhering to the residential scale and aesthetic; 'K' style and/or 'ogee' style gutters are preferred. Built-in gutters and half-round gutters are prohibited except when historical replication is required by the **\1** BO/AHJ ***/1/***.

4-6.8.3.2 Alternate drainage systems are permitted subject to **\1** BO/AHJ ***/1/*** approval and storm water management requirements. System should be one of those identified in the ENERGY STAR *airPLUS Construction Specifications* and have been proven an effective local practice based on similar systems on comparably built area housing. Note that *airPLUS* label is not required.

4-6.8.3.3 Non-potable water collection systems (rain-water harvesting) shall be constructed in accordance with Code and the EPA ENERGY STAR Construction criteria.

4-6.8.4 Roof Ventilation.

Provide vented attics unless dictated otherwise by local practices. In most heating climates a vented uninsulated (i.e. 'cold') attic with a sealed and insulated attic floor is common practice. However, if significant HVAC heat loss within the attic is anticipated through attic located duct distribution, exhaust fans, or other items, then an unvented, sealed attic is generally required. Whether attic is vented or not, the roof shall be vented with a 1-1/2" ventilation gap between roof sheathing and any insulation below, and include the Code required intake (i.e. eave or cornice vents) and exhaust (i.e. ridge vents) ventilation. Ridge vents typically allow more air to escape than 'mushroom' style vents.

4-6.8.4.1 For vented attics, provide balanced (intake/exhaust) passive ventilation for optimal performance. In colder regions, vented attics may require mechanical temperature-controlled fans to supplement passive ventilation. Determine the requirement based either on the analysis and calculations presented in Cold Regions Research Engineering Laboratory (CRREL) MP 5106, *Attic Ventilation Guidelines to Minimize Icings at Eaves*, or by another non-proprietary authoritative method. Guidelines for designing cathedral ceiling ventilation to prevent ice dam formation are also available from CRREL.

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CHAPTER 5 BUILDING SYSTEMS

5-1 UTILITIES.

For new housing developments, determine energy source based upon a life-cycle cost analysis of feasible alternatives in accordance with UFC 1-200-02 *High Performance and Sustainable Building Requirements.*

5-2 HEATING, VENTILATING AND AIR CONDITIONING (HVAC).

5-2.1 General.

Design HVAC systems for occupant comfort and control in accordance with code, which references ACCA Manuals D, J, and S for load calculation methodology. Equipment should be ENERGY STAR certified. For all fuel fired systems, provide direct vent sealed combustion equipment. In revitalization projects, replace all HVAC ducts in or below the floor slab with an above floor system, to maintain interior air quality and reduce contamination potential.

5-2.1.1 Provide separate zones for first and second floor. Provide ENERGY STAR certified programmable (set-back) thermostats in new construction and major revitalizations. Provide return air registers, transfer grill, or undercut door to maintain pressure balance throughout the house.

5-2.1.2 **\1** To the extent possible, ductwork shall be placed within the conditioned portion of the thermal envelope. Avoid placing ducts in unconditioned attics without sufficient duct insulation and condensation mitigation strategy. Attic ductwork shall be insulated even if it is a conditioned attic, to mitigate the potential for condensation. Do not install ductwork under or within floor slabs. This change allows for renovation of existing buildings where the HVAC system is replaced as well as allowing the designer the flexibility to best locate the HVAC system and ducts without having to bring the entire attic enclosure into the envelope. ***/1/***

5-2.1.3 Comply with UFC 3-450-01 *Noise and Vibration Control*, and the ASHRAE *Handbook of Fundamentals*. Design shall achieve a Noise Criteria (NC) rating between NC-20 and NC-30.

5-2.2 Heating.

Portable room heaters, floor furnaces, and heat lamps are prohibited. Electric resistance heat is prohibited except for existing work subject to the restrictions specified in UFC 3-410-01

5-2.2.1 Do not locate heating and cooling equipment that requires maintenance in attics or crawlspaces.

5-2.2.2 Roof discharge of heating equipment exhaust is preferred.

5-2.3 Ventilation.

Comply with Code for Unit mechanical ventilation. The preference is for a balanced intake/exhaust system, with manual override, coupled with an Energy Recovery Ventilation (ERV) system to ensure against over/under pressurization. System may be designed for intermittent cycling in accordance with ASHRAE 62.2 to optimize energy usage.

5-2.3.1 Bathroom exhaust fan shall be maximum 1.5 sone, and an exhaust fan with maximum 5.0 sone shall be provided in each kitchen. Exhaust fans must discharge to the exterior; discharging into attic, crawl space, or internal recirculation is prohibited

5-2.4 Air Conditioning.

In new construction and **\1** alterations **/1/**, provide air conditioning in locations where during the six warmest months of the year dry bulb temperature is 26.7 degrees C (80 degrees F), or higher for over 650 hours; or wet bulb temperature is 19.4 degrees C (67 degrees F), or higher for over 800 hours in accordance with OMB Circular A-45. Window or through-wall units are prohibited. See chapter 7 for refrigerant limitations.

5-3 ELECTRICAL AND COMMUNICATIONS

5.3.1 Electrical Distribution.

Provide exterior distribution in accordance with the housing specific sections of UFC 3-550-01 *Exterior Electrical Power Distribution.* Provide visual screening for meters, and do not locate meters adjacent to unit front entrances.

5-3.2 Service Panel.

Where possible, provide 200 amp minimum electrical service to each new dwelling unit. Locate service panel in discrete location within the dwelling unit, accessible to occupants, but not in a living, sleeping, or storage room.

5-3.3 Lighting.

Comply with applicable residential sections of UFC 3-530-01 *Interior and Exterior Lighting Systems and controls.* However, comply with IES “The Lighting Handbook; Reference and Application” for unit interior and exterior lighting locations, coverage, color rendition, and illuminance levels using average age bracket (25-65yrs).

5-3.3.1 Exterior Lighting.

Ensure adequate exterior illuminance is provided to the periphery of the dwelling units for safety and security. Luminaire selection shall be compatible with the architectural residential character of the neighborhood. Avoid ‘industrial-looking’ luminaries in housing areas. Consider motion or timer type (i.e. ‘dusk to dawn’) automatic lighting and step-down functions to minimize light trespass and nuisance glare towards adjacent

units. Unit exterior lighting shall be controlled from inside the respective dwelling unit, at each exterior door and from within the garage. Generally avoid decorative landscape lighting.

For general exterior site safety lighting outside of the unit periphery, including consolidated parking areas and street lighting, comply with UFC 3-530-01. Where life cycle cost effective, utilize LED or other high efficiency lighting technologies.

5-3.3.2 Interior Lighting.

Provide wall-switched overhead light fixtures in all walkable spaces including kitchen, dining room, bedrooms, walk-in closets, bathrooms, halls, stairs, and utility/storage rooms. Provide lighting for all closets 24 inches in depth or greater. Consider wall switch operated, ENERGY STAR certified ceiling fans in living/dining area, family room, and bedrooms when desirable. Fans should be provided with separate fan and light control. Provide lighting for attics and storage spaces. Consider occupancy sensor technology where appropriate for the space and intended function.

5-3.4 Building Telecommunications Systems.

For all dwelling unit types, comply with applicable portions of UFC 3-580-01 *Telecommunications Infrastructure Planning and Design,* and all of TIA-570-C *Residential Telecommunication Infrastructure Standard* (including the annexes).

The Communications System and/or cable TV (CATV) provider serving the installation should be responsible for installing and maintaining the distribution system up to the demarcation point, and the construction contractor is generally responsible from the demarcation point into and throughout the dwelling unit(s). At the demarcation point, locate network interface device(s) at a discrete location of the unit that is accessible, preferably near the utility room, and the Distribution device centrally located within the unit and tenant accessible. Interior unit cabling shall be a minimum of a combination of Category 6 wiring, coaxial cable, and fiber optical cable (if available) in accordance with Grade 2 residential cabling capability. Conduit is generally not required, but should be considered at metal stud framing, between units of a multifamily structure, and other vulnerable locations. Additionally, consider a 1 in. (2.5 cm) diameter conduit from house connection location to attic, basement or crawl space to facilitate future telecommunication wiring.

5-3.4.1 Outlet Locations.

Within the unit, provide telephone outlets at a minimum in kitchen, living room, family room, dining room, and all bedrooms, with multiple modular jacks compatible with multiple furniture arrangements in each room. Provide, as a minimum, duplex cable TV/television outlets in living room, kitchen, family room, and all bedrooms. Ensure that all outlet locations are compatible with multiple furniture arrangements.

5-3.5 Security Systems.

Security systems are not generally required in most family housing. However, multifamily housing areas may warrant systems to address region specific vulnerabilities, especially in high-rise**,** high-population facilities and in OCONUS locations depending on the Facility Security Level (FSL). These shall be coordinated with the Installation Safety/Security office. For Government-owned housing, refer to UFC 4-020-01 *Security Engineering Facility Planning Manua*l. Refer also to *The Risk Management Process for Federal Facilities.*

Housing associated with 'High Risk' personnel may also augment certain security measures. Refer to UFC 4-010-03, *Security Engineering Physical Security Measures for High Risk Personnel.*

5-4 WATER SYSTEMS

5-4.1 General.

For IBC buildings, comply with UFC 3-420-01, *Plumbing Systems* and the IPC which it augments. For IRC buildings, comply with the IRC and the following;

5-4.2 Water Supply Cutoff.

The interior service shut-off valve for each housing unit shall be accessible to the occupants. Do not install in crawlspaces. Typical locations include utility room, under kitchen sink, or basement. Coordinate additional curb stop/shut-off valve location for each building in accordance with Base requirements.

5-4.3 Exterior Hose Bibs.

Provide hose bibs in easily accessible locations at both front and rear of each dwelling unit. Hose bibs subject to freezing shall be frost-proof type.

5-4.4 Domestic Hot Water.

A "heat trap" must be provided with all water heaters. Where fuel-fired domestic water heaters are provided, sealed combustion units are required. Roof discharge for the vent is preferred. Tankless water heaters are generally preferred due to maintenance concerns associated with water tanks.

5-5 SANITARY SEWER.

For IBC buildings, comply with UFC 3-420-01, *Plumbing Systems,* and the IPC which it augments. For IRC buildings, comply with the IRC. For all housing types, locate vent stacks to rear of housing units, and consolidate to limit the number of roof penetrations. Provide drains for air-conditioning condensation, humidifier overflow, and water heater and relief valves. Drains shall discharge to the exterior.

5-6 GAS.

Comply with NFPA 54 *National Fuel Gas Code* and NFPA 58 *Liquefied Petroleum Gas Code* as applicable.

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CHAPTER 6 FIRE AND LIFE SAFETY

6-1 FIRE AND LIFE SAFETY.

6-1.1 General.

For IRC buildings, comply with the IRC except as modified in this UFC (e.g. refer to paragraph on window fall prevention). For IBC buildings, comply with UFC 3-600-01 *Fire Protection Engineering for Facilities.*

For existing work in housing types, comply with the UFC 3-600-01 compliance triggers, except where the IRC compliance triggers are more stringent.

For handicapped accessible units, refer to the Architectural Barriers Act Accessibility Standards (ABAAS) for alarm requirements.

6-1.2 Flame-Spread and Smoke-Developed Indices.

Comply with IRC or UFC 3-600-01 as applicable to the housing type.

6-1.3 Automatic Sprinklers.

All new family housing is required to have a complete automatic fire suppression system. For IRC housing, system shall be stand-alone or multipurpose, wet pipe system in accordance with NFPA 13D. Incorporate all applicable recommendations and guidelines of the *NFPA Automatic Sprinkler Systems for Residential Occupancies Handbook (latest edition)*.

Additional requirements for all residential sprinkler systems include:

6-1.3.1 Piping Protection.

Provide protection from living spaces for all non-metallic pipe even if the space does not require sprinkler protection and even if the pipe is listed for exposed locations.

6-1.3.2 Sprinkler Protection.

\1 In finished areas, **/1/** provide domed plate concealed, pendant concealed, or semi-recessed sprinklers to reduce the potential for unintended activation resulting from accidental misuse.

6-1.3.3 Relief Valve.

Consider a UL listed pressure relief valve if pressures are anticipated to exceed the pressure rating of any component.

6-1.3.4 Piping Distribution.

Maintain piping within the building thermal envelope. Antifreeze systems are prohibited due to ongoing ignition safety concerns.

6-1.3.5 Backflow Preventer.

Coordinate with the Base and/or privatized Utility for determination of the need for backflow prevention devices, which may not be required by IRC/NFPA 13D.

6-1.4 Fire-Resistant Separation.

Provide fire and smoke separations in compliance with IRC or UFC 3-600-01 as applicable. Avoid Fire retardant-treated plywood in unconditioned attic spaces at unit separation walls.

6-1.5 Smoke Alarms.

Provide interconnected hard-wired smoke alarms with battery backup, in accordance with IRC or UFC 3-600-01 as applicable. Smoke alarms and carbon monoxide alarms may be a combined system.

6-1.6 Carbon Monoxide (CO) Detection System (Interconnected System).

Provide CO detection in compliance with IRC or UFC 3-600-01 as applicable.

6-1.7 Overseas and Leased Housing Requirements.

Overseas family housing, whether constructed or leased, must comply with these life safety measures, and may also be required to adhere to base or host nation requirements.

CHAPTER 7 ENVIRONMENTAL

7-1 ENVIRONMENTAL.

7-1.1 General.

Construct in compliance with Federal, State, interstate, local and SOFA requirements as applicable to the project. DoD masterplanning guidance is provided in UFC 2-100-01 *Installation Master Planning.* For projects on Army Installations, refer also to AR 420-1 *Army Facilities Management,* and AR 200-1 *Environmental Protection and Enhancement.*

7-1.2 Environmental Planning.

Required Environmental planning due diligence is a function of the Installation Masterplanning process which must occur and result in an approved site prior to initiating an improvement or construction project.

7-1.3 Energy and Sustainability.

7-1.3.1 Federal Energy Reduction Mandates.

New Housing must be designed to exceed the baseline standards in the International Energy Conservation Code (IECC) for low-rise residential buildings (and ASHRAE Standard 90.1 for commercial and non-low-rise residential buildings) with energy consumption levels at least 30 percent below the baseline, where life-cycle cost-effective[8]. Refer to UFC 1-200-02 for guidance on conducting life cycle cost analysis.

7-1.3.1.1 Calculated Loads.

Refer to applicable Department of Energy (DOE) Guidance with regard to residential-specific loads to be considered in the energy reduction modelling calculation.

7-1.3.2 Sustainability.

Comply with UFC 1-200-02 to the extent applicable.

Army only: Army Housing projects shall be certified at LEED “Silver” level with at least 15 energy points (Energy and Atmosphere category) in accordance with current SDD policy dated January 2017. Improvement projects shall comply with the extent practicable and life cycle cost effective, but are not required to be LEED certified. Additional Army requirements include:

[8] (42 U.S.C. 6834(a)(3)(A))

7-1.3.2.1 For single family, duplex, and multiple single family housing (Townhouses) up to three stories, comply with *LEED BD+C: Homes and Multifamily Low-rise*, latest edition. For other housing, such as midrise and high-rise housing projects, and for housing that is combined with another building type, refer to UFC 1-200-02.

7-1.3.2.2 LEED Energy and Atmosphere prerequisites require housing to meet the ENERGY STAR for homes. However, ENERGY STAR for homes certification is not required.

7-1.3.2.3 Given the nature, breadth, and wide-ranging life-cycle operations and maintenance impacts of many LEED credits, credit determination shall be made in coordination with appropriate stakeholder review including operations and maintenance personnel, housing office, master-planning, and others as applicable to the credit.

7-1.4 Toxic Substances.

Refer to the Department of Defense Environmental Restoration Program and service specific environmental guidance documents[9] for the required assessments, surveys, sampling, mitigation, operational controls and other related procedures and due diligence associated with polychlorinated biphenyls (PCBs), radon, asbestos, lead based-paint, chlorofluorocarbons, and other substances regulated by EPA under the Toxic Substance Control Act (TSCA).

7-1.4.1 Polychlorinated Biphenyls (PCB).

Follow applicable guidance. Refer to UFGS specification section 02 84 22 *Removal and Disposal of Polychlorinated Biphenyls (PCB)* for technical implementation

7-1.4.2 Radon Hazard Mitigation.

Refer to UFC 3-101-01 and service specific guidance to determine whether active or passive systems are required. For new construction, comply with the most stringent of the IRC, GBCI pre-requisite credit requirements, and UFGS specification 31 21 13 *Radon Mitigation*, and EPA Indoor *airPLUS* Construction specifications for design and construction of the required radon control and construction measures. For **\1** alterations ***/1/*** projects of IRC buildings, comply with ASTM E2121 *Standard Practice for installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings*.

7-1.4.2.1 The preparation of the building for future active pressurization system installation is required for zone 1. It is recommended for zones 2 and 3.

[9] For Army, see AR 200-1 *Environmental Protection and Enhancement.* For Navy, see OPNAV Instruction 5090.1D – *Environmental Readiness Program.* Technical Criteria include UFC *Architecture*, UFC 3-810-01N *Navy and Marine Corps Environmental Engineering for Facility Construction*

7-1.4.2.2 Note that vent pipe fans are not permitted to be located in conditioned or habitable space. Unvented attics may be considered conditioned space if within the thermal envelope. Confirm with the **\1** BO/AHJ **/1/**. In such cases, an exterior or other approved location shall be selected.

7-1.4.2.3 Do not install exterior vent pipes on the front of the house. Choose a discrete location such as the back corner, or other approved non-obtrusive location.

7-1.4.3 Asbestos.

Follow applicable guidance. Asbestos materials shall not be used in new construction, repair or maintenance at shore facilities and supporting construction, even when those materials are not specifically banned by EPA. Use asbestos-free substitute materials. Technical guidance may be found in UFGS specifications 02 82 13.00 10 *Asbestos Abatement* and 02 82 16.00 20 *Engineering Control of Asbestos Containing Materials*.

7-1.4.4 Lead.

Follow applicable guidance related to lead-based paint, lead-in-dust, lead-in-soil, and related lead hazards. Do not use materials with lead content in new construction. Specific handling and abatement guidance may be found in UFGS specification section 02 83 13 *Lead-Based Paint Removal and Disposal.* Do not use lead-containing piping, flux, solder, fittings or fixtures in water distribution components.

7-1.5 Chlorofluorocarbons (CFCs) & Hydrochlorofluorocarbons (HCFCs).

Do not use CFC- or HCFC-based refrigerants, or other EPA class I or II ozone-depleting materials in heating, ventilating, air conditioning and refrigeration systems which have been phased out or are slated for phase out. For **\1** alterations **/1/** projects, retrofitting of refrigerant systems or complete system replacement should be evaluated as part of a life cycle cost analysis. Do not mix refrigerant systems. Consult the EPA's Significant New Alternatives Policy (SNAP) Program for updated list of substitutes.

7-1.6 Volatile Organic Compounds (VOC).

For IBC buildings, Comply with UFC 1-200-02. For new IRC buildings - and to the extent practicable in **\1** alterations **/1/** projects - comply with the EPA's Indoor *airPLUS Construction Specifications* which establishes VOC limits for residential building components such as composite wood, paints and finishes, carpets, adhesives and sealants. The Indoor *airPLUS* label is not required.

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APPENDIX A – REFERENCES

GOVERNMENT PUBLICATIONS

Architectural Barriers Act (ABA) Standards (2015) https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/aba-standards/single-file-version

Consumer Products Safety Commission (CPSC), http://www.cpsc.gov

CPSC Publication 325 – *Public Playground Safety Handbook*, https://www.cpsc.gov/s3fs-public/325.pdf

Department of Defense (DoD)

CRREL MP 5106, *Attic Ventilation Guidelines to Minimize Icings at Eaves,* Cold Regions Research and Engineering Laboratory (CRREL), 72 Lyme Road, Hanover, NH, 03755, www.crrel.usace.army.mil/library/technicalpublications.html

DoD Memorandum, Unified Facilities Criteria implementation (Ref. MIL-STD-3007) https://www.wbdg.org/pdfs/ufc_implementation.pdf

DoD Instruction 4165.57 (12 March 2015) – *Air Installation Compatible Use Zones (AICUZ),* http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/416557p.pdf

DoD Instruction 4715.16 (18 September 2008) – *Cultural Resources Management.* http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/471516p.pdf

DoD Directive 4165.63-M (21 July 2008) – *DOD Housing,* http://www.esd.whs.mil/DD/

DoD Instruction 4715.03 (May 1996) – *Natural Resources Conservation Program* http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/471503p.pdf

DoD MIL-STD-3007F –*Standard Practice for Unified Facilities Criteria UFC) and Unified Facilities Guide Specifications (UFGS)* https://www.wbdg.org/ffc/dod/federal-military-specifications-standards/mil-std-3007

Interagency Security Committee (DHS)

The Risk Management Process for Federal Facilities; An Interagency Security Committee Standard

UFC – Unified Facility Criteria https://www.wbdg.org/

UFC 1-200-01 – *DoD Building Code (General Building Requirements)*

UFC 1-200-02 – *High Performance and Sustainable Building Requirements (applicable to multi-family housing*)

UFC 2-100-01 - *Installation Master Planning*

UFC 3-101-01 - *Architecture*

UFC 3-110-03 - *Roofing*

UFC 3-120-10 - *Interior Design*

UFC 3-210-10 - *Low Impact Development*

UFC 3-301-01 - *Structural Engineering*

UFC 3-400-02 - *Engineering Weather Data*

UFC 3-410-01 - *Heating, Ventilating, and Air Conditioning Systems*

UFC 3-420-01 - *Plumbing Systems*

UFC 3-450-01 - *Noise and Vibration Control*

UFC 3-530-01 - *Interior and Exterior Lighting Systems and Controls*

UFC 3-550-01 - *Exterior Electrical Power Distribution*

UFC 3-570-01 - *Cathodic Protection*

UFC 3-600-01 - *Fire Protection Engineering For Facilities*

UFC 3-810-01N - *Navy and Marine Corps Environmental Engineering for Facility Construction*

UFC 4-010-01 –*DoD Minimum Anti-terrorism Standards for Buildings*

UFC 4-010-03 - *Security Engineering Physical Security Measures for High Risk Personnel*

UFC 4-020-01 – *Security Engineering Facility Planning Manual*

Department of the Air Force

Air Force Family Housing Guide for Planning Programming, Design and Construction
http://www.afcee.brooks.af.mil/dc/dch/mfhguide/toc.doc

Department of the Army

Army Regulation, AR 420-1 *Army Facilities Management*

Department of the Navy

NAVFACINST 11101.85H.1*, Appendix A – Navy Housing Project Standards*
http://www.housing.navy.mil/pubs/85H_Rev1_30Oct01.pdf

U.S. Marine Corps

MCO P11000.22 – *Marine Corps, Housing Management Manual*
http://www.usmc.mil/directiv.nsf/0dce83e13c9c8aa685256c0c0066c2e0/a2213818c030ffdb85256497006b1211?OpenDocument

Department of Energy (DOE)

Million Solar Roofs Initiative, https://www.nrel.gov/docs/fy04osti/34009.pdf

National Environmental Policy Act (NEPA) of 1969.
http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm

Environmental Protection Agency (EPA)

Comprehensive Procurement Guidelines (for recycled content standards)
https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program#products

Energy Star Certified Products https://www.energystar.gov/products

Federal Emergency Management Agency (FEMA)

FEMA P-320 *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*. https://www.fema.gov/media-library/assets/documents/2009

FEMA 320, *Taking Shelter from the Storm: Building a Safe Room Inside Your House*,
www.fema.gov/fima/tsfs02.shtm

FEMA 361, *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms*
https://www.fema.gov/media-library/assets/documents/3140

Federal Highway Administration (FHWA), Department of Transportation

Manual of Uniform Traffic Control Devices, http://mutcd.fhwa.dot.gov/

Office of Management and Budget (OMB), http://www.whitehouse.gov/omb/

OMB Circular A-45 - *Rental and Construction of Government Quarters*

U.S. Government Printing Office (GPO)

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IRC – *International Residential Code™ (Latest Edition)*

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APPENDIX B – BEST PRACTICES AND LESSONS LEARNED

The following content includes non-mandatory best practices and lessons acquired from completed and current Family Housing MILCON projects and is approved by the tri-services UFC working group for application to current and future design and construction projects. Content is organized in accordance with the format of this UFC. Users are encouraged to also check other non-MILCON sources for best practices and lessons learned.

Lessons Learned is knowledge or understanding gained by experience - either positive or negative. Best Practices are techniques that have been shown to produce optimal results. It is the responsibility of the design or construction agent to exercise professional judgement and expertise in the application to their project.

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CHAPTER B1 INTRODUCTION

B1-1 ACCESSIBILITY.

Whereas ABA is based on adult anthropometrics, non-mandatory Universal Design (aka Barrier-free Design) focuses on making the features of the house safe and accessible for everyone regardless of age, physical ability, or stature. To the extent practicable, accommodate the broadest range of family member needs and abilities. Examples include:

- Using pulls instead of knobs on cabinets which are easier on hands of all ages.
- Position light switches to accommodate the widest variety of users.
- Consider varied-height cabinets and countertops to accommodate multi-cook families (i.e. a very tall parent and a child working together to prepare a meal.
- Adjustable-height showerheads.
- Offset shower and/or tub controls to facilitate access from outside the tub or shower.
- Avoid changes in floor height, including interior thresholds.
- Consider lever handles instead of knobs for doors.
- Enhanced slip resistance.

Many other strategies can be found at The Center for Universal Design at the Institute for Human Centered Design; https://www.humancentereddesign.org/



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CHAPTER B2 RESIDENTIAL COMMUNITY PLANNING

B2-1 GENERAL – RESIDENTIAL NEIGHBORHOODS.

At Jefferson Terrace at Ft Lee, VA, (image below) dwelling units are part of a cohesive neighborhood community connected to the rest of the Post. Successful strategies employed here include:

- Residential streets differentiated by housing clusters providing dwelling unit variety.
- Street patterns that reinforce the sense of community and limit through traffic.
- Consistent setbacks and architecture, shared greenspaces.

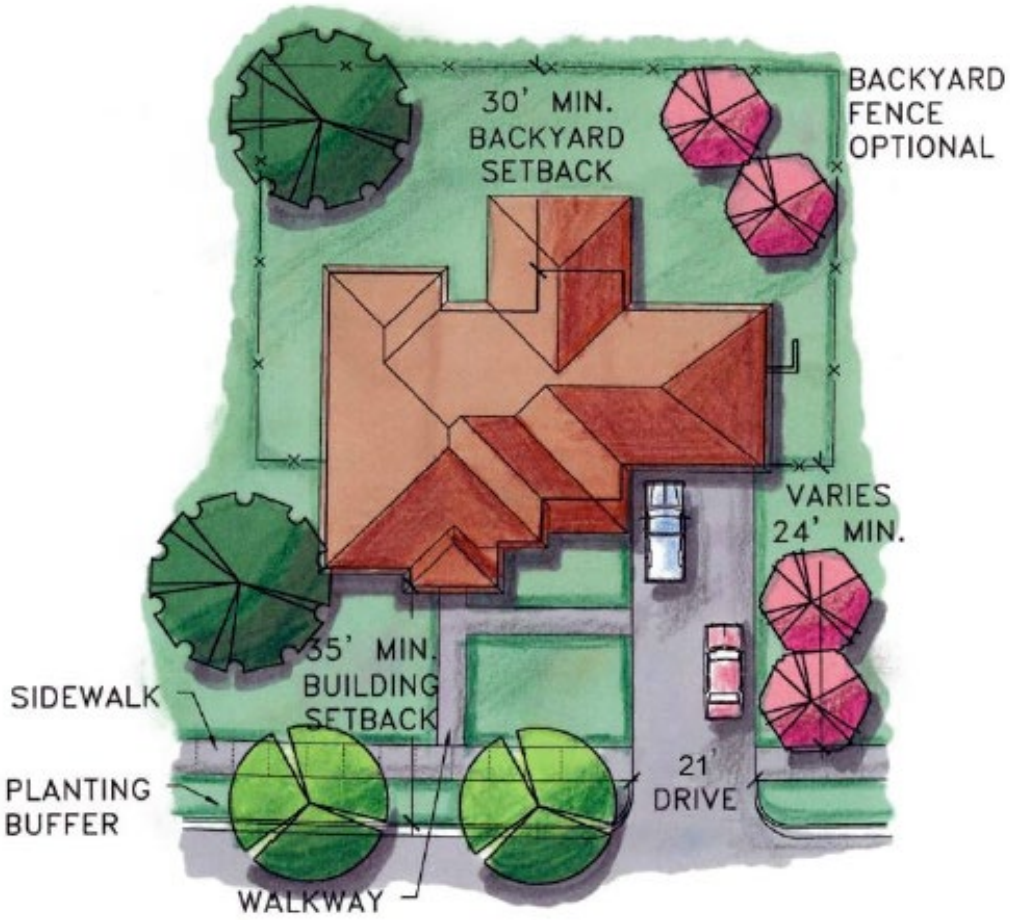


B2-2 NEIGHBORHOOD AND DENSITY.

The concept single detached unit site layout (below) employs several successful strategies including;

:

- Generous back yards that accommodate children, pets (when fenced) and family activities. Note that some housing locations permit multiple pets, so consider increasing the backyard sizes.
- Judicious use of landscaping without being excessive. Tree plantings adjacent to sidewalks should be minimized.
- Appropriate setbacks provide a clear and comfortable ‘public-private’ space buffer.



B2-2.1 Housing Types.

A mix of Housing unit types with varying densities within a neighborhood as clusters can be very successful, as demonstrated at gateway Village which includes a mix of duplexes, multi-family, and single detached units which provide a textured yet coherent neighborhood.



This housing project shown below incorporates additional site details that contribute to safe and aesthetically pleasing neighborhoods:

- Side yard located trash screening is discreetly located, and articulated similar to the house as an attractive element instead of an eyesore. (However, it is preferred to be set back a little further than shown here).
- Landscaping softens building corners and existing mature shade trees were retained to shade the patio and side yards, and reduce interior heat gain, making an attractive and yet functional site amenity.



Harrison Villa (below) is a neighborhood revitalization project consisting of duplex and single family detached units. Consistent architectural articulation sets these Ft Lee houses apart and contribute to a coherent community identity. Successful strategies include:

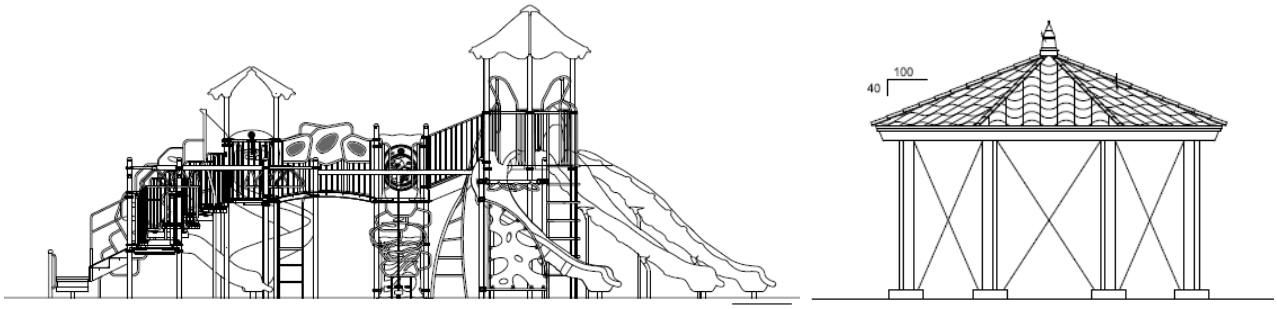
- Despite the inherently repetitive nature of a duplex, each unit of the duplex is slightly varied on the outside; altering the material palette slightly from unit to unit to differentiate while still realizing economies of scale of a large housing project.
- Headers, arched-tops fenestration openings provide visual interest and coherence to the neighborhood.
- Differentiating the main entrance with a small portico contributes to the sense of arrival.
- Roof slopes are consistently at 5/12 or greater, and the roof forms vary slightly across the elevation, providing human scale.
- Generous Roof overhangs provide visual benefit as well as cut down on heat gain.



B2-3 NEIGHBORHOOD RECREATION.

In this neighborhood recreational areas and playfields are well-integrated and within comfortable walking distance of the housing units they serve. Successful strategies employed here include:

- Dwelling unit backyards are integrated into the common site amenities yet retain unit privacy through landscaping, selective fencing. Viewsheds for monitoring children are maintained.
- Generous provision of shade trees and shade structures with consideration of playtime exposure addresses safety hazards of direct sun exposure and of skin contact with heated playground equipment.
- For playground equipment and playground areas in general, limit yellow colors which attract bees.
- Illuminated areas result in a decrease in incidents of vandalism. Consider illumination of areas and structures (such as bus and park shelters) that have been shown to be prone to vandalism.





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CHAPTER B3 SITE ENGINEERING

B3-1 NEIGHBORHOOD VEHICULAR AND PEDESTRIAN CIRCULATION.

Harrison Villa (below) successfully and safely addresses the circulation hierarchy through the following strategies:

- Residential streets are nicely differentiated and separated from collector streets, and incorporate sweeps, bends, and cul-de-sacs Collector streets serve as the neighborhood buffer and do not have houses on them.
- Landscaped buffers along collector streets.
- Integrated “greenway” pedestrian circulation connects neighborhood recreation areas with housing units without dangerous street crossings.



With strategic location of wider sidewalks, neighborhoods like this one at Ft Benning accommodates joggers and younger cyclists as well as pedestrians, so that housing is connected to recreation. This path runs parallel with the streets but separated by a greenspace buffer.



CHAPTER B4 FAMILY HOUSING SIZE AND FEATURE STANDARDS

B4-1 UNIT DESIGN – INTERIOR SPACES.

This 1,650 ft2, 3 bedroom, 2.5 bath duplex unit at Ft Lee is characterized by efficient space organization while maintaining functional adjacencies. Successful plan strategies include:

- Mirroring the units alongside the non-garage side vice the garage side means less visual prominence of the service portion of the house, lending a better streetscape and neighborhood experience.
- Despite the small unit sizes. Living spaces are combined into a great room towards the back of the unit adjacent to the patio, while retaining the formal living space in the front.
- Double doors lead to the back patio.
- The kitchen provides open plan concept that incorporates an island that doubles as informal eating (breakfast) area without adding much space.
- Despite limited ground floor space, a small foyer with closet provides just enough separation from the main living to contain items like coats, shoes, and sundry so they don't intrude on living spaces.
- Upstairs, ample landing space width is provided with efficient access to bathroom and sleeping spaces without having a 'corridor-like' feel.
- Double sinks in the master bathroom.



This 1,943 ft^2, 4 bedroom, 2.5 bath detached unit at Ft Benning includes the following successful strategies:

- Pleasant portico entrance is clearly differentiated, provides sense of arrival and does not enter directly into the living room.
- Space 'captured' over the garage in the form of a 'computer nook' (2nd floor) is a skillful way to gain usable space.
- Bedrooms are provided with generous size walk-in closets.
- Exterior storage integrated with the garage.
- Louder family activities are nicely segregated from a quieter more formal living room.



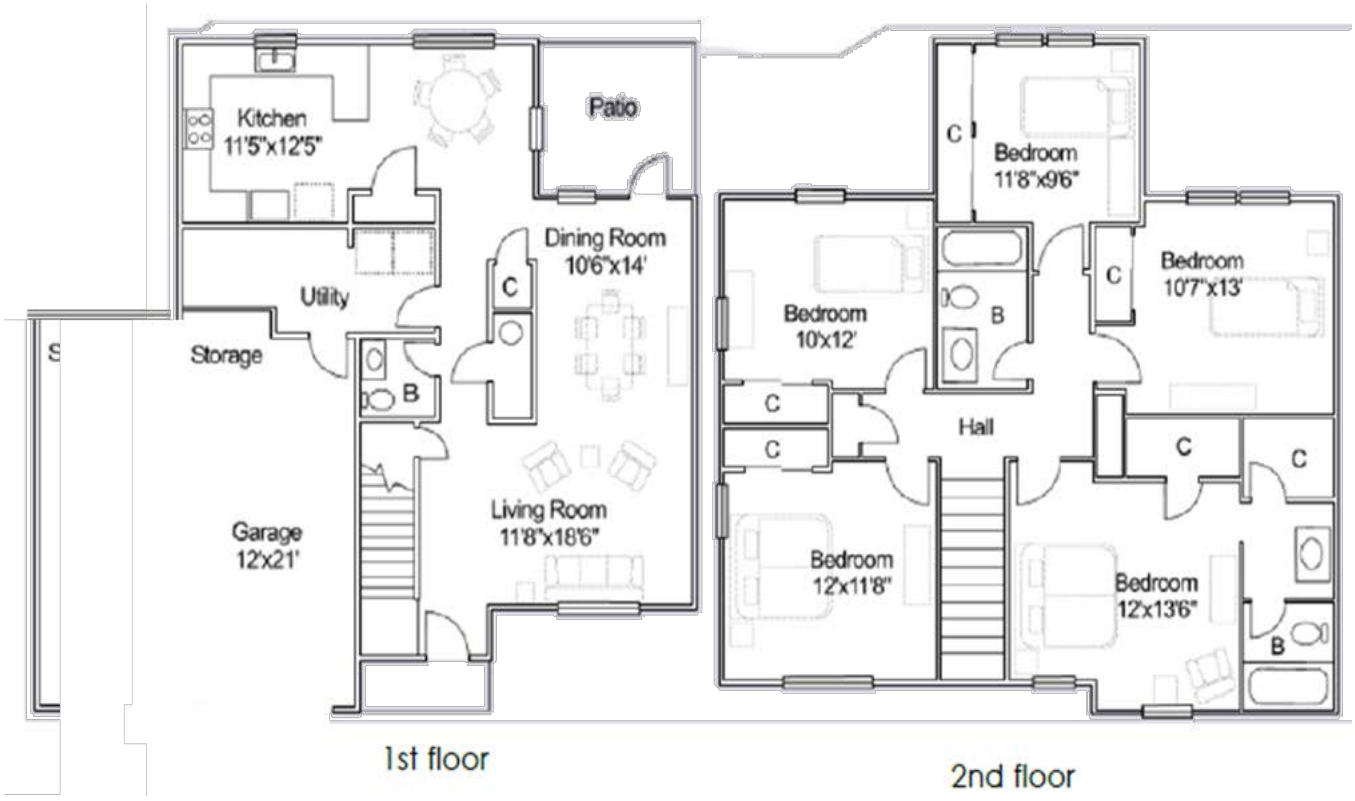


1st Floor

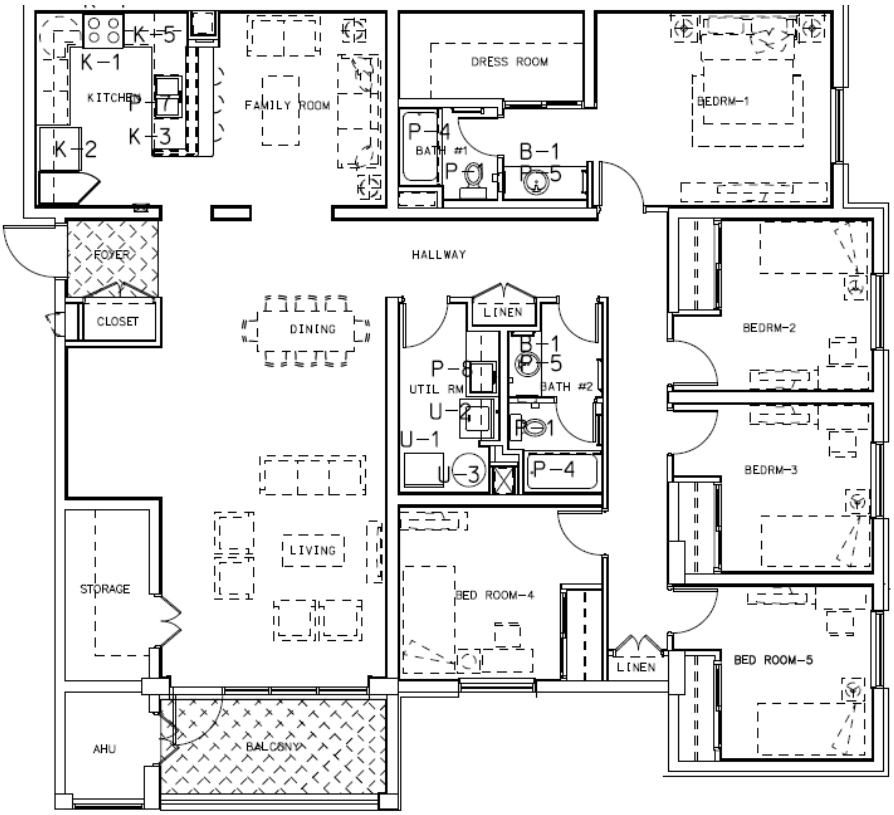
2nd Floor

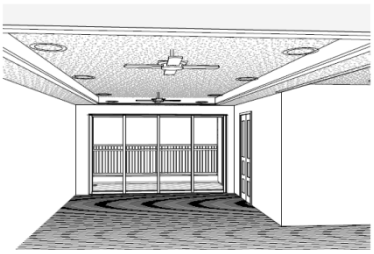
This single detached unit floor plan manages to fit 5 bedrooms and 2.5 baths within a 1,630 ft^2 footprint and still retain full functionality. Several successful strategies include:

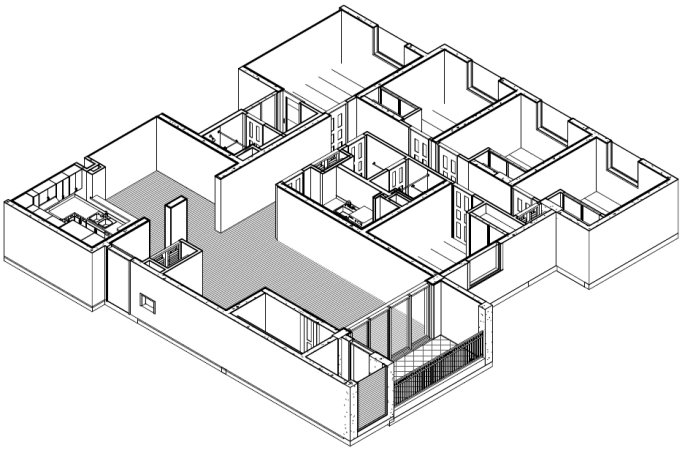
- Open plan kitchen with efficient work triangle.
- Patio is well-positioned to 'extend' living spaces outdoors, making the space feel less constrained than it would otherwise.
- Semi-combined living and dining room provides a balance of segregation and efficient integration.
- Efficient circulation throughout the unit provides for more usable space in living and sleeping areas.

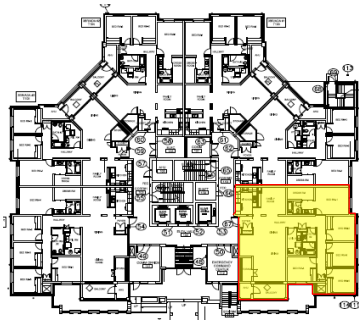


These 2,491 ft^2 high-rise apartment units at Camp Walker provide 5 bedrooms and 2 full baths within the programming benchmark square footage.









B4-1.1 Bathrooms.

Consider interlocking bathroom exhaust fans to run on low power full time and to run on high whenever the lights are turned on.

Do not locate windows over bathtub enclosures when the bathroom faces the street.

B4-1.2 Bedrooms.

Avoid using recessed can type lights in bedrooms; these tend to focus light in occupants eyes when lying in bed reading, or watching TV.

B4-1.3 Interior Storage and Closets.

Consider closet shelving/storage systems to optimize storage capacity.

B4-2 LAWNS.

Consider Sod for front yards: The front yards are often a high traffic area and difficult to establish seed into the turf quality needed. The sod has a longer planting period and could be established easier. It is often cost effective because the front yards are usually fairly small and sod prevents having to have the contractor return to the site for reseeding. The improved curb appeal that results from sodding has been preferred by both tenants and DPW.

For seeded areas, many climate zones benefit from a seed mix; i.e. in southern climates a Bermuda sod turf quality grass that was over-seeded with rye rooted during the dormant season and worked well. In more northern climates you might consider a tall fescue/bluegrass blend.

B4-3 GARAGES AND CARPORTS.

When you have a double garage door and the garage is on the front of your home, the door becomes a major design element. Using 2 two single doors can lessen the impact of one large door, allowing a better balance between the doors and the rest of the house.

B4-4 MECHANICAL SPACE.

In multifamily mid and high rise, do not locate mechanical rooms near dwelling units. Residents often complain about noise and vibration emanating from circulation pumps, air handlers, and other equipment.

B4-5 TRASH ENCLOSURE.

Screen enclosure doors should get latches, hardware, closer, and diagonal bracing to restrain it from sagging which becomes a later maintenance burden.

B4-6 LIFTS AND ELEVATORS.

Do not use ceramic tile or other vulnerable floor finish material in elevators. These finishes are prone to breakage from furniture, dropped objects, spills, and similar events.

B4-7 SOUND ATTENUATION.

Consider increasing sound attenuation/deadening between dwelling unit floor/ceiling assemblies with additional acoustical batt insulation. Lack of Noise mitigation/control is a frequent issue in multifamily housing and a slight increase in the insulation thickness can be a very cost effective solution. Consider other sound dampening strategies such as additional felt membranes or underlayment often specified with floor finishes.

B4-8 INTERIOR FINISHES.

For apartment style housing, consider high quality finishes within the primary common areas of the building. Upgraded finishes here can cost-effectively elevate the quality of the facility. Finishes here should complement that of the dwelling units. Examples include:

- Wood panels on hallway walls.
- Higher ceiling heights.
- Ceramic tile accents in targeted areas.
- Judicious use of carpet (where not heavily trafficked).
- Upgraded hallway lighting fixtures.

B4-8.1 Flooring.

For hardwood flooring, specify dimensionally stable certified products and ensure installation specifications adequately address the tolerances required to accommodate seasonal movement. This is critical to ensure that gaps do not open excessively in dry conditions leaving unsightly gaps and associated maintenance burden, as has been the case in several past projects.

B4-8.2 Ceilings and Ceiling Height.

Consider higher ceiling heights; for example 9 ft. (2.7 m) ceilings on the first floor of the dwelling unit (8' on the second), especially for large open living areas.

Cathedral or vaulted ceilings are encouraged, where climatically appropriate, to improve the quality of unit living space.

B4-8.3 Interior Doors, Frames and Hardware.

Ensure the correct placement of door stops if using the floor mount type that it does not create a tripping hazard.

Doors that have different environmental conditions on opposing sides are more vulnerable to the associated humidity changes, as for example, a main dwelling unit entrance door located off of a primary public circulation corridor for which mechanical zones may differ from the unit. This condition has imposed shrink/swell changes in wood doors. Ensure that the door materials selected are appropriate for the environmental exposure.

B4-8.4 Air Barrier Systems.

Apply an air barrier at the perimeter of the window system that is integrated with the surrounding wall system. Air flow around the frames from the exterior or from cavities within the wall system that are vented to the exterior greatly reduces the performance benefit of thermal breaks.

B4-8.5 Insulation.

Provide additional insulation behind the exterior window casing to mitigate the thermal bridging effect, and provide thermal breaks in all perimeter flashing or trim that surround the window. Never extend clip or veneer supports across the thermal break. These conditions may warrant submittal requirements that call for more detail than is typically required of construction document.

B4-8.6 Exterior Windows and Doors.

Consider automatic sliding entrance doors in high density multifamily housing (i.e. high-rise) and areas subject to high winds.

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CHAPTER B5 BUILDING SYSTEMS

B5-1 ELECTRICAL AND COMMUNICATIONS.

B5-1.1 Lighting.

B5-1.1.1 Exterior Lighting.

As the lighting in the image below demonstrate, site luminaires should be selected to not only ensure adequate security and visibility for pedestrians and tenants, but also for neighborhood architectural theme compatibility.





B5-1.1.2 Interior Lighting.

Carefully consider the appropriateness of occupancy sensors prior to designing them in the dwelling unit. These tend to have lower lamp life, and are generally not appropriate for bedrooms.

B5-1.2 Security Systems.

Consider security systems for addressing the inherent safety vulnerabilities of multi-family housing – i.e. elevators, common use basements, dumpster areas, hallways, and similar areas.

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UFC 4-720-01
13 February 2012

UNIFIED FACILITIES CRITERIA (UFC)

LODGING FACILITIES



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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**

This UFC supersedes AFSDG 4-724-01 Design: Visiting Quarters, June 21, 2005.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Center for Engineering and the Environment (AFCEE) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

JAMES C. DALTON, P.E. Chief, Engineering and Construction U.S. Army Corps of Engineers	JOSEPH E. GOTT, P.E. Chief Engineer Naval Facilities Engineering Command
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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Document: UFC 4-720-01
Superseding: AFSDG 4-724-01

Description: This UFC provides planning and design criteria for Lodging Facilities. This document was developed from AFSDG 4-724-01, dated 21 June 2005, Army Lodging Standard Design Criteria, and discussions with all the Service contacts noted in Chapter 1, Contacts.

Reasons for Document: This UFC was developed for the following reasons:

- Establish planning and design criteria for Navy Lodging Facilities (Navy Gateway Inns and Suites), which did not previously exist.

- Unify planning and design criteria among the Services. The Air Force had existing criteria in the form of AFSDG 4-724-01, dated 21 June 2005, and the Army has existing criteria in the form of Army Lodging Standard Design Criteria.

Impact: The following direct benefits, both positive and negative, will result from the publication of this UFC:

- The Navy now has design and planning criteria for their Navy Gateway Inns and Suites program. This will enhance the project development process and help ensure minimum standards are achieved.

- Unification of the Services' criteria reduces confusion among government and non-government project development personnel and reduces criteria maintenance costs.

Non-unification Issues: Lodging Facilities are substantially unified among Services and accommodate the same basic functions and overall facility design. However, differences exist between the Services that result from programmatic variations that are, in some cases, fundamental to the different Service missions:

- Room sizing, layout, finishes and design features vary somewhat among Services. These differences are essential for each Service to maintain their individual "brand" of visitor lodging facility, which is critical to a successful program. These differences are not detailed in this UFC and readers are directed to the Service agencies in Chapter 1, Contacts.

- Service-specific programming policies are referenced in Chapter 2. These references are essential given the lodging program variability among the Services.

Non-programmatic differences are minor and include the following:

- Army has additional hot water storage requirements to accommodate mission requirements as approved by the Army Facilities Standardization Committee.

- The Air Force requires some minor variations in mechanical criteria: guest room and toilet ventilation requirements, and temperature and humidity requirements for guest laundry and fitness spaces.

- The Army uses prefabricated kitchens in their suites and staff break area.

- The Army has additional grounds storage needs due to the fact that the lodging program maintains the lodging grounds. The Installation typically maintains the lodging grounds for the other Services.

- The Air Force provides a clothes washer and dryer in their suites.

- The Air Force provides a range in their OCONUS staff break area.

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CHAPTER 1 INTRODUCTION

1-1 SCOPE.

This UFC provides guidelines for evaluating, planning, programming, and designing lodging facilities (LF) to accommodate both temporary duty (TDY) travel and permanent change of station (PCS) travel as described below. The information in this UFC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental United States (CONUS) and outside the continental US (OCONUS). Alteration and renovation projects should update existing facilities to meet the guidance and criteria contained in this UFC within budgetary constraints. This UFC is not intended as a substitution for thorough review during design by individual Program Managers and Operations Staff in the appropriate Service.

Lodging programs are managed as follows:

- Army. The lodging facilities described in this document accommodate all official travel, including both PCS and TDY lodging.

- Navy. The lodging facilities described in this document accommodate all TDY lodging. PCS lodging is addressed by the NEXCOM Office, Navy Lodge program.

- Air Force. The lodging facilities described in this document accommodate all TDY lodging. PCS lodging is addressed by the Temporary Lodging Facilities Design Guide

- Marine Corps. The lodging facilities described in this document accommodate all TDY lodging. PCS lodging is addressed by the USMC HQ, Personal and Family Readiness Division (MRK).

1-2 USERS OF THIS UFC.

This UFC is intended as a source of basic architectural and engineering information for all individuals involved in the planning, design, or evaluation of LFs. Specific users of the UFC include the following:

1-2.1 Architects and Engineers.

Architects and engineers (A/Es) that provide design services will use this UFC under the direction of the Service design agencies.

1-2.2 Planning Personnel.

Installation and facility planning personnel will use this UFC, in conjunction with other required programming documents, for programming new or replacement facilities, pre-design planning, or assessing the extent of improvements required in an existing LF in order to achieve the standard established herein.

1-2.3 Additional Users.

Additional users include the following:

- Headquarters Staff and Field Operating Agencies,
- Major Command Staff/Regions,
- Installation Commanders,
- Installation Facilities Management,
- Installation Technical Proponents, and
- LF managers and senior staff.

1-3 DOCUMENT ORGANIZATION.

The criteria are organized to parallel the design process:

- Chapter 2—Planning and Programming. This section provides criteria relevant to site planning, project scope, funding, and execution of LF projects.
- Chapter 3—General Design Criteria. This section provides overarching technical design criteria such as codes and standards, site design, overall building design, infrastructure, and building systems.
- Chapters 4 and 5—Design Criteria. These sections provide detailed requirements for each functional space as well as illustrative design information. This section is divided into chapters for guest rooms and all other spaces.
- Appendices—Appendix A provides all applicable references. Appendix B provides “best practices” that include valuable background information, lessons learned, and design guidance the designer is expected to incorporate according to the needs of the project. Appendix C provides space criteria.

1-4 CONTACTS.

Prior to project development, confirm the acquisition methodology and coordinate the design team composition and facility requirements with the following contacts, as appropriate:

- Army. Family and Morale, Welfare and Recreation Command (FMWRC): U.S. Army Installation Management Command, Attn: Family and MWR Command-Director, Hospitality Programs, 11711 North IH 35, Suite 110, San Antonio, TX 78233-5498.

- Navy. CNIC (N924), Fleet & Family Readiness, Washington, DC (Program Manager), and CNIC (N944), Fleet & Family Readiness, Millington, TN (Facilities Support).

- Air Force. Air Force Center for Engineering and the Environment (AFCEE) for the acquisition methodology and HQ Air Force Services Agency, Lodging Facilities Branch (HQ AFSVA/SVOLF) for design team composition and facility requirements.

- Marine Corps. USMC HQ, Installations and Logistics, I&L (LF).

1-5 SCOPE OF FACILITY.

LFs provide quality, consistent, and cost effective lodging services to official government travelers. The design and configuration of LFs employ most concepts of a mid-priced, limited service private sector hotel—i.e., a hotel that does not have full-service food and beverage capability. Department of Defense Instructions (DoDI) 1015.11 and 1015.12 provide policy and resourcing for all lodging facilities and define TDY and PCS lodging. The Joint Federal Travel Regulations define the types of travelers that will use these facilities.

Criteria in this UFC include options and requirements. Options shall be approved by the agencies identified in Chapter 1, Contacts. All criteria or features not identified as options shall be considered the minimum requirement for the facility and shall be funded and incorporated unless a waiver is obtained from the agencies identified in Chapter 1, Contacts.

1-5.1 Types of Facilities.

There are two types of LFs:

- Central. Central facilities accommodate the main check-in function, the majority of the guest services and administration, and the guest rooms and suites. There will always be at least one central facility on an Installation that includes visitor lodging.

- Satellite. Satellite facilities accommodate additional guest rooms, suites and limited services and support functions. They may be located remotely from the central facility to serve additional Installation areas or near the central facility as part of a visitor lodging complex.

1-5.2 Functional Program Areas.

Table 1-1 provides a listing of all the LF functional program areas, indicates if each area is included in each type of facility, and describes the function of the area.

TABLE 1-1. FUNCTIONAL PROGRAM AREAS

Functional Program Area	Central	Satellite	Description
Guest Services			
Covered entry	X		Covered vehicle drive for loading/drop-off at main entry
Entrance vestibule	X	X	Entry airlock
Central lobby	X		Central facility lounge seating and circulation space between reception and other central guest services
Satellite lobby		X	Satellite seating/waiting and circulation space adjacent to main entry
Reception	X		Reception desk for check-in/out and guest service
Concierge[1]	X		Optional concierge desk/area for guest service
Bell cart station	X	X	Area near the entrance vestibule for storage of bell carts.
Coffee bar[1]	X		Optional area for self-service coffee
Food service[1]	X	X	Optional small cafeteria-style food service for continental or limited menu self-service meals (includes service, dining, and prep/storage)
Service			Self-service serving line
Dining (seating)			Seating area
Prep/storage			Limited food prep/warming kitchen and food and dry goods storage
Retail food service[1]	X		Optional contract (retail) food service ranging from a small coffee kiosk to a full-service restaurant
Retail sales[1]	X		Optional area adjacent to reception for sale of small items such as sundries, candy, drinks, etc.
Luggage storage	X		Secure room adjacent to reception for storage of guest luggage
ATM[1]	X	X	Optional ATM kiosk
Registration machines[1]	X	X	Optional self-service registration kiosks.
Public toilets	X	X[1]	Public toilets
DSN Phones[1]	X		Optional area for DSN phones
Fitness room[1]	X	X	Optional, small, guest fitness room
Conference room[1]	X		Optional conference room
Business center[1]	X		Guest-use computers and office equipment
Study room[1]	X	X	Optional room(s) used by guests for small group study sessions, typically only at training installations
Guest laundry	X	X	Self-service guest laundry
Gear wash[1]	X	X	Optional area for personnel to wash equipment after field exercises
Guest bulk storage, Option 1[1]	X	X	Optional area for self-service guest storage of large, bulky items
Vending[1]	X	X	Optional self-service guest vending

Functional Program Area	Central	Satellite	Description
Ice	X	X	Self-service ice dispenser on each floor
Patio[1]	X	X	Optional outdoor space for picnic tables, seating, grills, etc.
Patio storage[1]	X	X	Only available with patio, provides storage for amenities, as needed based on climate
Guest corridors/ circulation	X	X	Access to guest rooms and remote services
Guest room[2]	X	X	Standard room with a combined living/sleeping area and private bath. See Table 4-1, 4-5.
Family/business suite (Suite)[2]	X	X	Suite with separate living and sleeping areas, a compact kitchen and private bath See Table4-3
Administration Services			
Lodging communications	X		IT/communications room including guest and staff Internet, television, and administrative file server.
Manager's office	X		Private office See Table5-29
Asst. manager[1]	X		Optional private office See Table 5-29
Front desk supervisor	X		Private office See Table5-29
Accounting office	X		A single office or up to 3-4 workstations depending upon operation size
Clerical	X		Workstations for clerical staff in an open office area See Table 5-31
Reservations[1]	X		Optional workstations for reservations staff in open office area See Table 5-31
Work space	X		Copier, printers, facsimile machines, work space, common files, and administrative storage See Table5-31
Cash room	X		Secure room where front desk agents reconcile shift cash functions and store cashier banks
Floor Support			
Janitor areas	X	X	Janitor closet on each floor or wing.
Housekeeping areas	X	X	Housekeeping support and supplies on each floor or wing
Utility rooms	X	X	Mechanical, electrical, communications, and sprinkler rooms located for efficient utility distribution
Back-of-House Support			
Training room[1]	X		Optional room for staff training
Training office[1]	X		Optional office and/or training material storage area
Central Janitor areas	X	X	Central janitor closet with additional supply storage See Table 5-38
Housekeeping manager	X	X	Private office
Housekeeping assistant[1]	X	X	Optional private office for large programs
Soiled linen storage	X	X	Separate storage from clean linens, adjacent to receiving or laundry

Functional Program Area	Central	Satellite	Description
Clean linen storage	X	X	Separate storage from soiled linens
Receiving	X	X	Service entrance/loading dock
Receiving/supply office[1]	X		Optional private office
Linen laundry[1]	X		Optional space with industrial-grade equipment, based on local service contract linen costs and availability
Supply/general storage areas	X	X	Storage and warehousing of facility supplies
Cleaning fluid storage	X	X	Separate storage for cleaning chemicals
Utility rooms	X	X	Central facility mechanical, electrical, communications, and sprinkler rooms
Guest bulk storage, Option 2[1]	X	X	Optional staff-access secure room for guest storage of large, bulky items
Break area	X	X	Staff break area with kitchenette and lockers
Staff toilets	X	X[1]	Staff facilities
Maintenance workshop	X		Includes limited storage and accommodates repair of small equipment and furnishings
Grounds equipment storage[1]	X		Optional space with direct exterior access for grounds and exterior building maintenance supplies and equipment
Service circulation	X	X	Separate stairs, corridors and elevators from guest circulation

[1] Optional space requiring approval of the agencies noted in Chapter 1, Contacts.
[2] The final number, mix and variations of room types will be determined in the planning stage. See Chapter 2 for more information.
[3] Specific design needs for each Functional Program Area may be described in Tables in Chapters 4 and Chapter 5.

CHAPTER 2 PLANNING AND PROGRAMMING

2-1 INTRODUCTION.

This chapter provides basic guidelines for planning and programming new lodging facilities and renovating existing facilities. The number of guest rooms, suites, guest support areas, and service areas at each site will vary depending on the mission, but standard plans and requirements will remain consistent. Renovations will follow this guidance as closely as possible, understanding that variances will be made on a case-by-case basis. The agencies noted in Chapter 1, Contacts, have programming and design latitude and decision making authority in the following areas: site selection and exterior architectural treatment.

2-2 SITE PLANNING.

Installation planning personnel will determine the appropriate site for a new LF or campus. The footprint and mass of a new LF is significantly greater than traditional dormitory-style facility configurations; therefore, appropriate and adequate site selection is critical. Coordinate site and building height requirements with fire department capabilities, DoDI 4165.57, and airfield restrictions (if applicable).

Determine the most appropriate and cost effective location for the LF/campus based on the following factors:

- Development potential, future expansion and adjoining land uses. Expansion of lodging facilities usually involves adding guest rooms. It is generally impractical to add onto an existing lodging facility. Therefore, if potential future expansion is identified during the programming stage, allow space in the site development plan for additional structures and size site utilities accordingly.

- Proximity to and capacity of recreational centers and community facilities such as fitness centers, dining facilities, postal service centers, Installation exchanges, commissaries, pedestrian circulation systems, bike paths, and mass transit routes. Balance the proximity to community services with the need for quiet and privacy.

- Proximity to a particular activity or site that the lodging facility serves, if applicable, also considering transportation resources and routes to those activities.

- Existing topography and landscape. Site selection should minimize the need for excessive grading.

- Available Installation infrastructure such as roads and drives, parking, landscape, utilities, and fire department access.

- Future demands placed on the capacity of supporting infrastructure and utilities.

- Facilities requiring demolition.
- Off-Installation communities and adjoining neighborhoods.

2-3 PROGRAMMING.

2-3.1 Programming Policy.

Information and guidance regarding work classifications, funds sources and approval levels for both appropriated fund (APF or MILCON) and non-appropriated fund (NAF) projects may be found in DoDI 1015.11, 1015.12, and 1015.15 and the following documents:

2-3.1.1 Army.

- AR 420-1
- AR 215-1

2-3.1.2 Navy and Marine Corps.

- OPNAVINST 11010.20H
- NAVFACINST 11010.45

2-3.1.3 Air Force.

- AFI 32-1021
- AFI 32-1022
- AFI 32-1023
- AFI 34-205
- AFI 34-246

2-3.2 Initial Project Scope.

The initial primary facility scope of a LF project shall be programmed using the standards and criteria contained this UFC and the following documents:

- Army Lodging Standard Design Criteria and Army Standards for Army Lodging
- UFC 2-000-05N (P-80)
- AFH 32-1084

The organizations provided in Chapter 1, Contacts, will provide the number and types of rooms based on usage data. Planning shall incorporate accessibility requirements in all common guest support areas. Allow space for guest support areas, back-of-house service areas, and site requirements. Replacement of existing support functions will be considered in the programming of a new facility.

2-3.3 Final Project Scope.

The final project scope will be based on the results of an independent assessment performed through the agencies identified in Chapter 1, Contacts. This assessment validates the site selection; determines the overall number of room types, support areas, guest services to be provided; and identifies any companion projects necessary to provide a complete and usable facility.

The facility space program will accommodate the following:

- Projected guest utilization based on official historical usage, non-availability certificates issued, and projected usage based on new or planned activities that will yield 80% average projected occupancy for the proposed facility/complex.
- ABA-accessible room count per Chapter 3, Accessibility
- Potential for retention and renovation of existing facilities
- Need for additions/alterations versus completely new construction projects
- Existing on-Installation community facilities and their potential for meeting current and future needs
- Additional requirements such as potential surge conditions, significant transient crew requirements, and historic long-term TDY and PCS commitments

2-3.4 Guest Room and Suite Sizing.

Comply with Table 2-1 for guest room and suite net area standards (net area as measured from interior finished wall to interior finished wall). Commands desiring a waiver from these absolute planning factors must submit a fully justified request, formatted as a normal congressional reprogramming action, and an economic analysis to the organizations provided in Chapter 1, Contacts.

TABLE 2-1. NET AREA STANDARDS FOR NEW CONSTRUCTION AND RENOVATION

Room Type	Minimum	Maximum
Guest Room	300 ft^2 (27.9 m^2)	325 ft^2 (30.2 m^2)
Suite	450 ft^2 (41.8 m^2)	606 ft^2 (56.3 m^2)

2-3.5 Support Space Sizing.

Support space sizing standards are provided in Appendix C of this UFC. Sample space programs are included to demonstrate how to calculate space requirements.

2-4 FUNDING/COST GUIDANCE.

Design these facilities with the objective of achieving the lowest life cycle cost over a 50-year period. The budget must support an appropriate and high-quality program and the performance requirements outlined in this UFC. The following information provides guidance on developing a budget that will support these goals.

2-4.1 Site Cost.

The project will fund outdoor passive and/or active use areas and/or site amenities as required to provide an attractive and usable facility that is competitive with comparable commercial facilities. These features must complement the architecture of the campus and include amenities such as walks, site lighting, landscaping, benches, trash receptacles, and fencing if used to screen equipment or dumpsters. Additional amenities such as barbecue grills and tables are permitted, but they are the funding responsibility of the Installation or the Activity/Major Command.

2-4.2 Other Design Cost Considerations.

2-4.2.1 Guest Room and Suite Sizing.

Guest rooms and suite usable space minimums in Table 2-1 cannot be changed due to budgetary constraints.

2-4.2.2 Signage.

The project budget shall include all interior and exterior facility directional signage, room and informational signage, and the freestanding exterior facility identification (monument) sign.

2-4.2.3 Furnishings Fixtures and Equipment.

Chapters 4 and 5 provide the breakdown of furnishings, fixtures and equipment (FF&E) for each space and indicate whether the items are contractor furnished/contractor installed (CFCI), i.e., included in the project construction contract, or government furnished/government installed (GFGI), i.e., not part of the construction contract. Some

items are also classified as government furnished/contractor installed (GFCI). Items included in the project construction contract may be funded by different sources depending on the Service and overall project funding approach, so confirm the interior design funding sources with the agencies identified in Chapter 1, Contacts, prior to finalizing the project budgets.

2-4.3 Additional Funding/Cost Guidance for NAF Projects.

If the LF project is a NAF project, additional special reporting and approval requirements must be followed. See DoDI 7700.18 for this guidance.

2-5 RENOVATION PLANNING.

Lodging renovations range from building and system upgrades to complete reconfiguration. The requirements and recommendations in this UFC apply to renovations. Some flexibility in complying with established guidance contained in this UFC is allowed for renovated facilities, but the facilities shall include the required spaces to the greatest extent feasible. Flexibility in design may be considered based on existing conditions and physical limitations such as construction type, location and character of load bearing walls and columns, and others.

CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL.

UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, sustainability, and safety. Use this UFC in conjunction with the criteria identified in 1-200-01.

3-2 ACCESSIBILITY.

Per DoD requirements, provide accessible rooms per Table F224.2 of the ABA Accessibility Standard for DoD facilities. Comply with DoD Memorandum, DoD Housing Inspection Standards for Medical Hold and Holdover Personnel for wounded warrior accessibility. This will require some ABA guest rooms to include direct access to an adjoining guest room.

3-3 STRUCTURE.

Coordinate column/wall spacing to limit awkward placement within larger public spaces.

3-4 ARCHITECTURE.

3-4.1 Attics.

Attic access is required, but restricted to LF personnel only. Storage capability in attic areas shall not be provided.

3-4.2 Exterior Design.

The building design shall comply with Command and Installation architectural standards and incorporate the local geographical and cultural environment. See Appendix B, Best Practices, for additional guidance.

3-4.2.1 Exterior Finishes.

Exterior finishes shall be durable and low-maintenance. Coordinate exterior colors and finishes with the interior design standards noted in Chapter 3, Interior Design, paragraph 3-4.3.

3-4.2.2 Windows/Natural Light.

Provide for the admission of natural light in the design of the facility window systems and in the design of the overall footprint and floor depth. Select furniture systems that maximize the admission of natural light into the facility. The goal should be to achieve the LEED® “Daylight & Views” points. In designing for natural light admission, coordinate with Chapter 3, Electrical Design, paragraph 3-5.4.

Comply with the following requirements:

- Use tight-fitting, insulated, commercial-grade windows that meet antiterrorism requirements per UFC 4-010-01. Light-duty residential grade windows are not acceptable.

- Analyze the cost and sustainability benefits of Energy Star labeled windows and low emissive (Low E) double pane glazing for increased thermal performance, ultraviolet retardation, and maximum light transmission. Qualifying products are listed on the Energy Star website. Provide these windows and glazing if the analysis supports.

- Size windows nominally between 10 and 15 percent of the floor area they serve.

- Maximize window size and area to increase the admission of natural light into guest rooms.

- Select windows that are compatible with the type of window coverings to be used to ease maintenance.

- Provide solid surface windowsills at all windows.

3-4.2.3 Exterior Doors.

Comply with the following requirements:

- All public area entrance doors shall meet force protection and accessibility construction standards minimum requirements per UFC 1-200-01, and will be a minimum of 36 in. (910mm) in width.

- Remote, non-guest exit doors shall be equipped with an alarm that sounds at the front desk when the doors are opened. This alarm shall be programmable to be operational at specific times of the day.

- Secondary guest entrances shall have electronic key card locks.

- Doors shall be fully weather-stripped; include a heavy-duty metal threshold to prevent drafts, dirt, water, and insect entry; and be thermally insulated.

- Exterior entrance service doors will be hollow metal with hollow metal frames.

- All doors require doorstops, and wall-mounted bumpers will be used where possible. Provide blocking in walls as required.

- See Interior Doors below for locking system requirements.

3-4.2.4 Roofing.

Unless the installation's architectural compatibility standards state otherwise, all lodging facilities shall have sloped standing-seam metal roofs. Cool roofs are required unless engineering analysis on its suitability negates its use in accordance with ACSIM Sustainable Design and Development Policy.

Provide protection against falling ice and snow for sloped roofs located over building entrances. Coordinate exterior locations of dryer vents and bath exhausts to minimize roof penetrations and reduce the visual impact on exterior elevations.

3-4.2.5 Building Signage.

Building signage shall provide clear directional and informational assistance. Mechanical, electrical and/or utility room doors must have identifying signage to match other building signage.

3-4.3 Interior Design.

Interior design and FF&E packages shall comply with the Service-specific branding concepts that provide the finish and color requirements for each space. The agencies noted in Chapter 1, Contacts, shall provide the latest branding concept standards. See Appendix B, Best Practices, for additional general guidance.

3-4.3.1 Interior Doors.

All interior door hardware throughout lodging facilities will be lever style. If possible, provide single hardware assembly for door closure and hold open operation.

If an electronic locking system is not already in use at other Installation lodging facilities, provide a complete system, including the reception desk. If an electronic locking system is in use at other Installation lodging facilities, match existing system. Assure that the statement of work for the locking system software selected for Installation will interface with the Property Management System. All doors will operate from this same locking system except doors accessing utility and service functions.

3-4.3.2 Interior Construction.

Provide blocking for all wall- or ceiling-mounted equipment and furnishings.

Built-in cabinets must be well constructed with sturdy hardware and meet the requirements of the Kitchen Cabinet Manufacturer's Association standards. Particleboard may not be used. All case goods and hardware will be coordinated with the Comprehensive Interior Design package for the project to ensure matching woods, stains, and finishes as best possible. In all cases, concealed hinges will be provided. Finishes must be able to withstand frequent cleaning and must coordinate with the other finish materials. Countertops shall be solid surface/solid composite plastics only. Where no water source is present, plastic laminate with hardwood or solid surface edging may be permitted with approval from the agencies identified in Chapter 1, Contacts.

3-4.3.3 Finishes.

Finishes should take into account the intended uses and be highly durable. They must meet the requirements listed in NFPA 101 and UFC 3-120-10.

Comply with the following requirements throughout the entire facility:

- In moist climates, do not cover the inside of exterior walls with impervious materials such as mirrors or vinyl wall coverings to help preclude mold development in the wall.

- Procure a high quality, easy to maintain, durable carpet that provides a long lasting appearance.

- For additional finish criteria in specific areas, see Chapters 4 and 5.

3-4.4 Acoustics.

Design the facility to provide a comfortable acoustical environment and provide comprehensive sound isolation and sound absorption measures for individual spaces as appropriate. Provide acoustical design to prevent sound from noisy spaces such as corridors, toilets, elevator machine rooms, and mechanical rooms from having negative impact on the adjacent spaces. Comply with the following:

- Isolate sound-generating mechanical equipment to minimize sound and vibrations from being transmitted through the building structure. Isolation methods include isolation hangers or other appropriate methods.

- Walls between living units, between living units and corridors, between living units and other spaces, and exterior walls of living units shall have a minimum sound transmission class (STC) of STC 54.

- Floor and ceiling assemblies shall be a minimum of STC 55 and have an impact isolation class (IIC) of at least 60.

- Telephone, cable television, convenience outlets, and mechanical ducts shall be staggered or otherwise designed to not compromise the acoustical integrity of wall, floor, or ceiling assemblies.

- Where fluorescent lamps are used, specify fluorescent lamp ballasts with a sound level rating ‘A’.

At a minimum, provide the required STC ratings identified above and the ratings in Chapter 5, Functional Data Sheets, for individual spaces. Use the “Suggested Design Values” STC ratings in UFC 3-450-01 as the basis for the sound design of partition, door and window assemblies. Utilize gypsum board wall “improvements” to increase the STC of gypsum board “Stud Type” partitions to achieve the project sound requirements. Unless noted otherwise extend the room partitions and seal to the

structure above for rooms that have a noise source such as, but not limited to, corridors, toilets, classrooms, training rooms, maintenance rooms, and mechanical rooms. Unless indicated in Chapters 4 and 5, STC ratings do not need to be field verified.

3-5 SERVICES.

3-5.1 Plumbing.

Comply with the following:

Provide for the installation of fixtures and associated amenities noted in Chapters 4 and 5, Specific Design Criteria.

Design plumbing systems to take advantage of stacking bathrooms and common wet walls for efficiency.

Exposed plumbing pipes are not permitted.

Copper piping shall be used for all supply lines. If PVC drainage pipe is used above public spaces, the area shall be insulated for sound control.

Provide shut-off valves at all fixtures.

Toilet and bath fixtures must match and be white in color.

All bathroom plumbing fixtures exposed (pipes, faucets, etc.) shall be first-line plated brass, manufactured by nationally known manufacturers.

All tubs and lavatories shall have pop-up-type waste stoppers. Rubber stoppers are not permitted.

Tub/shower valves shall be pressure balanced anti-scald type. Locate faucet, showerhead and controls on interior wall to allow for placement of plumbing access panel.

Provide filtered water lines for break area refrigerators with automatic icemakers.

Provide hose bibbs on exterior walls of each building at 100 ft. (30.5m) intervals and where indicated in Chapters 4 and 5; freeze proof as dictated by climatic conditions.

Central hot water domestic systems (gas if possible) will be specified for all projects to reduce costs and provide better service for guests. The minimum requirements are to allow for simultaneous use of 100% of the showers discharging (maintaining a pressure of 15psi at the showerhead). Minimum hot water storage will be sized to maintain flow under 100% shower discharge for a five-minute period (capacity will vary based on number of rooms). The heat exchangers within the calorifier will be capable of raising the contents from 50°F (10°C) to 149°F (65°C) in one hour. The temperature of the hot water as it leaves the hot water storage calorifier will be 140°F (60°C). Service Exception: The Army requires that a circulating pump or other approved in-line system

shall be installed to provide hot water to the guest room taps at 110°F (43°C), 75% diversity for 30 minutes (capacity will vary based on number of rooms).

3-5.2 Heating, Ventilating, and Air Conditioning (HVAC).

In order to minimize the possibility of mold or mildew, ensure the humid area criteria provisions in the core mechanical UFCs as defined in UFC 1-200-01 are followed when designing the HVAC system. Air Force HVAC systems shall be designed in accordance with ETL 04-3.

3-5.2.1 System Selection.

Selection of the HVAC system shall be based upon the lowest total life cycle costs: include initial costs, operating costs, energy costs, system maintenance and repair costs, and component replacement costs, if not expected to achieve the same life cycle of the systems under consideration.

Refer to Appendix B, Best Practices, for additional information and considerations in system selection. Comply with the following:

- If a geothermal heat pump system (GCHP) is being considered, the soil reports prepared during the design process shall include borings to the depth necessary to consider the use of a ground source heat pump. The cost of the drilling and installation of the pipe shall be considered in the economic analysis.

- In the selection of chilled water systems, the design of HVAC enclosures shall take into account the space needed for chillers to receive air to cool condenser coils and room for service. The enclosure design shall prevent large amounts of pollen and vegetation from clogging condenser coils, be appropriately located on the site, and be compatible with surrounding architecture and exterior design elements.

- Supply air and outside air (OSA) will be ducted to the sleeping rooms. Branch ducts will be equipped with balancing dampers. Do not place ductwork over the shower area, and ceiling space will not be used as return air plenums. Soffit areas in guest room and suite closets are good ductwork locations. Determine the amount of transfer/return air sound attenuation between the guest rooms and adjacent areas.

- For new construction, do not locate HVAC units in the ceiling.

- Coordinate the location of sensors and thermostats with location of furniture and artwork throughout the building.

3-5.2.2 Maintainability.

Maintainability of the system is critical to the continued quality of life of the occupants. Design access to the system to minimize disruption or inconvenience to LF guests and

maximize servicing efficiency. Air Force shall comply with ETL 01-1. In renovated facilities when HVAC units are located above the ceiling, ensure that filters, controls, drain pans, and condensate piping, control valves and coils are easily accessible for servicing and cleaning. Condensate piping must be equipped with traps and threaded clean-outs at the unit. Design drawings must detail these features including minimum clearances for maintenance and required force protection setback distances.

3-5.2.3 Ventilation.

Each guest room will be supplied continuously with conditioned outside air via a central ventilation system to meet the current ASHRAE Standard 62.1 (Service Exception: For Air Force facilities meet ASHRAE Standard 62.2-2010, table 4.1a) or as required for building pressurization, whichever is larger. Equip all branch ducts with accessible volume control dampers. The guest room or suite's HVAC unit's fan must run continuously. Operable windows are not permitted in guest rooms in view of the foregoing.

3-5.2.4 Bathroom Exhaust.

Bathrooms shall be equipped with a central exhaust system. Comply with the following:

- The exhaust system shall run continuously and be interlocked with the building supply air system. Ensure the system meets HVAC-Related Background Sound criteria for hotel rooms as listed in the latest ASHRAE Handbook – HVAC Applications. Service Exception: For Air Force facilities, guest bathroom exhaust shall meet ASHRAE Standard 62.2-2010, table 5.2 for continuous exhaust.

- Include a manual volume damper accessible from the space for proper balancing.

- Include a life cycle cost evaluation for utilizing heat recovery from the exhaust system to precondition ventilation air.

3-5.2.5 Guest Room HVAC Systems.

Individual HVAC systems shall not be used as the primary facility HVAC system to condition outside air. When guest rooms are equipped with individual HVAC systems, these systems will be ducted vertical fan units or heat pumps placed within designated mechanical closets or mechanical rooms equipped with lockable doors. If individual HVAC systems are used as a secondary system for the guest rooms in humid areas, they must be carefully designed to avoid mold and mildew.

3-5.2.6 Piping System.

Where centralized hot and chilled water are utilized, individual HVAC systems shall be connected to a centralized mechanical system by a four-pipe hot water and chilled water distribution system to provide positive space control.

Where GCHPs are used, evaluate the need for a backup heating system (such as an auxiliary boiler) and towers in the loop based on site location.

3-5.2.7 Perimeter Fin Tube Heating.

In OCONUS areas or as applicable per local code where perimeter fin tube heating is utilized, provide temperature control for each zone.

3-5.2.8 Laundry Areas.

Design straight-run venting of dryers to avoid lint clogs. Dryer venting must be exhausted away from windows and exterior balcony areas.

3-5.3 Fire Protection and Life Safety.

Fire Protection shall be in accordance UFC 3-600-01. Fire sprinkler heads shall be concealed in occupied and living spaces.

Provide carbon monoxide detection in accordance with NFPA 720 and as part of the installed addressable fire alarm and emergency notification system in all LFs that contain carbon-based fuel burning systems. Comply with the following:

- Provide a separate carbon monoxide alarm (voice message) via the fire alarm system.
- Locate carbon monoxide detectors in the immediate vicinity of the bedroom portion of the guest rooms and suites.
- Locate carbon monoxide detectors on the ceiling in the same room as all permanently installed fuel-burning appliances.
- Transmit a separate carbon monoxide alarm signal to the Installation's Receiving Station.
- Transmit a separate carbon monoxide trouble and supervisory signals to the Installation's Receiving Station.

3-5.4 Electrical Design.

Surface-mounted conduit or wire-mold shall not be used in any guest rooms, public spaces or administrative spaces. General outlets required should comply with UFC 3-520-01. Comply with the following LF-specific requirements:

3-5.4.1 Lighting.

See Chapters 4 and 5, Functional Data Sheets for light level and control requirements that are exceptions or in addition to standard requirements. For the guest rooms and suites, adapt the Residential Housing sections of UFC 3-530-01 as modified by Chapters 4 and 5 of this UFC.

3-5.4.2 CCTV.

Provide the infrastructure for a CCTV system. The agencies identified in Chapter 1, Contacts, will determine funding requirements for the additional components required to develop a complete system. See Chapters 4 and 5, Functional Data Sheets for monitor and camera locations.

3-5.4.3 Telecommunication Systems.

See Chapters 4 and 5, Functional Data Sheets, for jack locations. Where “house phones” are indicated, these shall connect to the front desk or dedicated administrative areas only. Allow for easy, future upgrades to data and communications cables and allow for fiber optic cables for communications. Provide cellular repeaters as needed throughout the facility to ensure adequate mobile phone service.

Provide Internet access through a business class wired and WiFi network system throughout all spaces indicated in Chapters 4 and 5. The system must comply with DoDI 8420.01. At a minimum the system shall include multiple SSID, VLAN tagging, SNMP for remote management and monitoring with Power Over Ethernet for flexible deployment and password protection. Army should comply with Technical Criteria for the Installation Information Infrastructure Architecture (I3A).

3-5.4.4 Television Systems.

See Chapters 4 and 5, Functional Data Sheets, for outlet locations.

3-5.4.5 Electronic Security Systems (ESS).

See Chapters 4 and 5, Functional Data Sheets, for locations.

3-6 SITE WORK.

Organize the site to be compatible with the site planning and style of adjacent existing structures. Locate the building to reflect local climatic conditions. For example, provide protection from prevailing winds and glare and orient operable windows to take advantage of summer breezes. Locate the building to take advantage of passive solar heating and daylighting.

3-6.1 Site Circulation and Parking.

Comply with UFC 3-210-02. Provide guest access to lodging facilities from secondary (collector) streets to minimize the congestion associated with main arterial streets.

Where possible, divide main entrances with landscaped traffic medians between entry and exit lanes. Because of the high volume of traffic using the entrances, the minimum width of non-divided entry roads will be 24 ft. (7.3m).

3-6.1.1 Emergency and Service Vehicles.

Design access drives and parking areas to accommodate service vehicles. Provide access to fire protection vehicles in accordance with UFC 3-600-01 and UFC 4-010-01. Obtain width, weight, and turning radii of fire fighting vehicles from the Installation fire department.

3-6.1.2 Parking.

Provide a minimum of .5 parking spaces per guest room. Parking spaces shall be 10 ft. wide (3.1m) minimum. In addition to standard guest parking, provide a minimum of three short-term check-in parking spaces at central facilities. For programs with more than 200 rooms, provide a check-in space at the central facility for 1.5% of all guest rooms. As an option, identify each check-in space with a sign. Additional visitor parking with the exception of accessible parking is not required, but may be an option based on local requirements.

Provide one staff parking space for each daytime lodging staff person. Staff parking shall be separated from guest parking. Based on site size and layout, consider providing an optional sign to indicate staff-only parking with close access to the staff entrance. Parking areas will be sized to local conditions.

3-6.1.3 Pedestrian Access.

All sidewalks and walkways shall be a minimum of 6 ft. (1.8m) wide. Design and grade sidewalks to provide barrier-free access to the first floor of all lodging facilities and to any associated outdoor use areas. In addition to accessibility requirements, provide ramps and curb cuts throughout to accommodate rolling luggage and other moving needs. Provide connections to other functional areas of the Installation with pedestrian circulation systems.

3-6.2 Site Development.

Well-designed site amenities enhance the visual experience of a LF campus and complete the lodging project. The landscape architect shall coordinate with the architect and interior designer to ensure smooth transitions are made from within the building to the outdoors and vice versa. Provide effective transitions by incorporating building materials, colors, and design details into the site design and amenities. Also coordinate paving materials, signage and site furnishings. See Appendix B, Best Practices, for additional guidance.

3-6.2.1 Fencing.

Any fencing used as a screening material shall be compatible with the lodging campus and surrounding architecture, comply with Installation standards, and will be

accomplished with project funds. Fencing around the perimeter of the site, if desired, will be the responsibility of the Installation or Activity/Major Command.

3-6.2.2 Site Furniture.

Select site furniture that is in harmony with the architectural style and complements the building. Place the site furniture to help organize the outdoor spaces and to maximize usability.

3-6.2.3 Exterior Signage.

Signage includes the freestanding exterior facility identification (monument) sign and required site signage, including parking and street signage. All signage will be in accordance with the Installation signage program. The monument sign and building identification signage shall include the Service-specific appropriate branding styles and logos.

3-6.3 Drainage and Landscaping.

Comply with UFC 3-201-02 and UFC 3-210-10. See Appendix B, Best Practices, for additional guidance on landscaping specific to LFs.

3-6.4 Storm Water Management/ Low Impact Development.

Comply with UFC 3-210-10. See Appendix B, Best Practices, for additional guidance specific to LFs.

CHAPTER 4 SPECIFIC DESIGN CRITERIA – GUEST ROOMS AND SUITES

4-1 INTRODUCTION.

This chapter identifies the specific design needs for the guest rooms and suites. Sizing guidance for these rooms is provided in Chapter 2, Programming.

Design criteria are provided in a standard Functional Data Sheet (FDS) table format that generally follows the Uniformat II/Work Breakdown Structure. The Interior Construction/Built-in Equipment category includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window treatments, laundry machines, and retractable overhead screens. Furnishings and equipment are provided in separate tables for rooms and suites. Unless noted otherwise, finishes and features included in the FDS tables represent the required minimums.

4-2 GUEST ROOMS.

4-2.1 Design Criteria.

Table 4-1 identifies the specific design needs for the guest room, including its variations.

TABLE 4-1. GUEST ROOMS

Description/ Usage	The guest room includes combined living/work and sleeping areas and a private bathroom and can include the following variations: • an extended-stay studio suite version that has basically the same layout but trades closet space for a small pre-fabricated kitchenette • a pet-friendly version that has different finishes
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Entry doors shall be self-closing, solid core wood a minimum of 36-in (915 mm) wide with a decorative face, automatic electronic lock, swing bar door guard, deadbolt, and 180-degree one-way viewer. Provide a second viewer at the appropriate height in ABA rooms. Provide inoperable windows on as much of the exterior wall as possible. Provide full-height sliding closet doors with a header track and a floor track mounted directly to the floor. Opening hardware shall be integral with the frame.
Interior Construction/ Casework	Provide a ceiling fan with integral low-profile light and combined light dimmer and speed control. Provide closet shelf and hanging rod. Extended-stay studio suites include a prefabricated kitchenette unit.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished gypsum board. Provide vinyl corner guards on all exposed corners to 48 in (1220 mm) above the base. **Floor.** Commercial grade (heavy wear classification) carpet and pad. For pet-friendly rooms, provide porcelain tile flooring, commercial wood-grain vinyl or linoleum sheet flooring and base throughout. **Base.** Stained or painted wood or carpet. **Ceiling.** Painted gypsum wallboard.

TABLE 4-1. GUEST ROOMS

Plumbing	See Table 4-5 for bathroom plumbing requirements. For extended-stay studio suites, provide hot and cold water to the kitchenette unit.
HVAC	Provide a system per Chapter 3, General, and HVAC. Room HVAC systems will be standardized with electronic sensors or key card readers regulating temperature controls. Individual climate control must be provided and located within each guest room. Limit individual thermostat controls to the range of 65 to 78 F (18 to 26 C) degrees.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide outlets for all equipment. Provide a quad outlet at the desk and at least one of the two nightstands to power guest's equipment such as computers and chargers. Provide a minimum of one outlet in an easily accessible location for use with an ironing board/iron. Provide individual circuits for each guest room.
Lighting	Provide system per Chapter 3, General, and Lighting. In addition, provide backlit wide rocker switches at room entrance and bathroom. Task lighting provided by table or wall fixtures at the bed, desk and lounge seating shall provide adequate directional lighting for reading, typically 30-40 fc (325-430 lux).
Communication	**Telephone.** Provide one jack (ganged with data in single box) at the nightstand, one jack (ganged with data in single box) at the desk, and one jack at the CATV outlet location. Label each jack "phone." **Data.** Provide one jack (ganged with telephone in single box) at the nightstand and one jack (ganged with telephone in single box) at the desk. Label each jack "data port." Provide Wi-Fi service throughout the room. **CCTV.** None required. **CATV.** Provide an outlet at the TV location. **Security.** Door electronic card key access reader.
Acoustics	Provide acoustical separation per Chapter 3, Acoustics.
Special Requirements	Locate downlights and sprinkler heads such that they are not within 12 in (305 mm) of the sweep of the ceiling fan blades. Provide transition strips where different floor finishes meet.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

4-2.2 Furnishings, Fixtures and Equipment.

Coordinate FF&E packages with the interior designer and follow the requirements noted in Chapter 3, Interior Design. To assist planners and designers, Table 4-2 provides the general types of FF&E by Service for each space and indicates whether the item is CFCI, GFGI, or GFCI (F/I).

TABLE 4-2. GUEST ROOM FF&E

Army		Navy		Air Force	
FF&E	**F/I**	**FF&E**	**F/I**	**FF&E**	**F/I**
Queen bed	GFGI	Queen bed[1]	GFGI	Queen bed w/ bed box	GFGI
2 nightstands	GFGI	2 nightstands	GFGI	2 30-in-wide (760-mm) 3-drawer bedside chests	GFGI
2 nightstand lamps	GFGI	2 nightstand lamps	GFGI	2 nightstand lamps	GFGI
TV armoire w/drawers	GFGI	4-drawer dresser	GFGI	N/A	
Flat panel television	GFGI	Flat panel TV	GFGI	Flat panel TV (wall-mount)	GFGI
DVD player	GFGI	N/A		N/A	
Desk	GFGI	Desk	GFGI	Desk	GFGI
Desk chair	GFGI	Desk chair	GFGI	Desk chair	GFGI
Desk lamp	GFGI	Desk lamp	GFGI	Desk lamp w/ outlet	GFGI
Lounge chair	GFGI	Lounge chair	GFGI	Lounge chair(s) w/ ottoman(s)	GFGI
Window treatments	GFGI	Window treatments	GFGI	Window treatments	GFGI
Artwork	GFGI	Artwork	GFGI	Artwork	GFGI
Under counter refrigerator	GFGI	Under counter refrigerator	GFGI	5.3 ft^3 (.15m^3) Microfridge	GFCI
Telephone	GFGI	Telephone	GFGI	Telephone	GFGI
Ironing board, iron	GFGI	Ironing board, iron	GFGI	Ironing board, iron	GFGI
Ironing board caddy	CFCI	Ironing board caddy	GFGI	Ironing board caddy	GFGI
Full-length mirror	GFGI	Full-length mirror	GFGI	Full-length mirror	GFGI
Safe w/ pedestal	CFCI	Safe w/ pedestal	GFGI	Safe w/ pedestal	GFGI
Microwave	GFGI	Microwave	GFGI	Microwave (incl w/ microfridge)	GFGI
N/A		Coffee pot	GFGI	Coffee pot	GFGI
N/A		Alarm clock	GFGI	Alarm clock	GFGI
N/A		Ice bucket	GFGI	Ice bucket	GFGI
N/A		Luggage rack	GFGI	Luggage rack	GFGI
N/A		Wastebasket	GFGI	Wastebaskets	GFGI

[1] For Navy facilities when mission essential requirements dictate, provide two double beds and two separate and lockable closets/lockers for ranks of E-6 and below.

4-3 SUITES.

4-3.1 Design Criteria.

Table 4-3 identifies the specific design needs for the suite.

TABLE 4-3. SUITE

Description/ Usage	The suite includes separate and distinct living/work and sleeping areas, a kitchenette, and a private bathroom.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Entry doors shall be self-closing, solid core wood a minimum of 36-in (915 mm) wide with a decorative face, automatic electronic lock, swing bar door guard, deadbolt, and 180-degree one-way viewer. Provide a second viewer at appropriate height in ABA rooms. Provide inoperable windows on as much of the exterior wall as possible. Provide full-height sliding closet doors with a header track and a floor track mounted directly to the floor. Opening hardware shall be integral with the frame.
Interior Construction/ Casework	Provide a ceiling fan with integral low-profile light and combined light dimmer and speed control. Provide closet shelf and hanging rod. In PCS facilities, provide built-in shelving per the standard floor plan, which accommodates the additional storage requirements for longer stays. At the kitchenette, provide a solid-surface counter with base and upper cabinets. **Army** suites include a prefabricated kitchenette unit. **Air Force** suites include a ventless laundry washer/dryer combination.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished gypsum board. Provide vinyl corner guards on all exposed corners to 48 in (1220 mm) above the base. At the kitchenette, provide a solid-surface or ceramic tile backsplash. **Floor.** Commercial grade (heavy wear classification) carpet and pad. At the kitchenette, provide porcelain tile with a dark-colored epoxy grout and matching base. **Base.** Stained or painted wood or carpet. **Ceiling.** Painted gypsum wallboard.
Plumbing	Provide an under-mount stainless steel kitchen sink with a removable trap and drain plug. For **Army** suites, provide service to the prefabricated kitchenette unit. For **Air Force** suites, provide service to laundry washer/dryer combination. See Table 4-5 for bathroom plumbing requirements.
HVAC	Provide a system per Chapter 3, General, and HVAC. Room HVAC systems will be standardized with electronic sensors or key card readers regulating temperature controls. Individual climate control must be provided and located within both the bedroom and living areas. Limit individual thermostat controls to the range of 65 to 78 F (18 to 26 C) degrees.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide power to all equipment. Provide a quad outlet at the desk and at least one of the two nightstands to power guest's equipment such as computers and chargers. Provide a minimum of one outlet in an easily accessible location for use with an ironing board/iron. Provide individual circuits for each suite.

TABLE 4-3. SUITE

Lighting	Provide system per Chapter 3, General, and Lighting. In addition, provide backlit wide rocker switches at suite entrance, bedroom entrance, and bathroom. Task lighting provided by table or wall fixtures at the bed, desk and lounge seating shall provide adequate directional lighting for reading, typically 30-40 fc (325-430 lux).
Communication	**Telephone.** Living area—Provide one jack (ganged with data in single box) at the dining counter/table, one jack (ganged with data in single box) at the desk, and one jack at the CATV outlet location. Bedroom—Provide one jack (ganged with data in single box) at the nightstand and one jack (ganged with data in single box) at the dresser/TV area. Label each jack "phone." **Data.** Living area—Provide one jack (ganged with telephone in single box) at the dining counter/table and one jack (ganged with telephone in single box) at the desk. Bedroom—Provide one jack (ganged with telephone in single box) at the nightstand and one jack (ganged with telephone in single box) at the dresser/TV area. Label each jack "data port." Provide Wi-Fi service throughout the suite. **CCTV.** None required. **CATV.** Provide outlets at the two TV locations: One in the bedroom and one in the living area. **Security.** Door electronic card key access reader.
Acoustics	Provide acoustical separation per Chapter 3, Acoustics.
Special Requirements	Locate downlights and sprinkler heads such that they are not within 12 in (305 mm) of the sweep of the ceiling fan blades. Provide transition strips where different floor finishes meet. For **Air Force** ventless laundry washer/dryer combination, ensure adequate air circulation around the unit for heat dissipation and to accommodate maintenance. Ventless dryer does not need to be located on an exterior wall.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

4-3.2 Furnishings, Fixtures and Equipment.

Coordinate FF&E packages with the interior designer and follow the requirements noted in Chapter 3, Interior Design. To assist planners and designers, Table 4-4 provides the general types of FF&E by Service for each space and indicates whether the item is CFCI, GFGI, or GFCI (F/I).

TABLE 4-4. SUITE FF&E

Army		Navy		Air Force	
FF&E	**F/I**	**FF&E**	**F/I**	**FF&E**	**F/I**
Queen bed	GFGI	Queen bed	GFGI	Queen Bed w/ bed box	GFGI
2 nightstands	GFGI	2 nightstands	GFGI	2 30-in-wide (760-mm) 3-drawer bedside chests	GFGI
2 nightstand lamps	GFGI	2 nightstand lamps	GFGI	2 nightstand lamps	GFGI
TV armoire w/drawers	GFGI	N/A		N/A	
Dresser/wardrobe	GFGI	6-drawer dresser	GFGI	N/A	
2 flat panel televisions	GFGI	2 Flat panel TVs	GFGI	2 Flat panel TVs	GFGI
2 DVD players	GFGI	DVD Player	GFGI	DVD player	GFGI
Desk	GFGI	Desk	GFGI	Desk	GFGI
Desk chair	GFGI	Desk chair	GFGI	Desk chair	GFGI
Desk lamp	GFGI	Desk lamp	GFGI	Desk lamp w/ outlet	GFGI
Sleep sofa	GFGI	2-cushion sofa	GFGI	Sofa (2 or 3 cushion)	GFGI
Coffee table	GFGI	Coffee table	GFGI	Coffee table	GFGI
34-in (865mm) round table	GFGI	4-top dining table	GFGI	N/A	
3 small chairs	GFGI	4 small dining chairs	GFGI	N/A	
End table	GFGI	End table	GFGI	End table	GFGI
Floor lamp	GFGI	Floor lamp	GFGI	Floor lamp	GFGI
Table lamp	GFGI	Table lamp	GFGI	Table lamp	GFGI
Window treatments	GFGI	Window treatments	GFGI	Window treatments	GFGI
N/A		Lounge chair	GFGI	Lounge chair w/ ottoman	GFGI
2 telephones	GFGI	2 telephones	GFGI	2 telephones	GFGI
Ironing board, iron	GFGI	Ironing board, iron	GFGI	Ironing board, iron	GFGI
Ironing board caddy	CFCI	Ironing board caddy	GFGI	Ironing board caddy	GFCI
Artwork	GFGI	Artwork	GFGI	Artwork	GFGI
Safe w/ pedestal	CFCI	Safe w/ pedestal	GFGI	Safe w/pedestal	GFGI
Full-length mirror	GFGI	Full-length mirror	GFGI	Full-length mirror	GFGI
N/A		Microwave	GFGI	Microwave (incl w/ Microfridge)	GFGI
N/A		Coffee pot	GFGI	Coffee pot	GFGI
N/A		Alarm clock	GFGI	Alarm clock	GFGI
N/A		Ice bucket	GFGI	Ice bucket	GFGI
N/A		Luggage rack	GFGI	Luggage rack	GFGI
N/A		Wastebasket	GFGI	Wastebasket	GFGI
N/A		Under counter refrigerator	GFGI	5.3 ft3 (.15m3) microfridge	GFGI

Army		Navy		Air Force	
FF&E	**F/I**	**FF&E**	**F/I**	**FF&E**	**F/I**
N/A		Toaster	GFGI	N/A	
N/A		Utensils	GFGI	N/A	
N/A		Soap dish	GFGI	N/A	
N/A		N/A		Washer/dryer combined	GFCI

4-4 GUEST BATHROOMS.

Guest bathrooms are similar in configuration and amenities regardless of location in a guest room or a suite. Suite bathrooms may be a little larger, but not significantly. Provide the requisite number of ABA-compliant bathrooms in all room configurations.

Table 4-5 identifies the specific design needs for the guest bathroom.

TABLE 4-5. GUEST BATHROOMS

Description/ Usage	Lavatory, water closet, shower/tub, and associated amenities.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door, 36 in. (915mm) wide minimum. No windows required.
Interior Construction/ Casework	Provide a minimum 36-in wide (915mm) solid surface counter top with 4-in. (100 mm) back/side splashes, a 6-in. (150 mm) deep toiletry shelf, and integral soap holder. Provide a minimum of 9 in (230mm) of clear vanity space on both sides of the sink. In PCS facilities, provide a base cabinet with an integral tissue box holder, which accommodates additional storage needs. In other facilities, base cabinets and other under-counter storage are optional. Provide towel bars at the vanity and at the shower/tub, a door-mounted robe hook, toilet tissue dispenser, screw-in curved shower curtain rod, and a wall-mounted hair dryer at the vanity. Shower doors shall not be used. Provide a minimum 36-in-wide (915mm), mirror over the vanity. Provide a hair dryer mount. Coordinate with the agencies identified in Chapter 1, Contacts, to determine if a hard-wired hair dryer is to be provided or if it will be FF&E (see special requirements below).
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished mold-resistant gypsum wallboard. Provide a mud-set, one-piece full-height, solid-surface tub/shower surround with 2 recessed soap dishes. **Floor.** Mud set, non-slip, commercial-grade porcelain tile with epoxy grout. **Base.** Porcelain tile. **Ceiling.** Scrubable eggshell or semi-gloss paint (with mold inhibitor) on mold-resistant gypsum wallboard.
Plumbing	Provide a minimum 18-in. (455 mm) integral lavatory; a floor-mounted, tank-type, elongated, water saver water closet with full seat and lid; and a full-size shower with an entry curb sloping to a floor drain. The shower head shall be height adjustable over a wide range. A tub is optional and if provided shall be a cast-iron 60-in. (1525 mm) bathtub with a non-slip surface.
HVAC	Provide a system per Chapter 3, General, and HVAC. In addition, provide a minimum of eight air changes per hour and negative pressure. **Service Exception:** For Air Force, provide a system per Chapter 3, General, and HVAC, and negative pressure.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide a dedicated circuit for the hair dryer and size for a 1600-watt unit. Coordinate with the agencies identified in Chapter 1, Contacts, to determine if hair dryer will be hard-wired or a plug-in type.

TABLE 4-5. GUEST BATHROOMS

Lighting	Provide system per Chapter 3, General, and Lighting. Strategically locate light sources at the vanity to illuminate the occupant's face while eliminating harsh shadows on the face. Coordinating the vanity and other room surface reflectivity characteristics with the lighting design can assist this goal. Provide a recessed ceiling light fixture in the shower area.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	Provide transition strips where different floor finishes meet. If wallcoverings are used, seal wallcovering edges at ceiling and base with a clear caulk. ABA-compliant bathrooms will include a roll-in shower with a full-width trench drain along the back wall. If the hair dryer is not hard-wired (per Interior Construction) provide a 1600-watt hair dryer as FF&E.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

CHAPTER 5 SPECIFIC DESIGN CRITERIA – SUPPORT AND ADMINISTRATION

5-1 INTRODUCTION.

This chapter identifies the layout, adjacencies and specific design needs for the public, administrative, and support spaces. These spaces are broken down into guest services, administrative services, floor support, and back-of-house support as indicated in Table 1-1.

Design criteria are provided in the standard FDS table format that generally follows the Uniformat II/Work Breakdown Structure. The Interior Construction/Built-in Equipment category includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window treatments, laundry machines, and retractable overhead screens. Furnishings and equipment are not included in the FDS but are provided in Table 5-52. Unless noted otherwise, finishes and features included in the FDS tables represent the required minimums.

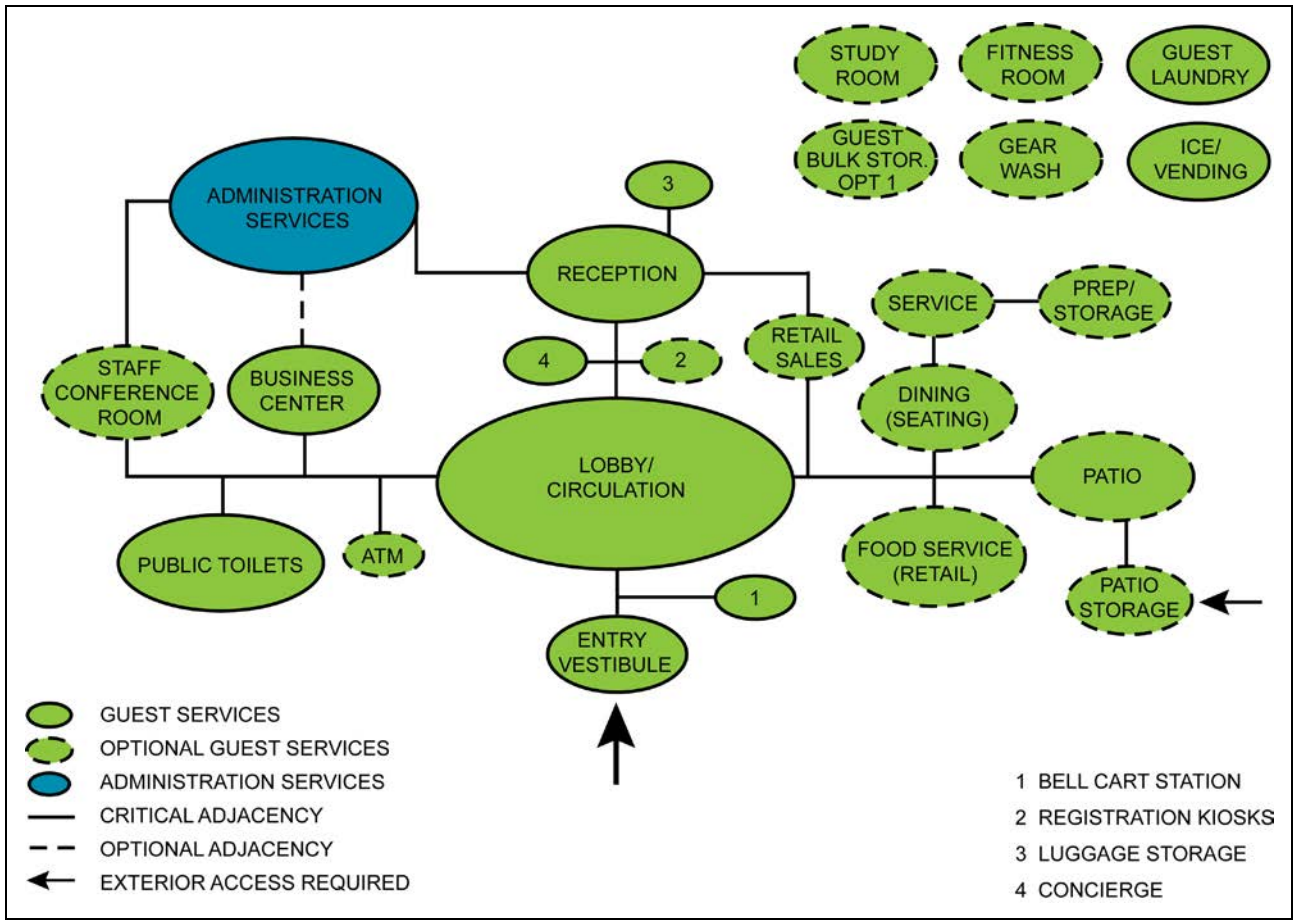
5-2 GUEST SERVICES.

Guest services represent all the public guest spaces of the facility. Public spaces for guest services are critical to the quality level of the guest experience. Most of these spaces are either located in or around the central lobby area or are distributed among the guest rooms and suites.

5-2.1 Guest Services Layout.

Figure 5-1 indicates the acceptable relative adjacencies of the guest services spaces.

FIGURE 5-1. GUEST SERVICES ADJACENCY DIAGRAM



5-2.2 Guest Services Design Criteria.

Tables 5-1 through 5-25 provide the guest services specific design criteria in the FDS format. Table 5-52 provides the FF&E for these spaces.

TABLE 5-1. COVERED ENTRY

Description/ Usage	This is the primary entrance for guests and visitors.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	NA.
Interior Construction/ Built-in Equipment	NA
Finishes	**Floor.** Paved.. **Ceiling.** Painted exposed structure.
Plumbing	None required.
HVAC	NA
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	NA.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	
Acoustics	No special provisions required.
Special Requirements	NA
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	NA

TABLE 5-2. ENTRANCE VESTIBULE

Description/ Usage	This is the primary entrance for guests and visitors.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Antiterrorism-compliant automated glass doors with infrared sensor operation.
Interior Construction/ Built-in Equipment	Provide a recessed or lay-down walk-off mat.
Finishes	**Walls.** Aluminum store front glazing system at front and back at a minimum. **Floor.** Stone or porcelain tile. **Base.** Match floor. **Ceiling.** Painted exposed structure or gypsum wall board.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** If inner doors will be locked during non-business hours, provide a house phone or intercom. **Data.** None required. **CCTV.** Provide outlets for full camera coverage of the vestibule and exterior entrance. **CATV.** None required. **Security.** If doors will be locked during non-business hours, provide an electronic card key access reader locking door.
Acoustics	No special provisions required.
Special Requirements	Provide an airlock as required by local climate. If the facility includes a reception desk, ensure desk is visible from the entrance and vice versa.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-3. CENTRAL LOBBY

Description/ Usage	The central lobby provides a comfortable seating/waiting area near or directly adjacent to the main entrance and open-feeling circulation between reception and guest services. Along with those spaces, this area serves as the interior architectural focal point of the facility and should feel warm and inviting.
Ceiling Ht.	10 ft. (3.1m) minimum over open areas. Vary the ceiling height to help define spaces and coordinate with other lobby and guest service areas.
Windows/Doors	Provide windows or glazed storefront on at least one wall of the entire lobby/guest services area.
Interior Construction/ Built-in Equipment	Provide built-in features such as planters, seating, a fireplace, and railings to enhance the design and define the areas. Provide vinyl corner guards. Provide wall or ceiling TV mount(s).
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Also see Chapter 3, Interior Design, for wall material guidance. **Floor.** Stone or porcelain tile and inset commercial-grade carpet and pad. Tile shall have .125-in (3 mm) grout joints. **Base.** Stained wood or stone/tile to match floor. **Ceiling.** Painted exposed structure or gypsum wall board with dropped soffits to define areas.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting. 20 fc (215 lux) general ambient and 50 fc (540 lux) at the seating area. Coordinate the lighting and interior design. Use recessed compact fluorescent downlights for general lighting with cove, wall sconces, decorative pendant, chandelier, or other indirect lighting as accents.
Communication	**Telephone.** House phone. **Data.** Provide a minimum of one jack at the seating area and Wi-Fi service throughout the lobby. **CCTV.** Provide outlets for full camera coverage. **CATV.** As an option, provide one outlet for a wall- or ceiling-mounted TV. **Security.** None required.
Acoustics	Provide features to minimize reverberation time and control noise. Provide noise attenuation measures to mitigate acoustical problems resulting from mechanical systems, plumbing systems, and vibration transmitted through the facility structure.
Special Requirements	Develop a professional wayfinding plan that is coordinated with the interior design and provides directions to guest services, public amenities, and guest rooms by room number.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-4. SATELLITE LOBBY

Description/ Usage	The satellite lobby provides a seating/waiting area near or directly adjacent to the main entrance and an enhanced circulation space that gives a sense of welcome and entry to the minimum-service satellite facilities.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	Provide vinyl corner guards.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Also see Chapter 3, Interior Design, for wall material guidance. **Floor.** Porcelain tile or other resilient flooring. **Base.** Coordinate with floor finish. **Ceiling.** Painted exposed structure or gypsum wall board with dropped soffits to define areas.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting. 20 fc (215 lux) general ambient and 50 fc (540 lux) at the seating area. Coordinate the lighting and interior design.
Communication	**Telephone.** As an option, provide a house phone. **Data.** Provide a minimum of one jack at the seating area and Wi-Fi service throughout. **CCTV.** Provide outlets for full camera coverage. **CATV.** None required. **Security.** None required.
Acoustics	Provide features to minimize reverberation time and control noise. Provide noise attenuation measures to mitigate acoustical problems resulting from mechanical systems, plumbing systems, and vibration transmitted through the facility structure.
Special Requirements	Develop a professional wayfinding plan that is coordinated with the interior design and provides directions to guest services, public amenities, and guest rooms by room number.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-5. RECEPTION

Description/ Usage	Reception accommodates check-in/check-out, other guest services and the administrative functions of the front desk staff.
Ceiling Ht.	8 ft. (2.4m) minimum. Vary the ceiling height to help define spaces and coordinate with other lobby and guest service areas.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	The reception/front desk will be custom designed for each project, ABA-compliant, and coordinated with the interior design of the entire lobby area. The transaction top and credenza work surfaces shall be solid surface material and the under counter areas shall be enclosed with built-in cabinetry. Coordinate the design with all power, data, and telephone wiring systems and ensure adequate ventilation of computer equipment. See Chapter 3, Interior Design, for overall design, color and finish guidance.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Also see Chapter 3, Interior Design, for wall material guidance. **Floor.** Match lobby in front of counter and provide commercial grade carpet and pad behind the counter. **Base.** Coordinate with floor finish. **Ceiling.** Gypsum wall board with dropped soffits over the counter to define areas.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting. 30 fc (325 lux). Use recessed compact fluorescent down lights for soffit and general illumination behind counter.
Communication	**Telephone.** Provide two jacks per workstation. **Data.** Provide two jacks per workstation. **CCTV.** Provide outlets for camera coverage of front and back of counter. Provide for monitors viewable from behind the counter but not in front. **CATV.** None required. **Security.** Provide a duress alarm at each workstation with direct connection to the supporting police/security authority.
Acoustics	No special provisions required.
Special Requirements	Ensure easy access to a facsimile machine and a photocopier by the front desk staff. Door bell at receiving will sound here.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-6. CONCIERGE

Description/ Usage	Optional area for a staff member to meet with guests and provide assistance on transportation and local activities.
Ceiling Ht.	Coordinate with central lobby.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Coordinate with central lobby. **Floor.** Coordinate with central lobby. **Base.** Coordinate with central lobby. **Ceiling.** Coordinate with central lobby.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide one jack. **Data.** Provide one jack. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	The concierge desk should be clearly visible from the reception area and lobby.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-7. BELL CART STATION

Description/ Usage	Provides storage for bell carts when not in use.
Ceiling Ht.	Coordinate with central lobby.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Coordinate with central lobby. Provide impact resistant wall board up to 48 in (1220 mm) above finished floor and provide wall bumper guards. **Floor.** Coordinate with central lobby. **Base.** Coordinate with central lobby. **Ceiling.** Coordinate with central lobby.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	This area should be clearly visible from the exterior entrance and the reception area.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-8. COFFEE BAR

Description/ Usage	The optional coffee bar provides a small area for self-service coffee directly off the central lobby in facilities without other food service options.
Ceiling Ht.	Coordinate with central lobby.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	Solid-surface counter with lockable base cabinets. Coffee machine.
Finishes	**Walls.** Coordinate with central lobby. **Floor.** Hard surface flooring that is coordinated with central lobby. **Base.** Coordinate with central lobby. **Ceiling.** Coordinate with central lobby.
Plumbing	Provide a connection to a coffee machine.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide a minimum of one counter-height duplex outlet.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-9. FOOD SERVICE – SERVICE

Description/ Usage	The optional food service area is a small, self-service area that is typically limited to breakfast. It is directly off of the lobby and may act as an extension of the entire lobby area. It is broken down into three sub-areas: Service where the food is served, dining where patrons sit to eat, and prep/storage where the food is prepared. This table describes the service area.
Ceiling Ht.	9 ft. (2.7m) minimum. Vary the ceiling height to help define spaces and coordinate with other lobby and guest service areas.
Windows/Doors	Swinging door with a vision panel and a deadbolt lock to the prep/storage area.
Interior Construction/ Built-in Equipment	Solid-surface service counters with lockable base cabinets. Coffee machine.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished gypsum wall board. Provide a solid-surface or resilient tile backsplash at the counter. **Floor.** Porcelain tile with .125-in (3 mm) grout joints. **Base.** Porcelain tile or stained wood. **Ceiling.** Coordinate with central lobby.
Plumbing	Provide water supply and drains for coffee machine and juice machine (if included). Provide a floor drain.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Ensure adequate counter-height outlets to power anticipated equipment such as coffee and juice machines, warming plates/lights, self-service microwave and toaster.
Lighting	Provide system per Chapter 3, General, and Lighting. 30 fc (325 lux) general ambient and 50 fc (540 lux) at the counters.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	The service area should be clearly visible from the dining area, but provide a sense of separation between the two spaces. Staff servicing the area should have visual control over the entire service and dining areas.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-10. FOOD SERVICE – DINING

Description/ Usage	The optional food service area is a small, self-service area that is typically limited to breakfast. It is directly off of the lobby and may act as an extension of the entire lobby area. It is broken down into three sub-areas: Service where the food is served, dining where patrons sit to eat, and prep/storage where the food is prepared. This table describes the dining area.
Ceiling Ht.	9 ft. (2.7m) minimum. Vary the ceiling height to help define spaces and coordinate with other lobby and guest service areas.
Windows/Doors	Provide windows or glazed storefront on at least one wall.
Interior Construction/ Built-in Equipment	Provide a wall or ceiling TV mount. Coordinate seating with FF&E and provide a bar/counter seating area and/or table seating.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished gypsum wall board. **Floor.** Porcelain tile with .125-in (3 mm) grout joints or commercial carpet and pad. **Base.** Porcelain tile or stained wood. **Ceiling.** Coordinate with central lobby.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting. 30 fc (325 lux) general ambient.
Communication	**Telephone.** None required. **Data.** Provide Wi-Fi service throughout. **CCTV.** None required. **CATV.** Provide a minimum of one outlet for wall- or ceiling-mounted TV(s). **Security.** None required.
Acoustics	Provide features to minimize reverberation time and control noise. Provide noise attenuation measures to mitigate acoustical problems resulting from mechanical systems, plumbing systems, and vibration transmitted through the facility structure.
Special Requirements	The dining area should be clearly visible from the lobby areas and reception, but provide a sense of separation between the spaces.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-11. FOOD SERVICE – PREP/STORAGE

Description/ Usage	The optional food service area is a small, self-service area that is typically limited to breakfast. It is directly off of the lobby circulation and may act as an extension of the entire lobby area. It is broken down into three sub-areas: Service where the food is served, dining where patrons sit to eat, and prep/storage where the food is prepared. This table describes the prep/storage area. Food preparation is typically limited to thawing and staging with minimal to no scratch preparation.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	Lockable swinging door with vision panel to the receiving area or service corridor.
Interior Construction/ Built-in Equipment	Provide minimum 24-in.- (610-mm-) deep stainless steel countertop, metal cabinets and wire shelves for food, utensil, equipment and supply storage. Commercial ice maker. Under-counter commercial-grade dishwasher, if scoped.
Finishes	**Walls.** Epoxy or semi-gloss or better latex painted mold-resistant gypsum wall board. Food prep areas will have ceramic tile with dark-colored epoxy grout or FRP panels. The walls shall be impact resistant up to 48 in. (1220 mm) from finished floor. **Floor.** Porcelain tile with epoxy grout. **Base.** Porcelain tile. **Ceiling.** High humidity-rated, ceramic-faced acoustical ceiling panels (ACP).
Plumbing	Food service scope will vary by location. Depending on final scope of food service, comply with the required codes and consider the following requirements: a hand-washing sink at each entrance; a two-compartment food preparation sink; commercial-grade dishwasher, a three-compartment, deep dishwashing sink with a gooseneck faucet and 180-F (82-C) hot water booster. The hot water booster shall also connect to the heavy-duty, commercial-grade dishwasher. Lodging prep areas will typically use grease interceptors in lieu of central grease traps to service individual equipment. Locate them to be easily accessible for cleaning, be located outside of food preparation areas, and not project above the floor in open walkways or work areas. At a minimum, provide one hand-washing sink, a separate two-compartment sink, a connection for an ice maker, and a floor drain.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Perform a power requirement survey as this area's power requirements are extremely site- and locale-specific. Provide a dedicated electrical circuit for the cold storage.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide one jack. **Data.** Provide one jack. **CCTV.** None required. **CATV.** None required. **Security.** Electronic door lock to receiving/service corridor if available.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-12. RETAIL FOOD SERVICE

Description/ Usage	Optional space (may be contract operation) that can range from a small coffee bar/kiosk to a full-service restaurant. Coordinate design, finishes and amenities with the service provider.
Ceiling Ht.	Coordinate with service provider.
Windows/Doors	Coordinate with service provider.
Interior Construction/ Built-in Equipment	Coordinate with service provider.
Finishes	**Walls.** Coordinate with service provider. **Floor.** Coordinate with service provider. **Base.** Coordinate with service provider. **Ceiling.** Coordinate with service provider.
Plumbing	Coordinate with service provider. Provide separate metering.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide separate metering.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Coordinate with service provider. **Data.** Coordinate with service provider. **CCTV.** Coordinate with service provider. **CATV.** Coordinate with service provider. **Security.** Coordinate with service provider.
Acoustics	Coordinate with service provider.
Special Requirements	Coordinate with service provider.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-13. RETAIL SALES

Description/ Usage	Optional area directly adjacent to reception and providing display space for retail items such as pre-packaged food, beverages, sundries, and small gifts.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	Counter with lockable base cabinets and display shelving. Provide a service counter open to behind the reception counter where the point of sale (POS) will reside.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished gypsum wall board. **Floor.** Match lobby circulation. **Base.** Stained wood. **Ceiling.** Gypsum wall board or ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide dedicated circuits to refrigerated/freezer display cases.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required **Data.** None required. **CCTV.** Provide outlets for full camera coverage. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	Locate the POS equipment in the reception area.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-14. LUGGAGE STORAGE

Description/ Usage	Secure room for limited storage of guest luggage. While this room is included under guest services, it is not publicly accessible and is directly adjacent to the reception staff areas.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door.
Interior Construction/ Built-in Equipment	Provide 24-in.-deep (610-mm) heavy-duty shelving on all walls. Provide 30 in. (760 mm) of vertical space between shelves.
Finishes	**Walls.** Painted impact-resistant gypsum wall board or CMU. **Floor.** Vinyl composition tile (VCT) or match lobby. **Base.** Rubber. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-15. ATM

Description/ Usage	Optional area or alcove directly off of the lobby with space for an automated teller machine (ATM).
Ceiling Ht.	Coordinate with lobby.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Coordinate with lobby. **Floor.** Coordinate with lobby. **Base.** Coordinate with lobby. **Ceiling.** Coordinate with lobby.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** Provide one jack. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	The ATM should be clearly visible from the reception area. Review requirement for CCTV coverage.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-16. REGISTRATION MACHINES

Description/ Usage	Optional area or alcove directly off of the lobby with space for one or more registration machine(s).
Ceiling Ht.	Coordinate with lobby.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Coordinate with lobby. **Floor.** Coordinate with lobby. **Base.** Coordinate with lobby. **Ceiling.** Coordinate with lobby.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** Provide one jack for each machine. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	In central facilities, the registration machine(s) should be clearly visible from the reception area.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-17. PUBLIC TOILETS

Description/ Usage	Male and female public toilets directly off the central lobby with an optional electric water cooler. Satellite facilities shall only have a single unisex toilet.
Ceiling Ht.	9 ft. (2.74 m) minimum.
Windows/Doors	Entrance doors. Unisex toilet shall have a door lockable from the inside.
Interior Construction/ Built-in Equipment	Solid-surface countertop with either under-mount or integral sinks. Solid composite or phenolic core toilet and urinal partitions. Toilet accessories: toilet paper dispensers, automatic paper towel dispenser, built-in trash receptacle, robe hooks, grab bars, sanitary napkin disposal and purse shelf (female water closet stalls), automatic soap dispensers, and optional seat cover dispensers. Full-width mirror over vanity. Fold-down diaper changing table/station in both the male and female toilets.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished mold-resistant gypsum wallboard with a ceramic tile wainscot. Use a dark-colored grout. **Floor.** Porcelain tile. Use a dark-colored grout. **Base.** Porcelain tile. **Ceiling.** Finished mold-resistant gypsum wall board.
Plumbing	Provide automatic flush-valve wall-hung water closets and urinals, and 18-in (455 mm) minimum, automatic lavatories based on the applicable code. Provide a floor drain outside of the internal circulation paths. As an option, provide a keyed hose bibb. Provide an electric water cooler near the entrance to the toilets.
HVAC	Provide a system per Chapter 3, General, and HVAC. In addition, provide a minimum of eight air changes per hour and negative pressure. **Service Exception:** For Air Force, provide a system per Chapter 3, General, and HVAC; use the continuous exhaust requirements per ASHRAE 62.1, table 6-4; and provide negative pressure.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-18. DSN PHONES

Description/ Usage	Optional area or alcove directly off of the lobby with space for one or more Defense Switched Network (DSN) phones.
Ceiling Ht.	Coordinate with lobby.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Coordinate with lobby. **Floor.** Coordinate with lobby. **Base.** Coordinate with lobby. **Ceiling.** Coordinate with lobby.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide one compliant jack for each DSN phone. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-19. FITNESS ROOM

Description/ Usage	Optional area with several fitness machines for guest use.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Lockable entrance door with a vision panel.
Interior Construction/ Built-in Equipment	Provide a minimum of one wall or ceiling TV mount. Provide an 8-ft.- (2.4m) high mirror covering one full wall. Provide an interior window to the corridor at 42 in. (1070 mm) above finished floor, a minimum of 36 in. (915 mm) high, and a minimum of 10 $ft.^2$ (.93 m^2) total window area.
Finishes	**Walls.** Finished double-layer (impact side) gypsum board. **Floor.** Resilient seamless rubber sheet flooring. **Base.** Rubber. **Ceiling.** ACP.
Plumbing	Provide either an electric water cooler or a bottle water cooler (FF&E).
HVAC	Provide a system per Chapter 3, General, and HVAC. In addition, provide 68 F (20 C) minimum, 74 F (23 C) maximum, less than 50% relative humidity, 20 cfm/person outside air and use CO_2 sensors to control outside air. Provide multi-speed ceiling fans. **Service Exception:** For Air Force, provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide flush-floor outlets for commercial-grade equipment sized appropriately for equipment spacing. Provide outlet(s) for wall- or ceiling-mounted televisions.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** House phone. **Data.** None required. **CCTV.** Provide outlets for full camera coverage. **CATV.** Provide outlet(s) for wall or ceiling mounted TV(s). Coordinate with selected fitness equipment to accommodate equipment with built-in or attached TVs. **Security.** Door electronic card key access reader.
Acoustics	Provide partition construction with a minimum STC rating of 52 per Chapter 3, Acoustics.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-20. CONFERENCE ROOM

Description/ Usage	Optional room used by guests or staff for meetings.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	Lockable entrance door(s) with a vision panel.
Interior Construction/ Built-in Equipment	Provide an 8-ft. (2.4m) minimum length built-in counter with lockable base cabinets. Provide a retractable overhead screen, a ceiling projector mount, and a wall-mounted dry-erase board.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished gypsum wallboard. **Floor.** Commercial grade carpet and pad. **Base.** Rubber, carpet or wood. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide a ceiling outlet for a projector.
Lighting	Provide system per Chapter 3, General, and Lighting. Consider dimming capability.
Communication	**Telephone.** Provide a house phone and one jack on each of three walls and a minimum of one centrally-located floor jack. **Data.** Provide two jacks in a single box on each of three walls, a minimum of one centrally-located floor jack, and a ceiling jack for the projector. Provide Wi-Fi service. **CCTV.** Provide outlets for full camera coverage. **CATV.** Provide one outlet. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 50 per Chapter 3, Acoustics.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-21. BUSINESS CENTER

Description/ Usage	Optional area that includes computers and office equipment for guest use. This may be a small area or alcove off of the lobby with a single computer or a separate room with multiple computers/workstations.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	Lockable entrance door, as required.
Interior Construction/ Built-in Equipment	Provide a 24-in. (610-mm) deep counter with cord cut-outs and grommets and knee space. Provide lockable cabinets and shelving. Note that CPUs will be stored in the lockable cabinets to preclude customer access.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished gypsum wallboard. **Floor.** Commercial grade carpet and pad. **Base.** Rubber or carpet. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide a minimum of two jacks in a single box. **Data.** Provide a minimum of two jacks in a single box and coordinate with final equipment schedule. Provide Wi-Fi service **CCTV.** Provide outlets for full camera coverage. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 50 per Chapter 3, Acoustics.
Special Requirements	If this is an alcove off of lobby circulation, provide visual control from reception. If it is a separate room, consider providing a staff entrance from the administrative areas to facilitate supervision and technical support/assistance.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-22. STUDY ROOM

Description/ Usage	Optional room(s) used by guests for small group study sessions and meetings.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	Lockable entrance door with a vision panel.
Interior Construction/ Built-in Equipment	Provide a wall-mounted marker board.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished gypsum wallboard. **Floor.** Commercial grade carpet and pad. **Base.** Rubber or carpet. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide a house phone and one jack on each of three walls and a centrally-located floor jack. **Data.** Provide two jacks in a single box on each of three walls and a centrally-located floor jack. Provide Wi-Fi service. **CCTV.** Provide outlets for full camera coverage. **CATV.** Provide one outlet. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 45 per Chapter 3, Acoustics.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-23. GUEST LAUNDRY

Description/ Usage	Self-service laundry for guests. Depending on facility size and mission, this may be either a single centralized room or rooms per every floor. If centralized, the room shall not be located directly off the lobby circulation areas. Laundry on the guest room floors shall be located off the guest corridors and near the vertical circulation, if possible.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entrance door with a large vision panel.
Interior Construction/ Built-in Equipment	Provide large, heavy-duty, residential washers and dryers. Provide removable covers to conceal the plumbing connections and a spacer between the dryers and the wall to preclude the dryer vent from become compressed due to dryer movement. Provide a wall TV mount and a tack board.
Finishes	**Walls.** Epoxy-painted, moisture-resistant gypsum board. **Floor.** Porcelain tile. **Base.** Porcelain tile. **Ceiling.** Moisture-resistant ACP.
Plumbing	Provide connections to the washers, one drain per washer with solid interceptors, and one additional floor drain. In PCS facilities provide a laundry sink with a solid interceptor and goose-neck faucet,
HVAC	Provide a system per Chapter 3, General, and HVAC. In addition, provide 20 C (68 F) minimum, 27 C (80 F) maximum. Provide straight-run vents to the outside for the dryers. Provide a minimum of six air changes per hour, 50 to 60% relative humidity, and negative pressure. **Service Exception:** For Air Force, provide a system per Chapter 3, General, and HVAC. Provide straight-run vents to the outside for the dryers. Provide ventilation in accordance with ASHRAE 62.1-2010, table 6-1, Hotels, Motels, Resorts, Dormitories-laundry rooms, central.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide concealed outlets for currency change machine and laundry vending, if provided as powered equipment (see Table 5-52).
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** As an option, provide a house phone. **Data.** None required. **CCTV.** Provide outlets for full camera coverage. **CATV.** As an option, provide an outlet for wall-mounted TV. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 54 per Chapter 3, Acoustics. Partitions between the laundry room and a guest room or suite shall have a minimum STC rating of 60 per Chapter 3, Acoustics.
Special Requirements	Mount utility connections 36 in. (915 mm) above finished floor and ensure easy access for maintenance. Consider Wi-Fi for laptop use while waiting for laundry.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-24. GEAR WASH

Description/ Usage	Optional area used by guests coming in from field exercises to clean their personal equipment. This is typically only included at school/training Installations. Locate this room at a secondary, ground floor building entry.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Lockable entrance door with a vision panel.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Epoxy-painted, moisture-resistant gypsum board. **Floor.** Sealed concrete. **Base.** 4-in. (100 mm) ceramic tile. **Ceiling.** Moisture-resistant ACP.
Plumbing	Three deep, stainless steel wash sinks with flexible nozzles, one hose bibb, and floor drains with sediment traps located to ensure proper drainage.
HVAC	Provide a system per Chapter 3, General, and HVAC. Provide a minimum of 12 air changes per hour, 50 to 60% relative humidity, and negative pressure.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting. 30 fc (325 lux).
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** Provide outlets for full camera coverage. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 52 per Chapter 3, Acoustics.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-25. GUEST BULK STORAGE, OPTION 1

Description/ Usage	Optional self-service areas used by PCS guests to store luggage and other bulky items.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Lockable entrance door.
Interior Construction/ Built-in Equipment	Built-in, heavy-gauge wire cages with closers that allow for use of individual padlocks. Each cage shall enclose 25 $ft.^2$ (2.3 m^2) and have 14 linear ft. (4.3 m) of durable wall-mounted shelving.
Finishes	**Walls.** Epoxy-painted, impact-resistant gypsum board. **Floor.** Sealed concrete. **Base.** Rubber. **Ceiling.** ACP or exposed structure.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting. 30 fc (325 lux).
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	Access passageways to cages shall be a minimum of 6 ft. (1.8 m) wide to facilitate movement of items. Distribute rooms among guest rooms on multiple floors and locate near suites, if possible. These may be adjacent to guest laundry with access from the laundry rooms.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-26. VENDING/ICE

Description/ Usage	Self-service drink, snack and ice vending area for guests. A minimum of one area per floor, located off the guest corridors and near the vertical circulation, if possible. First-floor vending area shall be recessed off a hallway and easily accessible from both the lobby and the first-floor guest rooms. These areas may be combined with the guest laundry—see Special Requirements.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	Commercial ice dispenser sized at 300 lbs (136 kg) per 200 guests.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished gypsum wallboard. **Floor.** Porcelain tile. **Base.** Porcelain tile. **Ceiling.** ACP.
Plumbing	Provide a connection to the ice machine and a floor drain positioned under the ice machine and out of view.
HVAC	Provide a system per Chapter 3, General, and HVAC. Ensure adequate ventilation to support the equipment.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Confirm power/outlet requirements with machine manufacturer.
Lighting	Provide system per Chapter 3, General, and Lighting. 10 fc (110 lux).
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** Provide outlets for full camera coverage. **CATV.** None required. **Security.** None required.
Acoustics	Provide partition construction with a minimum STC rating of 52 per Chapter 3, Acoustics. Partitions between vending/ice and a guest room or suite shall have a minimum STC rating of 60 per Chapter 3, Acoustics.
Special Requirements	If combined with the guest laundry, provide the plumbing, power, and ventilation requirements to support the selected equipment. If only one area is provided per floor, locate centrally.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-27. PATIO

Description/ Usage	Optional exterior patio for guest use.
Ceiling Ht.	Not applicable.
Windows/Doors	Not applicable.
Interior Construction/ Built-in Equipment	Not applicable.
Finishes	**Walls.** Not applicable. **Floor.** Patterned/textured concrete, stone or brick pavers. **Base.** Not applicable. **Ceiling.** Not applicable.
Plumbing	Provide a hose bibb. Provide a gas connection to a grill if availability and budget permit.
HVAC	Not applicable.
Fire Protection and Life Safety	Not applicable for uncovered patios. Fire protection may be applicable if patio is covered.
Power	Provide exterior outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting. Provide .5 fc (11 Lux) with energy efficient outdoor light fixtures.
Communication	**Telephone.** None required. **Data.** Provide Wi-Fi service. **CCTV.** Provide outlets for full camera coverage. **CATV.** None required. **Security.** None required.
Acoustics	Not applicable.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-28. PATIO STORAGE

Description/ Usage	Only available with a patio, this room or shed accommodates storage of seasonal items, as needed based on climate.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Lockable entry door with a vision panel.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Painted concrete/CMU or gypsum wallboard. **Floor.** Sealed concrete. **Base.** None required. **Ceiling.** None required.
Plumbing	None required.
HVAC	None required.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-29. GUEST CORRIDORS/CIRCULATION

Description/ Usage	The public horizontal and vertical circulation paths.
Ceiling Ht.	8 ft. 4 in. (2.5 m) minimum.
Windows/Doors	Maximize natural light in corridors. Windows can be located at corridor ends and/or at corners and intersections.
Interior Construction/ Built-in Equipment	None required.
Finishes	See Chapter 3, Interior Design, for color and finish guidance. **Walls.** Finished gypsum wallboard. Provide impact-resistant wall construction up to a minimum height of 48 in. (1220 mm) above finished floor. Provide a chair rail, surface-mounted corner guards, and a vinyl bumper rail to protect walls from housekeeping carts. **Floor.** Commercial grade carpet and pad. **Base.** Carpet, wood or tile. **Ceiling.** Painted gypsum wall board or ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Consider added outlets for housekeeping.
Lighting	Provide system per Chapter 3, General, and Lighting. Provide an average of 10 fc (110 lux) through a combination of wall sconces and recessed compact fluorescent downlights.
Communication	**Telephone.** As an option, provide house phones at elevator lobbies. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required. See Special Requirements for elevator acoustical criteria.
Special Requirements	Corridors shall be a minimum width of 6 ft. (1.8 m). **Elevators.** Coordinate the elevator interior with the lobby area design and provide a durable, non-porous, solid-surface wall finish such as high-pressured laminate. Provide stainless steel cart rails and doors (interior and exterior). Minimum load capacity shall be 2,500 lbs (1135 kg), minimum opening shall be 42 in. (1070 mm), and minimum speed shall be 150 ft/min (45.7m/min). Consider faster, traction-type elevators for buildings above five floors. Partitions between the elevators and elevator equipment rooms and guest rooms or suites shall a minimum STC rating of 60 per Chapter 3, Acoustics.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

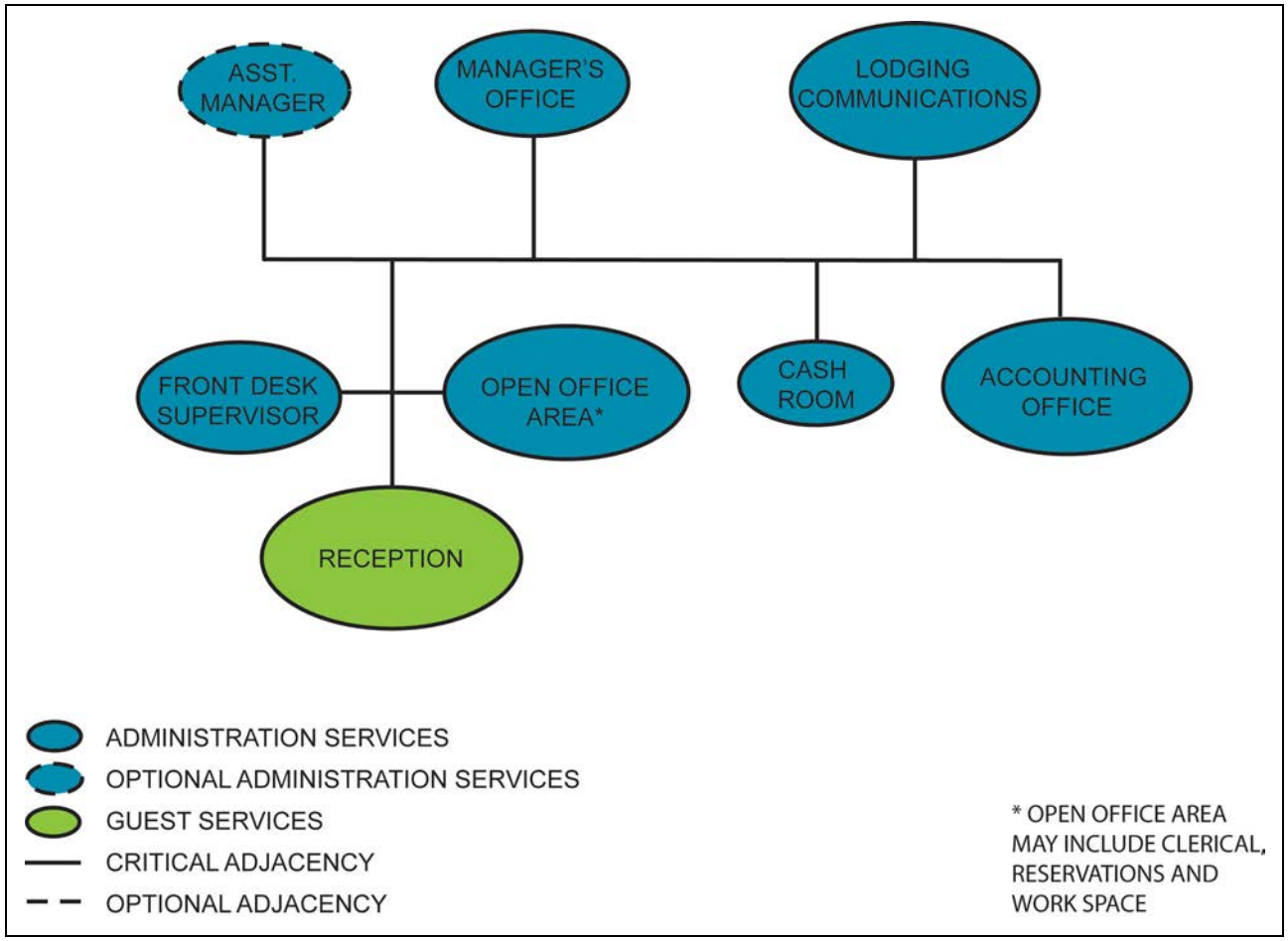
5-3 ADMINISTRATIVE SERVICES.

Staff administrative spaces support the overall administration of the facility and/or Installation program. They are typically located adjacent to/behind reception. Design to minimize staff circulation through guest services areas.

5-3.1 Administrative Services Layout.

Figure 5-2 indicates the acceptable relative adjacencies of the guest services spaces.

FIGURE 5-2. ADMINISTRATIVE SERVICES ADJACENCY DIAGRAM



5-3.2 Administrative Services Design Criteria.

Tables 5-29 through 5-32 provide the guest services specific design criteria in the FDS format. Table 5-52 provides the FF&E for these spaces.

TABLE 5-30. LODGING COMMUNICATIONS

Description/ Usage	IT communications room includes guest and staff internet, television, and administration file server.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Lockable entry door.
Interior Construction/ Built-in Equipment	NA.
Finishes	**Walls.** Paint. **Floor.** Concrete. **Base.** None required. **Ceiling.** Painted exposed structure or gypsum wall board.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Locking passage door.
Acoustics	No special provisions required.
Special Requirements	NA.
For use during project execution by the appropriate Service agency	
Occupancy	Staff access only.
Min. net ft^2 (m^2)	No minimum required.

TABLE 5-31. PRIVATE ADMINISTRATIVE OFFICES

Description/ Usage	The number of private offices will vary by facility and Installation depending on the program and other, existing resources. Offices will vary in size as well. The following private offices may be included in a LF: manager, assistant manager, and front desk supervisor/superintendant.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door. Provide exterior windows if possible.
Interior Construction/ Built-in Equipment	Provide a coat hook on the door and wall-mounted tack and/or marker boards. In the front desk supervisor office provide a one-way window with a view of the front desk and lobby areas.
Finishes	**Walls.** Finished gypsum wallboard. **Floor.** Commercial grade carpet and pad. **Base.** Rubber or carpet. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide a minimum of one duplex outlet per wall and one additional duplex outlet at the desk location.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide two jacks in a single box adjacent to the desk duplex outlet. **Data.** Provide two jacks in a single box adjacent to the desk duplex outlet. **CCTV.** In the front desk supervisor office provide for a monitor. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 45 per Chapter 3, Acoustics.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-32. ACCOUNTING OFFICE

Description/ Usage	Depending on the size of the facility and Installation program, this may be an office for one or two people or an open-office area for up to five accounting staff.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entrance door. Provide exterior windows if possible.
Interior Construction/ Built-in Equipment	As an option, provide a wall-mounted tack and/or marker board.
Finishes	**Walls.** Finished gypsum wallboard. **Floor.** Commercial grade carpet and pad. **Base.** Rubber or carpet. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide three duplex outlets per workstation and additional outlets as needed for shared office equipment.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide two jacks in a single box per workstation. Provide additional jacks as necessary for shared equipment. **Data.** Provide two jacks in a single box per workstation. Provide additional jacks as necessary for shared equipment. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 45 per Chapter 3, Acoustics.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-33. OPEN OFFICE AREA

Description/ Usage	This is an open office work area that accommodates workstations for clerical and reservations staff, administrative storage, and general work space. It may accommodate shared equipment such as photocopiers, facsimile machines, and printers or those may be in a separate area (see Special Requirements below).
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entrance door. Provide exterior windows if possible.
Interior Construction/ Built-in Equipment	As an option, provide wall-mounted tack and/or marker boards as appropriate.
Finishes	**Walls.** Finished gypsum wallboard. **Floor.** Commercial grade carpet and pad. **Base.** Rubber or carpet. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC. Also see Special Requirements.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide three duplex outlets per workstation and additional outlets as needed for shared office equipment.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide two jacks in a single box per workstation. Provide additional jacks as necessary for shared equipment. **Data.** Provide two jacks in a single box per workstation. Provide additional jacks as necessary for shared equipment. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 45 per Chapter 3, Acoustics.
Special Requirements	If possible, separate shared equipment such as printers and photocopiers into a dedicated space that will meet the requirements for indoor environmental quality LEED® credits. Regardless, this shared equipment shall be easily accessible by front desk and administrative staff. The front desk staff in particular must be able to access this equipment quickly to minimize time away from guests.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-34. CASH ROOM

Description/ Usage	This secure room is used by front desk staff to reconcile shift cash functions, including balancing cash drawer and making deposits.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door.
Interior Construction/ Built-in Equipment	Provide a 24-in- (610mm) deep counter with upper cabinets. Provide a three-drawer (minimum) secure cash drawer rack that is permanently affixed to wall and has an individual lock on each drawer. Coordinate sizing of this rack with the front desk cash registers. Provide a drop cash safe with a tumbling drum.
Finishes	**Walls.** Finished gypsum wallboard. **Floor.** Commercial grade carpet and pad. **Base.** Rubber or carpet. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide one jack located below counter. **Data.** Provide two jacks in a single box located below counter. **CCTV.** Provide outlets for full camera coverage. **CATV.** None required. **Security.** Electronic card key access reader. Provide a duress alarm that sounds at the Installation Security Office. The agencies identified in Chapter 1, Contacts, may waive this requirement.
Acoustics	No special provision required.
Special Requirements	Walls shall extend to bottom of deck above for security.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

5-4 FLOOR SUPPORT.

Floor support spaces are staff areas located on each floor of guest rooms and suites in support of those rooms. Tables 5-33 through 5-35 provide the floor support specific design criteria in the FDS format. Table 5-52 provides the FF&E for these spaces.

TABLE 5-35. JANITOR AREAS

Description/ Usage	Janitor closets located in a central location on each floor. Some building configurations may require two closets on each floor. This space may be combined with the housekeeping closets on the guest room floors.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door.
Interior Construction/ Built-in Equipment	Built-in shelving and wall brackets for mops and brooms.
Finishes	**Walls.** Epoxy painted, moisture-resistant gypsum wall board or CMU. **Floor.** Stained and sealed concrete or porcelain tile. **Base.** Rubber. **Ceiling.** None.
Plumbing	Provide a mop sink and a floor drain.
HVAC	Provide a system per Chapter 3, General, and HVAC. Provide negative pressure.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-36. HOUSEKEEPING AREAS

Description/ Usage	Rooms located in a central location on each floor. Some building configurations may require two housekeeping areas on each floor. These rooms store the housekeeping carts, guest amenities, clean linens for the rooms served, and accommodate temporary storage of dirty linens. This space may be combined with the janitor closets on the guest room floors.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door.
Interior Construction/ Built-in Equipment	Built-in shelving and wall brackets for mops and brooms.
Finishes	**Walls.** Epoxy painted, moisture-resistant gypsum wall board or CMU. **Floor.** Stained and sealed concrete or porcelain tile. **Base.** Rubber. **Ceiling.** None.
Plumbing	Provide an optional service connection to a dishwasher. If any water source is present, provide a floor drain.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-37. UTILITY ROOMS

Description/ Usage	Mechanical, electrical, communications, and sprinkler rooms located on each floor as needed for efficient utility distribution. The majority of these rooms will be switch closets to accommodate data pulls, CATV pulls and boosters, and telephone pulls. Those rooms shall be no more than 280 ft. (85.4m) from any guest room.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door. Size doors to allow future equipment removal.
Interior Construction/ Built-in Equipment	Built-in equipment racks.
Finishes	**Walls.** Epoxy painted, gypsum wall board or CMU. **Floor.** Stained and sealed concrete. **Base.** Rubber. **Ceiling.** None.
Plumbing	In mechanical equipment rooms only, provide one hose bibb and floor drain.
HVAC	Provide a system per Chapter 3, General, and HVAC. Switch closets require individual temperature and humidity control per equipment requirements. Do not duct return air from any adjacent space through the communication room.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** As required for system. **Data.** As required for system. **CCTV.** None required. **CATV.** As required for system. **Security.** See Special Requirements.
Acoustics	Provide partition and door construction with a minimum STC rating of 52 per Chapter 3, Acoustics. Mechanical rooms or rooms with noise-generating equipment that are located adjacent to guest rooms or suites shall have partition construction with a minimum STC rating of 60 per Chapter 3, Acoustics.
Special Requirements	The main, first floor electrical room and the mechanical rooms shall be accessible from both the exterior and the interior. Do not combine switch closets with the mechanical rooms and minimize the potential for water damage in the switch closets—do not locate valves, connections, cleanouts, drain traps or similar joints within or directly above the switch closets. Do not co-locate high-power electrical systems in the switch closets due to potential signal interference. Ensure that facility staff will have access (through the key card system) to the facility communications equipment.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

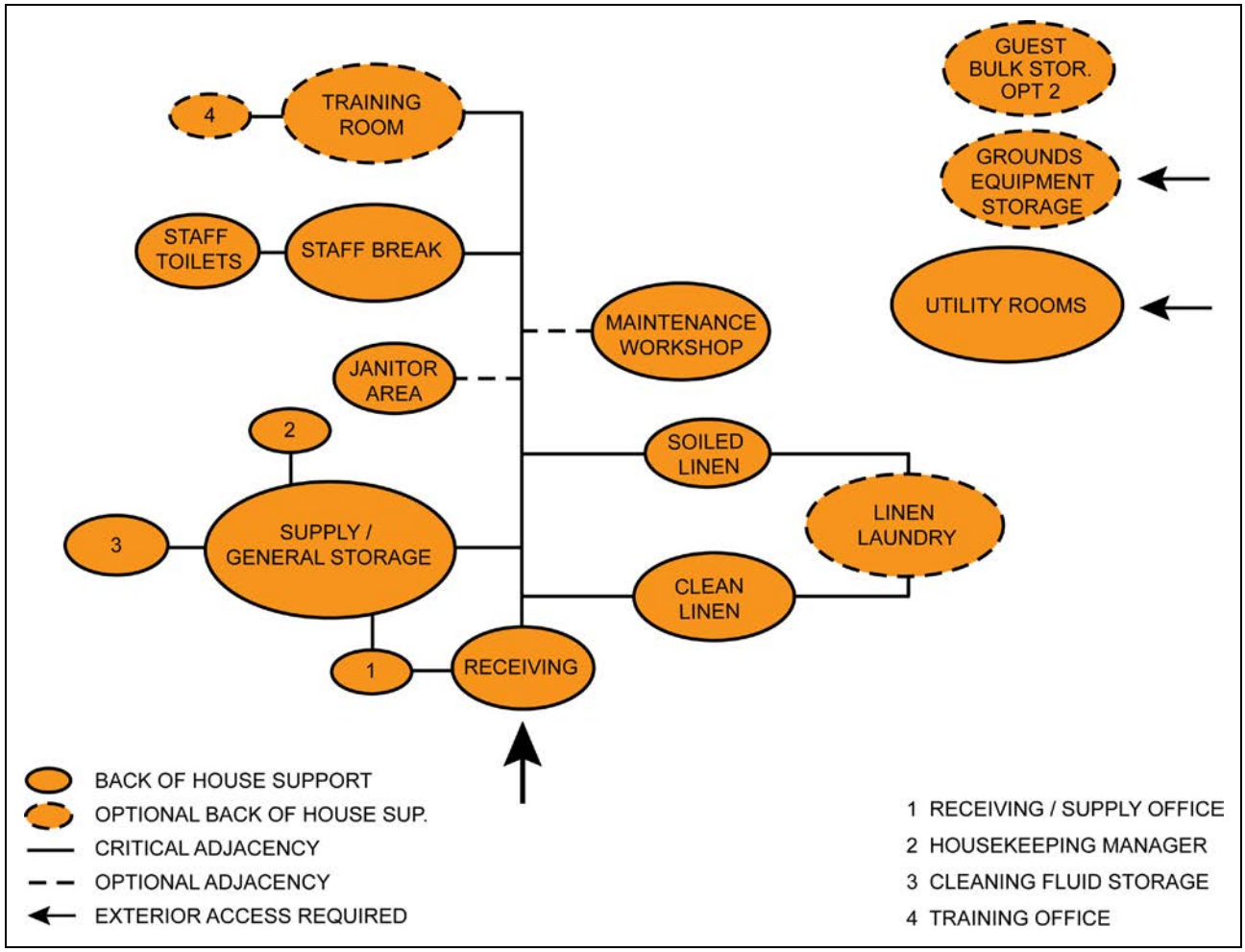
5-5 BACK-OF-HOUSE SUPPORT.

Back-of-house support spaces are staff-only areas—typically limited to the first floor—that provide facility and staff support functions.

5-5.1 Back-of-house Support Layout.

Figure 5-3 indicates the acceptable relative adjacencies of the back-of-house support spaces.

FIGURE 5-3. BACK-OF-HOUSE SUPPORT ADJACENCY DIAGRAM



5-5.2 Back-of-house Support Design Criteria.

Tables 5-36 through 5-51 provide the back-of-house support specific design criteria in the FDS format. Table 5-52 provides the FF&E for these spaces.

TABLE 5-38. TRAINING ROOM

Description/ Usage	Optional dedicated room for staff training.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door with a small vision panel.
Interior Construction/ Built-in Equipment	Provide a secure cabinet for AV equipment. Provide a retractable overhead screen, a ceiling projector mount, and a wall-mounted marker board.
Finishes	**Walls.** Finished gypsum wallboard. **Floor.** Commercial grade carpet and pad. **Base.** Wood or carpet. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide a ceiling outlet for a projector. Also provide floor outlets in a center core.
Lighting	Provide system per Chapter 3, General, and Lighting. Consider dimming capability.
Communication	**Telephone.** Provide one jack on each wall and floor jacks in a center core. **Data.** Provide two jacks in a single box on each wall, floor jacks in a center core, and a ceiling jack for the projector. **CCTV.** None required. **CATV.** Provide one outlet. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 45 per Chapter 3, Acoustics.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-39. TRAINING OFFICE/STORAGE

Description/ Usage	This optional space may be used for storage of staff training supplies or for both administration of the staff training program and storage of supplies.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Finished gypsum wallboard. **Floor.** Commercial grade carpet and pad. **Base.** Rubber or carpet. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide a minimum of one duplex outlet per wall and, if serving an administrative function, one additional duplex outlet at the desk location.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** If serving an administrative function, provide two jacks in a single box adjacent to the desk duplex outlet. **Data.** If serving an administrative function, provide two jacks in a single box adjacent to the desk duplex outlet. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 45 per Chapter 3, Acoustics.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-40. JANITOR AREA

Description/ Usage	Central janitor closet(s) serving the first floor public and staff spaces and including additional supply storage.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door.
Interior Construction/ Built-in Equipment	Built-in shelving and wall brackets for mops and brooms.
Finishes	**Walls.** Epoxy painted, moisture-resistant gypsum wall board or CMU. **Floor.** Sealed and stained concrete or porcelain tile. **Base.** Rubber. **Ceiling.** None.
Plumbing	Provide a mop sink and a floor drain.
HVAC	Provide a system per Chapter 3, General, and HVAC. Provide negative pressure.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-41. HOUSEKEEPING OFFICE

Description/ Usage	This is a private office for the housekeeping manager and housekeeping assistant to conduct administrative and staff management functions.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Painted gypsum wall board. **Floor.** Carpet or VCT. **Base.** Rubber or carpet. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide a minimum of one duplex outlet per wall, one additional duplex outlet at the desk location, and one additional duplex outlet at the time clock location.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide two jacks in a single box adjacent to the desk duplex outlet. **Data.** Provide two jacks in a single box adjacent to the desk duplex outlet. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 45 per Chapter 3, Acoustics.
Special Requirements	The timeclock is installed on the wall outside the office immediately adjacent to the entry door.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-42. SOILED/CLEAN LINEN STORAGE

Description/ Usage	Separate, distinct storage areas for soiled and clean linen storage. Both shall be adjacent to receiving and/or optional linen laundry.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door with a small vision panel.
Interior Construction/ Built-in Equipment	24-in. (610 mm) deep, heavy-duty, built-in shelving.
Finishes	**Walls.** Epoxy painted gypsum wall board or CMU. **Floor.** Sealed concrete. **Base.** Rubber. **Ceiling.** ACP or none.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting. 15 fc (160 lux) average.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	The soiled linen storage consists primarily of space for storage of laundry carts and open floor space for sorting. The clean linen storage consists primarily of storage shelving.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-43. RECEIVING

Description/ Usage	Central receiving area for deliveries with a loading dock.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Provide an exterior pedestrian door with electronic lockset and a small vision panel. At a minimum, provide double doors from the dock to the interior. As an option, provide an electrically-operated, insulated overhead coiling door at the dock.
Interior Construction/ Built-in Equipment	Loading dock width shall be capable of accommodating a single city delivery truck at minimum, and depth shall be 60 in. (1525 mm) minimum. Provide stairs to the ground level, a manual dock leveling mechanism, and dock bumpers. Provide roof overhang protection of the dock.
Finishes	**Walls.** Epoxy painted impact-resistant gypsum wallboard or CMU. **Floor.** Sealed concrete. **Base.** Rubber. **Ceiling.** ACP or none.
Plumbing	Provide one hose bibb and a floor drain.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide one duplex outlet per wall.
Lighting	Provide system per Chapter 3, General, and Lighting. 30 fc (325 lux) from recessed fluorescent fixtures.
Communication	**Telephone.** Provide a house phone or exterior speaker at the entrance gate and/or dock exterior. As an option, provide one jack (ganged with data in single box) located adjacent to a duplex outlet at the interior of the loading dock. **Data.** As an option, provide one jack (ganged with phone in single box) located adjacent to a duplex outlet at the interior of the loading dock. **CCTV.** Provide outlets for camera coverage of the dock and access gate. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	Provide a door bell adjacent to the house phone/speaker that sounds at the interior receiving area and reception. Coordinate loading dock size and height with anticipated delivery vehicles. This area may serve as the primary employee entrance.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-44. RECEIVING/SUPPLY OFFICE

Description/ Usage	Small optional private office adjacent to receiving and supply/general storage area for administration of maintenance staff, inventory and deliveries.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable half-lite entry door.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Painted gypsum wallboard. **Floor.** VCT. **Base.** Rubber. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide a minimum of one duplex outlet per wall with an additional duplex outlet at the desk location.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide one jack (ganged with data in single box) at the desk location. **Data.** Provide one jack (ganged with phone in single box) at the desk location. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	Door bell at receiving will sound here.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-45. LINEN LAUNDRY

Description/ Usage	This optional space accommodates the in-house laundry of all bed linens and towels.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Lockable entry door with a small vision panel.
Interior Construction/ Built-in Equipment	Large, high capacity industrial extractors and dryers—coordinate dryer size/quantity to ensure appropriate turn-over. Extractors must be mounted on vibration-isolated concrete foundations. Provide a built-in table for folding laundry and storage shelves/lockers. In larger facilities/programs or when permanent-press-type linens with a crease-resistant finish are not available, evaluate the need for a pressing/folding machine. Provide optional high-speed commercial-grade ceiling fans.
Finishes	**Walls.** Epoxy painted CMU or mold-resistant gypsum wallboard. Provide rub rails, and metal/high-impact plastic corner guards. **Floor.** Sealed concrete. **Base.** Rubber. **Ceiling.** Moisture-resistant ACP.
Plumbing	Provide connections to the extractors, a stainless steel laundry sink with a solid interceptor and goose-neck faucet, an emergency eye wash station, one drain per washer with solid interceptors, and one additional floor drain.
HVAC	Provide a system per Chapter 3, General, and HVAC. Provide separate straight-run vents to the outside for the dryers. Provide a minimum of six air changes per hour, 50 to 60% relative humidity, and negative pressure.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Provide a wall-mounted safety disconnect switch for each extractor.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide one jack. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 52 per Chapter 3, Acoustics.
Special Requirements	This room shall be located on the first floor of the facility. Allow 36 in. (915 mm) from each machine to the wall to accommodate venting, maintenance, and product delivery systems.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-46. SUPPLY/GENERAL STORAGE/CLEANING FLUID STORAGE

Description/ Usage	Provides warehousing and accessible storage for everything from spare furniture and TVs to consumable goods and operational supplies. Approximately 80% of the area is secured warehousing storage and the remaining 20% is accessible for daily restocking. The two areas may be combined in one large room or in two separate rooms (see Interior Construction). Provide a separate adjacent area for storage of cleaning fluids.
Ceiling Ht.	10 ft. (3.1 m) minimum. 12-16 ft. (3.7-4.9 m) typical.
Windows/Doors	Lockable entry door.
Interior Construction/ Built-in Equipment	Provide a minimum of 200 linear ft. (610m) of 30-in.- (760 mm) deep heavy duty shelving. Shelving shall be designed to support 300 lbs. (136 kg) over 7 ft. (2.1m). The lowest shelf shall be mounted 6 in. (150 mm) above finished floor. Provide a full-height, lockable cage to divide the warehousing section from the accessible storage or these may be two separate rooms.
Finishes	**Walls.** Epoxy painted CMU or impact-resistant gypsum wall board. **Floor.** Sealed concrete. **Base.** Rubber. **Ceiling.** None required.
Plumbing	Cleaning fluid storage shall include an emergency eye wash station and a floor drain.
HVAC	Provide a system per Chapter 3, General, and HVAC. Cleaning fluid storage shall include negative pressure.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	Ensure open floor area for packing/unpacking activities and that there is space to accommodate queen size mattresses and furniture storage. The separate area for storage of cleaning fluids shall meet LEED® requirements.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-47. GUEST BULK STORAGE, OPTION 2

Description/ Usage	This optional secure room accommodates storage of guest's larger, bulkier items, such as bicycles, steamer trunks, etc. It is typically only provided in facilities that accommodate long-term stays and only when budget permits. Locate it on the ground floor near a secondary public entrance.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Lockable entrance door.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Epoxy-painted CMU or impact-resistant gypsum board. **Floor.** Sealed concrete. **Base.** Rubber. **Ceiling.** ACP or exposed structure.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting. 30 fc (325 lux).
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	This is not a self-service space. Staff will accompany guests and provide access to the space.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-48. BREAK AREA

Description/ Usage	The primary function of this space is a staff lounge/break area with a kitchenette and lockers. In central facilities this area can also dual-function as a staff meeting/training area. It is directly adjacent to the staff toilets. In satellite facilities, it serves the staff break functions only.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Provide windows or other means of natural light if possible. If an entry door is included, provide a vision panel.
Interior Construction/ Built-in Equipment	Half-height, double-stacked lockers per full staff count (not only on-duty). Provide solid-surface counter at kitchenette with upper and base cabinets and under-counter dishwasher. **Army** provides a prefabricated Kitchenette unit. **Air Force** provides a range with exhaust hood at OCONUS facilities. TV wall mount, tackboard, and lockable bulletin board. In central facilities when this area will function as a staff meeting/training area, provide a ceiling projector mount and a retractable overhead screen.
Finishes	**Walls.** Painted gypsum wall board with ceramic backsplash at the kitchenette. **Floor.** Provide a high-quality resilient or hard-surface flooring. **Base.** Coordinate with flooring. **Ceiling.** ACP.
Plumbing	Provide an under-mount stainless steel, kitchen sink with a gooseneck single lever faucet and a disposal. Provide connections to the refrigerator ice maker and the coffee machine. As an option, provide a dishwasher. For **Army,** provide service to the prefabricated kitchenette unit.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** Provide one jack (ganged with data in single box). **Data.** Provide one wall jack (ganged with phone in single box) and a ceiling jack adjacent to the projector mount, if provided. Provide Wi-Fi service throughout. **CCTV.** None required. **CATV.** Provide one outlet for wall-mounted TV. **Security.** Electronic card key access reader, if applicable.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-49. STAFF TOILETS

Description/ Usage	Male and female staff toilets directly adjacent to the staff break area.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Entrance doors.
Interior Construction/ Built-in Equipment	Solid-surface countertop with either underhung or integral sink. Solid composite or phenolic core toilet and urinal partitions. Toilet accessories: toilet paper dispensers, automatic paper towel dispenser, built-in trash receptacle, robe hooks, grab bars, sanitary napkin disposal and purse shelves (female water closet stalls), seat cover dispensers, and automatic soap dispensers. Full-width mirror over countertop.
Finishes	**Walls.** Finished mold-resistant gypsum wallboard with a ceramic tile wainscot. Use a dark-colored grout. **Floor.** Porcelain tile with integral patterns. Use a dark-colored grout. **Base.** Porcelain tile. **Ceiling.** Epoxy or semi-gloss or better enamel painted, mold-resistant gypsum wall board.
Plumbing	Provide automatic flush-valve wall-hung water closets and urinals, and automatic lavatories based on the applicable code. Provide a floor drain. Provide a keyed hose bibb.
HVAC	Provide a system per Chapter 3, General, and HVAC. In addition, provide a minimum of eight air changes per hour and negative pressure. **Service Exception:** For Air Force, provide a system per Chapter 3, General, and HVAC; use the continuous exhaust requirements per ASHRAE 62.1, table 6-4; and provide negative pressure.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-50. MAINTENANCE WORKSHOP

Description/ Usage	A general work room for repair of equipment and furnishings.
Ceiling Ht.	10 ft. (3.1 m) minimum.
Windows/Doors	Double, lockable entrance doors.
Interior Construction/ Built-in Equipment	Built-in shelving and wall brackets for tools. Built in workbenches. Provide built-in tools/equipment as necessary based on the maintenance program.
Finishes	**Walls.** Epoxy painted CMU or impact-resistant gypsum wallboard. **Floor.** Sealed concrete. **Base.** Rubber. **Ceiling.** None required.
Plumbing	Plumbing requirements shall accommodate the specific maintenance program. Needs may include a handwashing sink, emergency eyewash station, a hose bibb, and floor drains to ensure drainage.
HVAC	Provide a system per Chapter 3, General, and HVAC. Coordinate ventilation requirements with the selected equipment.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General. Coordinate power requirements and outlet locations with equipment to ensure adequate circuits and correct outlet locations. Provide a minimum of two 240 volt outlets.
Lighting	Provide system per Chapter 3, General, and Lighting. 50 fc (540 lux) general lighting and 75 fc (810 lux) task lighting at the workstations.
Communication	**Telephone.** Provide one jack (ganged with data in a single box) on each wall. **Data.** Provide one jack (ganged with telephone in a single box) on each wall. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	Provide partition and door construction with a minimum STC rating of 52 per Chapter 3, Acoustics.
Special Requirements	Scope of maintenance activities can vary significantly based on program. Carefully coordinate power, HVAC, and equipment requirements.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-51. GROUNDS EQUIPMENT STORAGE

Description/ Usage	Optional small shed or closet in **Navy** and **Air Force** facilities with direct exterior access for storage of grounds and exterior building maintenance supplies and equipment.
Ceiling Ht.	9 ft. (2.7 m) minimum.
Windows/Doors	Lockable entrance door.
Interior Construction/ Built-in Equipment	Built-in shelving and wall brackets for tools.
Finishes	**Walls.** Semigloss enamel painted CMU. **Floor.** Sealed concrete. **Base.** None required. **Ceiling.** None required.
Plumbing	Provide an exterior hose bibb.
HVAC	Provide a system per Chapter 3, General, and HVAC. Coordinate any specific requirements with the equipment to be stored.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety. Coordinate any specific requirements with the equipment to be stored.
Power	Provide outlets per Chapter 3, General. Provide one duplex outlet per wall.
Lighting	Provide system per Chapter 3, General, and Lighting. 15 fc (160 lux)
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	If this is provided as a separate structure, the exterior architecture shall match the main lodging facility.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-52. GROUNDS EQUIPMENT STORAGE (ARMY)

Description/ Usage	**Army** space with direct exterior access for storage of grounds and exterior building maintenance supplies and equipment.
Ceiling Ht.	9 ft. (2.7 m) minimum.
Windows/Doors	Lockable personnel door and 8 ft. x 8 ft. (2.4m x 2.4m) manually-operated, insulated overhead door.
Interior Construction/ Built-in Equipment	Built-in shelving and wall brackets for tools.
Finishes	**Walls.** Semigloss enamel painted CMU. **Floor.** Sealed concrete. **Base.** None required. **Ceiling.** None required.
Plumbing	Provide a utility sink, an emergency eyewash station, and a floor drain. Provide an exterior hose bibb.
HVAC	Provide a system per Chapter 3, General, and HVAC. Coordinate any specific requirements with the equipment to be stored.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety. Coordinate any specific requirements with the equipment to be stored.
Power	Provide outlets per Chapter 3, General. Provide one duplex outlet per wall.
Lighting	Provide system per Chapter 3, General, and Lighting. 15 fc (160 lux)
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** Door electronic card key access reader.
Acoustics	No special provisions required.
Special Requirements	If this is provided as a separate structure, the exterior architecture shall match the main lodging facility.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

TABLE 5-53. SERVICE CIRCULATION

Description/ Usage	Staff horizontal and vertical circulation paths between back-of-house support areas.
Ceiling Ht.	8 ft. (2.4 m) minimum.
Windows/Doors	Provide heavy-duty swinging doors between the service corridors and public spaces.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Epoxy painted CMU or impact-resistant gypsum wallboard. Provide bumper rails and corner guards. **Floor.** Stained and sealed concrete or VCT. **Base.** Rubber. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and HVAC.
Fire Protection and Life Safety	Provide systems per Chapter 3, General, and Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General.
Lighting	Provide system per Chapter 3, General, and Lighting. 20 fc (215 lux) average.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Special Requirements	Corridors shall be a minimum width of 8 ft. (2.4 m). **Elevators.** Provide stainless steel cart rails and doors (interior and exterior) and provide wall hooks for grommeted wall padding. Size the elevators to accommodate a king size mattress, housekeeping service cart, and a stretcher for medical emergencies. Minimum load capacity shall be 3,000 lbs (136 kg). Provide a key operated lock-down/hold feature.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Guests.
Min. net ft^2 (m^2)	

5-6 FURNISHINGS, FIXTURES AND EQUIPMENT.

Coordinate FF&E packages with the interior designer and follow the requirements noted in Chapter 3, Interior Design. To assist planners and designers, Table 5-52 provides the general types of FF&E by Service for each space and indicates whether the item is CFCI, GFGI, or GFCI (F/I). Note that interior construction items such as toilet accessories, built-in shelving, cabinets, wall-mounts, and plumbed or attached equipment are included in the FDSs. Therefore, if a space has no FF&E, it is not included here.

TABLE 5-54. FURNISHINGS AND EQUIPMENT

Functional Program Area	Army		Navy		Air Force	
	Furnishings and Equipment	F/I	Furnishings and Equipment	F/I	Furnishings and Equipment	F/I
Guest Services						
Entrance Vestibule	Newspaper racks	GFGI	Newspaper racks	GFGI	N/A	
Lobby	3-cushion sofa	GFGI	3-cushion sofa	GFGI	3-cushion sofa	GFGI
	Lounge chairs	GFGI	Lounge chairs	GFGI	Lounge chairs	GFGI
	Coffee table	GFGI	Coffee table	GFGI	Coffee table	GFGI
	End tables	GFGI	End tables	GFGI	End tables	GFGI
	Table lamps	GFGI	Table lamps	GFGI	Table lamps	GFGI
	Area rugs	CFCI	Area rugs	GFGI	N/A	
	Brochure rack	GFGI	Brochure rack	GFGI	Brochure rack	GFGI
	Artwork and plants	GFGI	Artwork and plants	GFGI	Artwork	GFGI
	N/A		N/A		Accent table	GFGI
Reception	Keycard encoders	CFCI	Keycard encoders	GFGI	Keycard encoders	CFCI
	CCTV monitors	CFCI	CCTV monitors	GFGI	CCTV monitors	GFGI
	Artwork	GFGI	Artwork	GFGI	N/A	
	Telephones	GFGI	Telephones	GFGI	Telephones	GFGI
	Folio buckets	GFGI	Folio buckets	GFGI	N/A	
	Computers	GFGI	Computers	GFGI	Computer(s)	GFGI
	Printers	GFGI	Printers	GFGI	Printer(s)	GFGI
	Key box	CFCI	Key box	GFGI	N/A	
Concierge[1]	N/A		Desk	GFGI	N/A	
	N/A		Desk chair	GFGI	N/A	
	N/A		2 side chairs	GFGI	N/A	
	N/A		Telephone	GFGI	N/A	
	N/A		Computer	GFGI	N/A	
	N/A		Brochure rack	GFGI	N/A	
Bell Cart Station	Luggage carts	GFGI	Brass-plated luggage cart w/ 8-in (200mm) wheels and carpet	GFGI	Luggage carts	GFGI

[1] Optional space requiring approval of the agencies noted in Chapter 1, Contacts.

Functional Program Area	Army		Navy		Air Force	
	Furnishings and Equipment	F/I	Furnishings and Equipment	F/I	Furnishings and Equipment	F/I
Food Service (Service)[1]	Microwave(s)		Microwave(s)	GFGI	N/A	
	Toaster(s)		Toaster(s)	GFGI	N/A	
	Food display racks/cases		Food display racks/cases	GFGI	N/A	
	Refrigerated display case		Refrigerated display case	GFGI	N/A	
Food Service (Dining)[1]	Dining tables	GFGI	Dining tables	GFGI	N/A	
	Chairs	GFGI	Chairs	GFGI	N/A	
	Flat panel television	GFGI	Flat panel TV	GFGI	N/A	
Food Service (Prep/storage)[1]	Work/prep tables	CFCI	Work/prep tables	GFGI	N/A	
	Reach-in freezer	CFCI	Reach-in freezer	GFGI	N/A	
	Reach-in refrigerator	CFCI	Reach-in refrigerator	GFGI	N/A	
Retail food service[1]	N/A		N/A		TBD by PVA[2]	GFCI
Retail sales[1]	N/A		N/A		Food display racks/cases	GFGI
	N/A		N/A		Refrigerated display case(s)	GFGI
	N/A		N/A		Wall mounted shelves	CFCI
	N/A		N/A		Merchandise display racks	GFGI
	N/A		N/A		Microwave	GFGI
ATM[1]	ATM machine	GFGI	ATM machine	GFGI	ATM machine	GFGI
Registration machines[1]	Registration machine(s)	GFGI	Registration machine(s)	GFGI	Registration machine(s)	GFGI
Fitness Room[1]	Treadmill	GFGI	Treadmill	GFGI	Treadmill	GFGI
	Elliptical cross-trainer	GFGI	Elliptical cross-trainer	GFGI	Elliptical cross-trainer	GFGI
	Chest press	GFGI	N/A		N/A	
	Shoulder press	GFGI	N/A		N/A	
	Rear delt-fly	GFGI	N/A		N/A	
	Flat panel television	GFGI	Flat panel TV	GFGI	Flat panel TV	GFGI
	Clean and dirty towel storage	GFGI	N/A		Clean and dirty towel storage	GFGI

[1] Optional space requiring approval of the agencies noted in Chapter 1, Contacts.
[2] To be determined by the Project Validation Assessment (PVA) based on market conditions and mission requirements.

Functional Program Area	Army		Navy		Air Force	
	Furnishings and Equipment	F/I	Furnishings and Equipment	F/I	Furnishings and Equipment	F/I
Conference Room[1]	Conference table	GFGI	Conference table	GFGI	Conference table	GFGI
	Conference chairs	GFGI	Conference chairs	GFGI	Conference chairs	GFGI
	N/A		Projector	GFGI	Multi-media projector	GFGI
	N/A		Flip chart easel	GFGI	N/A	
	Credenza	GFGI	N/A		Credenza	GFGI
	Flat panel television	GFGI	N/A		Flat panel TV	GFGI
	VCR/DVD	GFGI	N/A		DVD	GFGI
Business Center[1]	Computers and printers	GFGI	Computers and printers	GFGI	Computer(s) and printer(s)	GFGI
	Desk chairs	GFGI	Desk chairs	GFGI	Desk chairs	GFGI
Study Room[1]	Credenza	GFGI	N/A		Mission dependant	GFGI
	Flat panel television	GFGI	N/A		Mission dependant	GFGI
	VCR/DVD	GFGI	N/A		Mission dependant	GFGI
	AV cabinet	GFGI	N/A		Mission dependant	GFGI
	House phones	GFGI	N/A		Mission dependant	GFGI
	Tables and chairs (10 ppl)	GFGI	Tables and chairs (10 ppl)	GFCI	Mission dependant	GFGI
Guest Laundry	Change machine	CFCI	Change machine	GFGI	N/A	
	Laundry vending	CFCI	Laundry vending	GFGI	Laundry vending	GFCI
	Flat panel television	GFGI	N/A		N/A	
	House phone	GFGI	N/A		N/A	
	Chairs	GFGI	N/A		Chairs (space permitting)	GFGI
	Laundry-folding table	GFGI	Laundry-folding table	GFGI	Laundry-folding table	GFGI
	N/A		N/A		Laundry carts	GFGI
Gear Wash[1]	Drying racks	CFCI	Drying racks	CFCI	N/A	
Vending[1]	Drink vending	GFGI	Drink vending	GFGI	N/A	
	Snack vending	GFGI	Snack vending	GFGI	N/A	
Patio[1]	N/A		Outdoor lounge seating	GFGI	N/A	
	N/A		Outdoor patio tables w/ umbrellas	GFGI	N/A	
	N/A		Gas grill	GFGI	N/A	
	N/A		Picnic tables	GFGI	N/A	
Patio Storage[1]	N/A		Per program	GFGI	N/A	
Guest corridors/ circulation (elevator lobbies)	Console tables	GFGI	Console tables	GFGI	N/A	
	Chairs	GFGI	Chairs	GFGI	Chairs or bench	GFGI
	Mirror	GFGI	Mirror	GFGI	Mirror	GFGI
	Artwork	GFGI	Artwork	GFGI	Artwork	GFGI

[1] Optional space requiring approval of the agencies noted in Chapter 1, Contacts.

Functional Program Area	Army		Navy		Air Force	
	Furnishings and Equipment	F/I	Furnishings and Equipment	F/I	Furnishings and Equipment	F/I
Administration Services						
Manager's office	Credenza	GFGI	Credenza	GFGI	N/A	
	Desk	GFGI	Desk	GFGI	Desk	GFGI
	Desk chair	GFGI	Desk chair	GFGI	Desk chair	GFGI
	Lateral file	GFGI	Lateral file	GFGI	Lateral file	GFGI
	Small conference table	GFGI	Small conference table	GFGI	N/A	
	4 conference chairs	GFGI	4 conference chairs	GFGI	N/A	
	Telephone	GFGI	Telephone	GFGI	Telephone	GFGI
	Computer equipment	GFGI	Computer equipment	GFGI	Computer w/ peripherals	GFGI
	N/A		Bookcase	GFGI	Bookcase	GFGI
	N/A		N/A		Side chair	GFGI
Asst. manager's office[1]	Credenza	GFGI	Credenza	GFGI	N/A	
	Desk	GFGI	Desk	GFGI	Desk	GFGI
	Desk chair	GFGI	Desk chair	GFGI	Desk chair	GFGI
	Lateral file	GFGI	Lateral file	GFGI	Lateral file	GFGI
	Telephone	GFGI	Telephone	GFGI	Telephone	GFGI
	Computer equipment	GFGI	Computer equipment	GFGI	Computer w/ peripherals	GFGI
	Side chair	GFGI	Side chair	GFGI	Side chair	GFGI
	N/A		Bookcase	GFGI	Bookcase	GFGI
Front desk supervisor	Credenza	GFGI	Credenza	GFGI	N/A	
	Desk	GFGI	Desk	GFGI	Desk	GFGI
	Desk chair	GFGI	Desk chair	GFGI	Desk chair	GFGI
	Side chair	GFGI	Side chair	GFGI	Side chair	GFGI
	Lateral file	GFGI	Lateral file	GFGI	Lateral file	GFGI
	Telephone	GFGI	Telephone	GFGI	Telephone	GFGI
	Computer equipment	GFGI	Computer equipment	GFGI	Computer w/ peripherals	GFGI
	CCTV monitor	GFGI	CCTV monitor	GFGI	CCTV monitor	GFGI
	Key box	CFCI	Key box	GFGI	N/A	
	N/A		Bookcase	GFGI	Bookcase	GFGI
Accounting office	Modular workstations with side chairs	GFGI	Modular workstations with side chairs	GFGI	Desk(s) and desk and side chairs	GFGI
	Telephones	GFGI	Telephones	GFGI	Telephones	GFGI
	Computers	GFGI	Computers	GFGI	Computers	GFGI
	Key box	CFCI	Key box	GFGI	N/A	GFGI
	N/A		N/A		Lateral file(s)	GFGI
	N/A		N/A		Bookcase(s)	GFGI

[1] Optional space requiring approval of the agencies noted in Chapter 1, Contacts.

Functional Program Area	Army		Navy		Air Force	
	Furnishings and Equipment	**F/I**	**Furnishings and Equipment**	**F/I**	**Furnishings and Equipment**	**F/I**
Clerical	Modular workstation with side chair	GFGI	Modular workstation with side chair	GFGI	Desk(s) and desk and side chairs	GFGI
	Telephone	GFGI	Telephone	GFGI	Telephone(s)	GFGI
	Computer	GFGI	Computer	GFGI	Computer(s)	GFGI
	N/A		N/A		Lateral file(s)	GFGI
	N/A		N/A		Bookcase(s)	GFGI
Reservations[1]	Modular workstations with side chairs	GFGI	Modular workstations with side chairs	GFGI	Desk(s) and desk and side chairs	GFGI
	Telephones	GFGI	Telephones	GFGI	Telephone(s)	GFGI
	Computers	GFGI	Computers	GFGI	Computer(s)	GFGI
	Key box	CFCI	Key box	GFGI	N/A	
	N/A		N/A		Lateral file(s)	GFGI
Work space	Copier	GFGI	Copier	GFGI	Copier	GFGI
	Facsimile machine	GFGI	Facsimile machine	GFGI	Facsimile machine	GFGI
	Paper shredder	GFGI	Paper shredder	GFGI	Paper shredder	GFGI
	File cabinets	GFGI	File cabinets	GFGI	File cabinets	GFGI
	Work table	GFGI	Work table	GFGI	Work table	GFGI
Cash room	Telephone	GFGI	Telephone	GFGI	Telephone	GFGI
	2 Desk chairs	GFGI	2 Desk chairs	GFGI	Desk chair(s)	GFGI
Floor Support						
Janitor Areas	Janitors cart		Janitors cart	GFGI	N/A	
Housekeeping Areas	Housekeeping cart	GFGI	Housekeeping carts	GFGI	Housekeeping carts	GFGI
	Vacuum cleaners	GFGI	Vacuum cleaners	GFGI	Vacuum cleaners	GFGI
Back-of-House Support						
Training Room[1]	N/A		N/A		Tables	GFGI
	N/A		N/A		Chairs	GFGI
	N/A		N/A		Flat Screen TV	GFGI
	N/A		N/A		DVD	GFGI
	N/A		N/A		Overhead projector	GFGI
Training Office[1]	Desk	GFGI	N/A		Desk	GFGI
	Desk chair	GFGI	N/A		Desk chair	GFGI
	Lateral file	GFGI	N/A		Lateral file	GFGI
	Side chair	GFGI	N/A		Side chair	GFGI
	Book shelves	GFGI	N/A		Book shelves	GFGI
	Computer	GFGI	N/A		Computer	GFGI
	Telephone	GFGI	N/A		Telephone	GFGI
Janitor Areas	Carpet extractor	GFGI	Carpet extractor	GFGI	N/A	
	High-speed buffer	GFGI	High-speed buffer	GFGI	N/A	

[1] Optional space requiring approval of the agencies noted in Chapter 1, Contacts.

Functional Program Area	Army		Navy		Air Force	
	Furnishings and Equipment	F/I	Furnishings and Equipment	F/I	Furnishings and Equipment	F/I
Housekeeping Manager	Desk	GFGI	Desk	GFGI	Desk	GFGI
	Desk chair	GFGI	Desk chair	GFGI	Desk chair	GFGI
	Credenza	GFGI	Credenza	GFGI	N/A	
	Lateral file	GFGI	Lateral file	GFGI	Lateral file	GFGI
	Side chair	GFGI	Side chair	GFGI	Side chair	GFGI
	Key box	GFGI	Key box	GFGI	Key box	GFGI
	2 storage cabinets	GFGI	2 storage cabinets	GFGI	2 storage cabinets	GFGI
	Telephone	GFGI	Telephone	GFGI	Telephone	GFGI
	Computer	GFGI	Computer	GFGI	Computer	GFGI
	Time clock	GFCI	Time clock	GFGI	Time clock	GFCI
Soiled/Clean Linen Storage	Linen delivery carts	GFGI	Linen delivery carts	GFGI	Linen delivery carts	GFGI
Receiving	Hand/platform truck	GFGI	Hand/platform truck	GFGI	N/A	
Receiving/supply office[1]	Desk	GFGI	Desk	GFGI	N/A	
	Desk chair	GFGI	Desk chair	GFGI	N/A	
	Lateral file	GFGI	Lateral file	GFGI	N/A	
	Side chair	GFGI	Side chair	GFGI	N/A	
	Telephone	GFGI	Telephone	GFGI	N/A	
	Computer equipment	GFGI	Computer equipment	GFGI	N/A	
	Key box	CFCI	Key box	GFGI	N/A	
Linen Laundry[1]	Linen carts	GFGI	Laundry trucks	GFGI	N/A	
	Anti-static/ antifatigue mat	GFGI	Anti-static/ antifatigue mat	GFGI	N/A	
	Ironer/folding machine	CFCI	Ironer/folding machine	GFGI	N/A	
Break area	Flat panel television	GFGI	Flat panel TV	GFGI	Flat panel TV	GFGI
	Tables	GFGI	Tables	GFGI	Tables	GFGI
	Chairs	GFGI	Chairs	GFGI	Chairs	GFGI
	N/A		Refrigerator	GFGI	Refrigerator (full-size)	GFGI
	N/A		Microwave	GFGI	Microwave	GFGI
	N/A		Coffee machine	GFGI	Coffee machine	GFGI
	N/A		Overhead projector	GFGI	N/A	

[1] Optional space requiring approval of the agencies noted in Chapter 1, Contacts.

Functional Program Area	Army		Navy		Air Force	
	Furnishings and Equipment	**F/I**	**Furnishings and Equipment**	**F/I**	**Furnishings and Equipment**	**F/I**
Maintenance Workshop	Desk	GFGI	Desk	GFGI	Desk	GFGI
	Desk chair	GFGI	Desk chair	GFGI	Desk chair	GFGI
	Lateral file	GFGI	Lateral file	GFGI	Lateral file	GFGI
	Chairs	GFGI	Chairs	GFGI	Chairs	GFGI
	Telephone	GFGI	Telephone	GFGI	Telephone	GFGI
	Computer	GFGI	Computer	GFGI	Computer	GFGI
	Work tables	GFGI	Work tables	GFGI	Work tables	GFGI
	Storage cabinets	GFGI	Storage cabinets	GFGI	Storage cabinets	GFGI
	Key box	CFCI	Key box	GFGI	Key box	GFGI
	N/A		N/A		Carpet extractor	GFGI
	N/A		N/A		High-speed buffer	GFGI
	N/A		N/A		Grounds equipment	GFGI
Grounds Equipment Storage[1]	Grounds equipment	GFGI	Grounds equipment	GFGI	N/A	
Service Circulation	Tracking mats at entrances	GFGI	Tracking mats at entrances	GFGI	Tracking mats at entrances	GFGI

[1] Optional space requiring approval of the agencies noted in Chapter 1, Contacts.

APPENDIX A REFERENCES

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ASHRAE

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ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, GA 30329, www.ashrae.org

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U.S. ENVIRONMENTAL PROTECTION AGENCY

Energy Star, U.S. Environmental Protection Agency, http://www.energystar.gov/

U.S. GREEN BUILDING COUNCIL

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KITCHEN CABINET MANUFACTURERS ASSOCIATION

Kitchen Cabinet Manufacturers Association Standards, 1899 Preston White Drive, Reston, VA 20191-5435, www.kcma.org

NACE

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UFC 1-200-01, General Building Requirements

UFC 2-000-05N (P-80), Facility Planning Criteria for Navy/Marine Corps Shore Installations

UFC 3-101-01, Architecture

UFC 3-120-01, Air Force Sign Standard

UFC 3-120-10, Interior Design

UFC 3-201-02, Landscape Architecture

UFC 3-210-02, POV Site Circulation and Parking

UFC 3-210-10, Low Impact Development

UFC 3-400-01, Energy Conservation

UFC 3-410-01FA, Heating, Ventilating, and Air Conditioning

UFC 3-450-01, Noise and Vibration Control

UFC 3-520-01, Interior Electrical Systems

UFC 3-530-01, Design: Interior and Exterior Lighting and Controls

UFC 3-600-01, Fire Protection Engineering for Facilities

UFC 4-010-01, DoD Minimum Antiterrorism Standards for Buildings

APPENDIX B BEST PRACTICES

B-1 INTRODUCTION.

The following material identifies background information and other current, good design practices for LFs. The designer is expected to review and interpret this guidance and apply the information according to the needs of the project.

B-2 PROJECT PLANNING.

B-2.1 Site Analysis Costs.

Project programmers must consider costs for the following:

- Preliminary soils analyses essential to determine whether extensive site work and foundation costs are required. Also, organic soil analyses for exterior landscape plant materials may be required.

- Local environmental and climatic conditions such as heavy snow loads, wind loads, high humidity, and extreme temperatures result in additional costs due to structural, and to a lesser extent, insulation requirements.

- Projects located in areas prone to seismic activity.

- Projects located in designated historic districts may incur additional cost in order to ensure compliance with historic preservation requirements.

- The Installation will fund site development costs to include cut/fill and other work necessary to make the site usable. The Installation will provide all NAF projects with a clean site up to 6 in. (150 mm) below grade in accordance with DoDI 1015.15. The Installation is responsible for supporting costs. This considers all work outside the 5-ft. (1525 mm) building line and includes site preparation, roads, utilities, landscaping demolition, etc.

B-3 SITE DESIGN.

B-3.1 General Considerations.

B-3.1.1 Site Development.

The site plan is one of the more important elements of any project design and can greatly impact the overall success of the LF project. Involve the installation community planner, architect, landscape architect, and civil, mechanical, electrical, and communication engineers, and the organizations identified in Chapter 1, Contacts. Achieve spatial balance and scale through thoughtful placement and arrangement of structures, landscaping and landforms. Pay special attention to building orientation, mass and scale in developing the site plan.

B-3.1.2 Proximity to Common Use Areas.

Although the emphasis in LF campus planning is to create a residential neighborhood atmosphere, somewhat separated from surrounding base administrative and mission related functions, proximity and access to common public use facilities are desired. The design of vehicular paths, pedestrian paths and landscape can help define layers of boundary around the lodging facility campus to provide this separation, but can also enhance the flow into and out of the adjacent community areas, such as the dry cleaners, post office, dining establishments, theatre, fitness center, enlisted dining facility, and clubs.

B-3.1.3 Adjacencies to Public Areas.

Adjacent recreational spaces additionally enhance these layers of boundary and can buffer other non-desired areas or functions. Site planning and community planning will define an edge to the LF campus, while considering the importance of adjacent community and common public areas. Reference AFPAM 32-1010 for additional useful information and guidance on this subject.

B-3.1.4 Community Planning.

Develop a sense of order, arrival, orientation and community in planning the site. To the extent possible, lodging structures must not be overwhelming in apparent size. Site lodging facilities in relationship to one another to create outdoor spaces for use as passive or active recreation areas. Overall room requirements and available acreage will establish the number of stories of a new LF facility. Any configuration needs to ensure an efficient use of available real estate, but may require additional fire protection, structural, and life safety costs associated with buildings over three stories in height. Locate industrial areas and spaces such as loading docks, mechanical rooms, electrical rooms, trash dumpsters, HVAC equipment toward the rear of the facility or otherwise away from the guest view.

B-3.1.5 Building Placement.

Building placement and design should also take advantage of views that are scenic, pleasant, or interesting. Designers must be sensitive to the approaches to the facility and strive to create a clear sense of arrival for newcomers.

B-3.1.6 Climatic Considerations.

LF design and building orientation must take advantage of local climatic conditions. Where practical, use passive solar construction techniques to reduce energy consumption. Local climate conditions must be considered as well as other site organization issues such as the creation of outdoor space, building scale or orientation to other facilities, when determining the best project site.

B-3.1.7 Natural Features.

Site facilities should take advantage of the positive features of the site. Provide protection from undesirable winds and glare. Incorporate shading from excessive sun in warm climates. Solar gain and prevailing winds can enhance energy conservation and yield significant cost savings. Design roof overhangs to account for sun angles to provide solar shading. Achieve mutual shading by sensitively arranging adjacent structures. Avoid excessive east or west-facing glass and design for maximum cross-ventilation where feasible.

B-3.2 Site Circulation.

B-3.2.1 Vehicular Access.

Plan vehicular layout to eliminate, or at least minimize, the adverse impact of noise and headlights shining into guest room windows. Consider delivery truck access and required easements.

B-3.2.2 Emergency Service.

Reference Chapter 3, Fire Protection and Life Safety, for a minimum separation required between lodging facilities and the closest adjacent building. This separation is for fire protection purposes but may also be dictated by force protection requirements and local fire protection policies.

B-3.2.3 Service Vehicles.

Access drives and parking areas will be designed to accommodate service vehicles. Where interior court areas are proposed between adjoining lodging structures, consider designing the main pedestrian walks to accommodate such vehicles. When doing so, these walkways must be a minimum of 8 ft. (2.4m) wide and must be constructed using reinforced concrete to accommodate medium weight vehicles. Consider treating the walkways with a patterned concrete system to minimize the negative visual impact of the wider access route. Consider materials such as concrete grass road type pavers to provide access for infrequent service vehicles.

Consider installing removable bollards as needed to restrict unauthorized vehicle access. Where possible, separate service entrances associated with mechanical rooms or mechanical enclosures from guest parking areas.

B-3.2.4 Bus Route Access.

Where possible and appropriate, consider access to public transportation systems in project design. If the Installation provides bus service, designers will consider including shelters and walks to serve guest needs. Bus shelters must be compatible with the architectural style of existing buildings and guidelines established by the Installation.

B-3.2.5 Pedestrian Access.

Consider including links to jogging/biking trails as part of the site development process. In northern tier locations, consider the use of sidewalks above steam heat tunnels to keep walkways free of ice in the winter, or consider heated or covered walks in lieu of open corridors.

B-3.2.6 Bicycle Parking.

Provide bicycle parking facilities within the lodging campus area as determined by the Installation and in accord with UFC 4-010-01. Racks will comply with base architectural guidelines. Provide all bicycle parking on concrete surfaces adjacent to sidewalks or first floor building corridors. If these areas are covered and screened from view of the general public, they must be located outside the force protection setback. Consider covered bicycle parking enclosed on a minimum of three sides in northern tier or highly corrosive environments. Consider lockable bicycle lockers, which maximize security and minimize visual clutter.

B-3.3 Site Considerations.

B-3.3.1 Finished Floor Elevation.

Establishing the ground-level finished floor elevation of LF facilities is one of the more important aspects of site planning. The finished floor elevation affects grading, cut and fill, visual impact of the facility and interior-exterior transitions. In addition, the finished floor elevation has a significant impact on the landscape architect's ability to effectively introduce plant materials into the new environment.

Leveling the site without sensitivity to other demands results in barren sites that lack visual interest. The landscape architect, architect, and civil engineer must work closely together to achieve optimal design results.

B-3.3.2 Grading.

Grade the site to achieve an orderly transition from the point where guests enter the site by vehicle or on foot to the point where they are at the first floor entrance. Site grading must consider the impacts of the parking area, the lodging facility, bus-stop shelters, sidewalks, outdoor passive use areas, mechanical equipment, and trash dumpsters. Provide smooth transitions (no steps) at building entries. For renovation projects, make every effort to eliminate stairs to the facility. Where appropriate, use grading to control the negative visual impacts that these man-made facilities have on the visual environment. See the discussion of landforms below.

Lodging facilities tend to be linear and relatively narrow in configuration and therefore lend themselves to an orientation paralleling existing contours. Where on-site storm water retention is required, the location of retention areas must be carefully thought out in terms of function as well as visual impact. Use large water retention sites for outdoor recreation areas. Refer to UFC 3-210-10 for further storm water guidance.

B-3.3.3 Landforms.

Use landforms to soften the impact of parking on the landscape and to positively enhance force protection of the lodging facility campus. Use landforms such as mounds and swales in conjunction with landscape plant materials to soften or obscure the parking areas, provide spatial articulation, or enhance drainage structures or surface water retention areas. Use landforms to add interest and diversity to the project. In particular, landforms can perform an important function around outdoor activity areas by screening undesirable views.

B-3.3.4 Storm Drainage.

Depending on the geographic location and the availability of nearby subsurface storm drains, provide underground storm drainage for each lodging campus. All site water must either be intercepted in drop inlet structures or be designed to drop directly into a subsurface system. If subsurface storm drains are not available at the proposed site, include as part of the lodging facility project. As a minimum, divert surface water to an underground system to a point where it is discharged into above ground storm drains. Project funds will provide for appropriate surface water retention and erosion prevention, and will provide for drop inlets as necessary to intercept surface runoff and prevent walkways from being flooded.

B-3.3.5 Utility Corridors.

The site planner will develop underground utility corridors (easements) in coordination with the base community planner, electrical, mechanical, communication and civil engineers. Design corridors to accommodate future expansion. Place utility corridors no closer than one and one-half times the crown width of nearby mature trees or 35 ft. (10.7m), whichever is greater. Locate utility corridors to allow for future street-tree plantings. Consider using pipe tunnels and trenches.

B-3.4 Site Amenities.

B-3.4.1 Site Lighting.

Site lighting is an integral part of any lodging project. Provide lighting to ensure occupants have a means of safely moving between outdoor spaces. All signage and lighting must be in compliance with the Installation's standards. The selection of materials and locations must be a joint decision between the landscape architect and the electrical engineer. Energy-efficient lamps such as high-pressure sodium with color correction ensuring optimum visual acuity are recommended for energy-conscious site lighting. Consider life-cycle costs of lamp replacement, though, when specifying fixture and lamp types.

Provide adequate site lighting at any point where there is a change in grade requiring steps, near accessible parking areas, under stairwells, and near main entrances to buildings. A lighted sign may be appropriate for night visitors. Use the recommendations of the referenced documents in Chapter 3, Electrical Design, to establish illumination levels. Design exterior lighting such that zero direct-beam illumination leaves the building site. Consider motion detection and photosensitive

sensors to achieve energy efficient lighting design. Additionally, consider a solar collection system if the geographical location of the lodging facility can support the required solar levels required.

B-3.4.2 Outdoor Areas.

Include outdoor passive and/or active use areas in all lodging campus plans. These features will include project-funded amenities such as walks, site lighting, landscaping, pavilions, and fencing (only if used to screen equipment or dumpsters enclosures). Where appropriate, design pavilions to become an integral part of the site. The pavilions must complement the architectural style and materials of the lodging. Consider additional amenities such as barbecue grills, tables, and benches.

B-3.4.3 Sustainability.

Incorporate sustainable design concepts into the lodging facility campus. Consider recycling centers and containers and other refuse issues when developing site design and landscaping. Coordinate locations of recycling and refuse containers with site furnishings and landscape to complement the campus and building design. Emphasize ease of use and service access to these containers. Army should comply with the USACE Army LEED Implementation Guide.

B-3.5 Landscape Architecture.

B-3.5.1 Landscape Site Design.

Perform a site analysis that includes visual elements, hydrology, security, climatic conditions, topography, maintenance, existing vegetation, spatial and program analysis, soil quality, and circulation patterns. Consider these landscape design techniques and principles:

- Enframement. Use landscape elements to focus attention on important features by manipulating and placing tree masses and screening undesirable features.

- Visual Separation. Separate multiple buildings into framed units and arrange shrubs and small trees around a building to soften structural lines.

- Spatial Articulation. Use plant materials to create outdoor enclosed spaces, to separate spaces one from another, and to direct people through outdoor spaces by visually defining and reinforcing patterns of movement.

- Visual Screening or Enhancement. Use landscape elements to screen unattractive views of objects such as trash dumpster areas, pad mounted electrical transformers, parking areas, and mechanical utilities.

- Wind Control. Use landscape elements to control, slow, guide, deflect, or filter the prevailing winds.

- Sun Control. Use landscape elements around buildings, walkways, and parking areas to intercept direct and reflected radiation from buildings and parking.

B-3.5.2 Landscape Irrigation.

Landscape with indigenous materials and plants to minimize irrigation needs. Consider irrigation systems for arid and semi-arid climatic regions. Use bubbler or drip irrigation systems adjacent to building facades to minimize impact of over spray. Provide all irrigation systems with solid-state automatic multi-station controllers, state-of-the-art control valves, and backflow preventers in accordance with building codes. Provide separate metering for the irrigation system.

In cold climates, locate backflow preventers in the mechanical room. Where freezing is not a problem, locate backflow preventers within screened mechanical enclosures. Include adjusting turf spray coverage, duration of watering cycles, repairing leaks, and general maintenance to ensure proper functioning during the maintenance period for all irrigation systems. Water conservation is a high-priority factor in development of the irrigation design. Take advantage of non-potable water if possible.

B-4 BUILDING DESIGN.

Building design for LFs shall address needs for comfort while incorporating functional building systems. Comprehensive interior design is a critical component, ensuring appropriate finish, material, and furnishing selections. The goal is to provide a cohesive lodging campus reflecting a quality appearance, appropriately sited within the existing community, fulfilling functional and operational requirements, and addressing guest's needs.

B-4.1 Mass and Scale.

Large lodging facilities often have a greater mass than many buildings on an Installation. Modulate the form and facade of these buildings with setbacks, repetitive details, and less dominant colors to soften their physical appearance and blend them in terms of form, proportion, and perceived size. Combine size, shape, proportion, repetition, and placement of design features such as fenestrations, roofs, and columns, etc., to project the architectural character and mass of a building. When planning the project, consider the possibility of future renovations or additions to minimize extensive changes.

Lodging facilities must provide a commercial hospitality environment with an architectural scale that imparts a clear sense of relative comfort, ease, and satisfaction. Architectural scale is defined as the comparative relationship of a structure or space to the human form to possess a human scale. Use relative proportions, height, form and volume of the building or space and its formal relationship to other buildings or spaces to achieve this sense of scale.

B-4.2 Architectural Compatibility.

Despite its massive size, a lodging facility's architectural character must be in context with its surroundings. Architectural character is typically defined in the architectural compatibility standards available at most Installations.

B-4.3 Exterior Finish Materials.

Select reliable, conventional building systems for lodging facilities, and use building materials and finishes that are durable and easy to maintain. Select architectural systems based on their aesthetics, simplicity, economic characteristics, and compliance with Installation architectural guidelines. Consider the benefits and limitations of brick, split face concrete block, and custom pre-finished tilt-up wall construction; they have been used successfully as primary exterior wall finishes. If allowed within Installation standards, brick or split-face block are the preferred exterior finishes. Consider the recycled content requirements for affirmative procurement of products included in the Environmental Protection Agency list of guideline items such as insulation, cement and concrete, latex paint, patio blocks, and structural fiberboard.

B-5 INTERIOR DESIGN.

The interior design of LFs encompasses functional area requirements, relationships, and interior materials and finishes. Several basic lodging functions must be addressed during the design phase of any lodging project. Designers must fully understand the relationships between these interactive functions and take a holistic approach to creating a fully integrated facility:

- Residential. Guest rooms are residential. Activities include sleeping, resting and relaxation (television viewing, reading, etc), personal hygiene and grooming, personal cooking (microwave), and personal study.

- Guest Support. Guest support activities include reception, vending, laundry, retail sales, administration, guest business activities, secure luggage storage, small-scale food and beverage, and meeting/conference activities.

- Services. Service activities allow the facilities to operate efficiently and include back-of-house and guest support services. Back-of-house activities include utility services, maintenance, staff functions, housekeeping, bulk storage, linen storage, supply storage, delivery and refuse removal.

The interior design and architectural design of the facility must be in context with characteristics of the built environment of the local region. The interior design also has a direct impact on the quality of life for the guests.

B-5.1 Interior Design Services.

Interior design shall comply with the Service-specific branding concepts that provide the finish and color requirements for each space. The agencies noted in Chapter 1, Contacts, shall provide the latest branding concept standards. See UFC 3-120-10 for further information on interior package requirements.

A budget is established for all FF&E. FF&E is specified to be durable, functional and aesthetically pleasing with cost and maintenance factors high in consideration. Interior designers must be diligent in staying within the budgeted amount for the entire furnishings package. Interior designers should refrain from one-of-a-kind or custom-made furnishings and lighting. In some instances, custom-sized case goods are required due to architectural constraints affecting the room layout; no special approval is required in these cases.

B-5.2 Color and Materials Selection.

Select materials to be long-lasting and durable to ease maintenance. Finishes and color scheme should provide a warm, inviting facility for guests.

B-5.3 Interior Finishes.

When selecting interior finishes, consider the recycled content requirements for affirmative procurement of products included in Environmental Protection Agency list of guideline items. Federal agencies must purchase products made with recycled materials unless these products do not meet technical requirements, are more expensive than comparable virgin material products, are not available competitively from two or more sources, or are not available in a timely manner. The items in this list related to interior design include carpet and cushion, latex paint, floor tiles, and shower and restroom dividers. This list changes as the Environmental Protection Agency adds new items every other year. The complete list of guideline items and their recycled content requirements is found on the Environmental Protection Agency website. Additionally, designers are encouraged to work with product manufacturers for other available products.

B-5.3.1 Carpet.

Consider new products with additional wear-ability and maintenance abilities, and consider recycled/recyclable goods.

B-5.3.2 Walls.

The use of natural materials such as stone on the interior can provide a durable finish and provide warmth and texture to the space and will be considered as part of the entrance/lobby area design. If budget allows, consider the use of a textured acrylic finish in common areas and guest rooms, providing a durable coating, rich in texture and easy to maintain.

B-5.3.3 Ceilings.

Lay-in acoustical tile ceiling systems with exposed suspended grid systems will be specified for use in administrative areas, business centers, and conference areas only, as they convey a nonresidential quality and are easily damaged. Avoid heavily textured acoustical treatments, including a sprayed popcorn ceiling application, which is difficult to patch.

Coordinate ceiling treatment with lighting selections. Consider varying ceiling heights and combination task and ambient lighting packages, especially in corridors and large areas, such as lobbies and conference rooms, to create interest. Emphasize natural light as much as possible. Consider the use of painted wood crown molding throughout primary guest support areas and in suites.

B-5.4 Furniture Considerations.

Coordinate with the Comprehensive Interior Design package during the design process. All case goods and hardware will be coordinated with the Structural Interior Design package for the project to ensure matching woods, stains, and finishes as best possible. Selection of materials and finishes for the main lobby area will accommodate heavy use.

B-5.5 Signage, Artwork and Accessories.

B-5.5.1 Public Area Artwork.

Provide artwork for all public areas. Coordinate with the installation and the organizations identified in Chapter 1, Contacts. Graphics presentation and content must be well designed, coordinated with the architecture and interior design packages, and compatible with the local geographical culture. All artwork shall be hung with security hangers. Silk plants are authorized for common areas.

B-5.5.2 Accessiblity in Signage.

Interior signage will be in accordance with the installation sign standards, accessibility requirements defined in Chapter 3, Accessibility, and UFC 3-120-01. All interior signage will be funded as part of the LF project. Provide clearly visible unit room names and/or numbers for all guest support areas including main entrance signage and direction signage, service areas, and individual guest rooms and suites. Coordinate directional signage and individual guest room numbering schemes with the local lodging manager and base communications. Consider odd numbers on one side of the hallway and even numbers on the opposite side.

B-5.5.3 Fixture Color and Finish Requirements.

With the exception of emergency pull boxes, all speakers, electrical panel covers and access panel covers exposed to interior rooms, thermostat controls, fire extinguisher cabinets, hose boxes, electrical boxes, plumbing chase covers, etc. will have a factory finish to match the color of surrounding walls or ceiling as specified in the Structural Interior Design package. Standard factory finish colors may not be acceptable.

B-5.6 Equipment Considerations.

- Coordinate the use and location of recycling centers throughout the common areas to complement the interior design while supporting sustainability guidance.

- All appliance colors should be coordinated with the FF&E. The construction contractor or design/build contractor will submit cut/datasheets of proposed equivalents/substitutions appliances for review/approval.

- Purchase appliances meeting Energy Star program standards and specifications as included in this guide. Qualifying products are listed on the Energy Star website.

B-6 BUILDING SYSTEMS.

B-6.1 Energy Performance.

Sustainable energy efficient performance in lodging facilities cannot be achieved solely by individual building systems but must be supplemented by other design factors. Comply with UFC 3-400-01. Design factors such as mechanical systems and management controls selection, thermal insulation characteristics, building orientation, solar shading, landscape, electrical system design, occupancy sensor devices, and appliance selection will be considered.

There are many other factors designers must consider, but they will keep in mind the importance of life cycle cost analysis for lodging facilities. The military Services keep their facilities for a longer period of time than most buildings in the private sector. Therefore, considerable attention will be given to energy-efficient design in the initial planning process. Efficient energy management policies require consideration of whole building design that relies on renewable energy sources.

B-6.2 Structural.

B-6.2.1 Structural Selection.

Select an economical structural system based on force protection requirements, facility size, projected load requirements, subsoil conditions, local availability of materials and labor, feasibility of prefabrication, local construction practices, and resistance to fire, wind, snow, seismic, geologic, and permafrost conditions. Decisions concerning the structural system have substantial impact on construction costs. Coordinate column spacing and layout with the floor plan to ensure column placement within or in alignment with walls. Minimize columns awkwardly placed within guest rooms or living areas, and limit placement to larger public spaces.

B-6.2.2 Structural Best Value.

Analyze the proposed structural system to determine if it is the best value method to realize the architectural design intent. Larger projects such as a new LF campus design or fast track design-build projects will consider new alternative construction methods and materials. Based on the required expertise needed to apply new construction methods, these systems are not recommended for smaller lodging projects.

B-6.2.3 Life Cycle Considerations.

Roof systems and supporting structure will consider life cycle costs as well as long-term durability and ease of maintenance. Concrete tile roofing systems and metal roofing systems are recommended for typical lodging construction.

B-6.3 Mechanical System Selection.

Use of a central plant will be considered for LF campuses. A central plant with heating and cooling equipment reduces maintenance and capitalizes on the higher efficiency of larger capacity commercial equipment. Ground-mounted and through-the-wall AC systems may also be considered, as appropriate.

Consider the use of renewable energy technologies as part of the selection of the HVAC system or as a supplemental energy source. Reference UFC 3-400-01 for further guidance. The use of ground source heat pumps is encouraged if economically feasible. Benefits include energy conservation and reduced maintenance. Energy Management Control Systems (EMCS) are effective energy savings systems and highly encouraged.

B-6.4 Plumbing.

Mechanical engineers, architects and structural engineers must work together to carefully plan the size and location of plumbing chases with minimal impact on usable living space. Consider collocating plumbing chases with exhaust risers serving each guest room.

B-6.5 Electrical/Communications.

The electrical design of a LF project will be based on maximum guest room hotel occupancy. Provide surge protection on service entrances, distribution panels, and sensitive load circuits. Mass Notification system speakers will be 4 in. (100mm) diameter, recessed, and factory finished to match color of wall or ceiling as specified in the Structural Interior Design package.

The standards referenced in this UFC apply to the planning, design, and construction phase of new LF construction and renovation to existing facilities and systems. These standards will also serve as a checklist for reviewing drawings and specifications for electrical design of LF projects. Floor plans must show the location of all electrical equipment, items, devices, controls, and loads. Construction drawings must include one line for all electrical equipment (transformers, switching gear, panels, loads, etc) including schedules for all panels, circuits, and loads. Consideration to daily operation and maintenance will be emphasized. This list will not be considered complete or all-inclusive, but rather a starting place. Improved concepts and additions will be added as well as “lessons learned.” Cross-exchange of new, improved, more efficient data is encouraged to increase the electrical group knowledge and processes as well as to further minimize life-cycle costs for lodging facilities. Ensure that 110v, 60hz duplex outlets are provided in rooms in overseas locations, in addition to any differing local standard (i.e., such as the 220/230v, 50hz European standard).

B-6.5.1 Lighting.

Lodging facilities have historically suffered from poor lighting levels, thus designers must provide a much higher quality light source, light level and fixture selection to enhance new LF spaces and their use. The designer must be cognizant of lighting for both day and night situations and will emphasize the use of natural light in combination with lamps to provide a comfortable lighting level. Consider the use of a certified lighting consultant, and provide the highest quality illumination within budget and life cycle cost limitations.

Coordinate lighting selections with ceiling treatments and consider combinations of recessed lighting, light coves, indirect lighting and soffit lighting as alternatives. Coordinate ductwork and lighting locations to use soffit areas as possible. Provide blocking in walls throughout for all wall- mounted accessories including wall mounted lighting fixtures. Limit the types of lamps necessary to simplify inventory. LED lamps and compact fluorescent lighting are good alternatives over traditional lighting systems based on long term energy efficiencies, improved luminance, and long lamp life spans. Specify interior lighting that meets Energy Star program standards. Qualifying products are listed on the Energy Star website. Consider solar-powered exterior luminaries when they meet lighting requirements and are cost effective.

B-6.6 Corrosion Protection.

Conform with NACE International standards for corrosion control on all LF projects. This includes material selection—non-metal or no dissimilar metals, cathodic protection for all underground metal systems, protective coatings for above ground structures and underground metal, and industrial water treatment. Include corrosion protection for electrical components in humid/salt air environments. Consider nitrogen purge or refrigeration type dehumidification protection systems depending on size and capacity.

APPENDIX C SPACE CRITERIA

C-1 INTRODUCTION.

C-2 Space Criteria Chart provides the space criteria standards for all the support spaces. Space standards vary according to the number of guest rooms and suites, the number of floors, whether the facility is central or satellite, and optional programs and spaces. Some spaces must be custom programmed for each facility considering specific site and operational factors. The final space program shall be carefully coordinated with and approved by the agencies identified in Chapter 1, Contacts. To help illustrate the potential combinations of spaces and how they will generate a complete space program, three examples are included in C-2:

- Sample A describes an Army central facility that has 400 rooms and four floors in a 400-room program on a training Installation with 10% suites.

- Sample B describes a Navy central facility that has 200 rooms and four floors in a 200-room program with 5% suites.

- Sample C describes an Air Force central facility that has 350 rooms and four floors in a 350-room program with 5% suites.

C-2 SPACE CRITERIA CHART.

Functional Program Area		Base Area[1]		Space Standard (planning factor)	Notes/explanation	Sample A			Sample B			Sample C		
		ft.^{2}	m^2			Option/Quan	ft.^{2}	m^2	Option/Quan	ft.^{2}	m^2	Option/Quan	ft.^{2}	m^2
Guest Services	Covered Entry	550	51.1	Per Central Facility	Count 50% of actual roof area	Required	275	0.0	Required	275	25.5	Required	275	0.0
	Entrance Vestibule	100	9.3	Per Facility	Standard size	Required	100	9.3	Required	100	9.3	Required	100	9.3
	Central Lobby	4	0.4	Per Central Facility guest room (gst rm)	Includes lobby circulation and seating areas	Required	1600	148.6	Required	800	74.3	Required	1400	130.1
	Satellite Lobby	260	24.2	100sf + 1sf per Satellite gst rm	Reduced circulation and seating	N/A	N/A		N/A			N/A		
	Reception	150	13.9	150sf <100 Program gst rm + 75sf per ea addl 100 gst rms up to 375sf max	75sf per staff, minimum two staff. Count all program guest rooms	Required	375	34.8	Required	225	20.9	Required	338	31.4
	Concierge	45	4.2	Per optional Central Facility space	Concierge station in lobby	No			No			No		
	Bell Cart Station	20	1.9	20sf <100 Facility gst rm + 10sf per ea addl 50 gst rms	10sf per cart	Required	80	7.4	Required	40	3.7	Required	70	6.5
	Coffee Bar	25	2.3	Per optional Central Facility space	Optional self-service coffee	No			No			No		
	Food Service: Prep and Storage	150-240	13.9-22.3	Per optional Central Facility space	To be custom programmed with a minimum of 150sf to max of 240sf	Yes	150	13.9	No			No		
	Food Service: Service	90-120	8.4-11.1	Per optional Central Facility space	To be custom programmed with a minimum of 90sf to max of 120sf	Yes	100	9.3	No			No		
	Food Service: Dining	150	13.9	Optional space at 150sf <100 Central Facility gst rm + 115sf ea addl 50 gst rm up to 600sf max	All three Food Service spaces must be programmed together	Yes	600	55.7	No			No		
	Retail Food Service	TBD	TBD	Variable optional Central Facility space based on retail provider	Coordinate the space program with the retail food service vendor	No			No			Yes	650	60.4
	Retail Sales	TBD	TBD	Variable optional Central Facility space based on retail provider	Coordinate the space program with the retail vendor	No			No			Yes	80	7.4
	Luggage Storage	75	7.0	75sf <100 Program gst rm + .25sf per ea addl gst rm to 150sf max	Count all program guest rooms	Required	150	13.9	Required	100	9.3	Required	138	12.8
	ATM	10	0.9	Per optional Central Facility space	Optional one ATM machine	No			Yes	10	0.9	Yes	10	0.9
	Registration Machines	20	1.9	Per optional Facility space	Optional two to three kiosks in any facility	Yes	20	1.9	No			Yes	20	1.9
	Public Toilets	100	9.3	Minimum for Central Facility male/ female toilets + 25sf per addl fixture as determined by code	Use applicable code for specific facility to determine final fixture count	Required	400	37.2	Required	250	23.2	Required	400	37.2
	Unisex Toilet	50	4.6	Unisex toilet for satellite facility	Satellite facilities only	N/A			N/A			N/A		
	DSN Phones	10	0.9	Per optional Facility Space	Optional DSN phone for guest use	No			No			Yes	10	0.9
	Fitness Room	300	27.9	Optional space at 300sf <100 Central Facility gst rms +50sf per ea addl 200 gst rm. 600sf max	Calculated at 50sf per cardio machine	Yes	375	34.8	Yes	350	32.5	Yes	363	33.7
	Staff Conference Room	440	40.9	Per optional Central Facility space	Standardized room accommodates 20 people	Yes	440	40.9	Yes	440	40.9	Yes	440	40.9
	Business Center	75	7.0	Optional space at 75sf <100 Central Facility gst rms +25sf per ea addl 100 gst rm. 300sf max.	75sf for two workstations and circulation with 25sf for each addl workstation	No			Yes	100	9.3	Yes	138	12.8
	Study Room	250	23.2	Per optional Facility space. One room per 75 gst rms or one rm per floor, whichever is less.	Typically provide one per floor or fewer, depending on local demand	Yes	1000	92.9	No			No		

FIGURE C-1. SPACE CRITERIA

Functional Program Area		Base Area[1]		Space Standard (planning factor)	Notes/explanation	Sample A			Sample B			Sample C		
		ft.^{2}	m^2			Option/Quan	ft.^{2}	m^2	Option/Quan	ft.^{2}	m^2	Option/Quan	ft.^{2}	m^2
Guest Services	Guest Laundry	110	10.2	Per 40 Facility gst rm	Accommodates two to four washers and two to four dryers per every 40 gst rm	Required	1100	102.2	Required	550	51.1	Required	963	89.4
	Gear Wash	170	15.8	Per optional Facility room	Only provided at training bases	No			No			No		
	Guest Bulk Storage, Opt 1	45	4.2	Per one cage (25sf net) per 4 suites for optional space	Distributed as needed to accommodate suites	Yes	450	41.8	No			No		
	Vending	60	5.6	Per optional Facility floor	Accommodates two optional vending machines	Yes	240	22.3	Yes	240	22.3	No		
	Ice	30	2.8	Per Facility floor	Accommodates one ice dispenser	Required	120	11.1	Required	120	11.1	Required	120	11.1
	Patio	TBD	TBD	Variable optional space	To be custom programmed based on site availability and design	No			No			No		
	Patio storage	TBD	TBD	Variable optional space	To be custom programmed based on the final patio scope	No			No			No		
	Guest Rooms and Suites	TBD	TBD	Each room	Quantity and distribution of rooms and suites to be determined by an independent assessment. See Table 2.1 for size guidance.	360/40	126,000	11705.4	190/10	61,500	5713.4	332/18	110,400	10256.2
Administration Services	Lodging Communications	TBD	TBD	Per Facility	TBD based on Service and Installation specific requirements	Required	250	23.2	Required	250	23.2	Required	250	23.2
	Administrative areas													
	Manager (Army)	180	16.7	Per office	Typically one per Central Facility	1	180	16.7	N/A			N/A		
	Manager (Navy, AF)	120	11.1	Per office	Typically one per Central Facility	N/A			1	120	11.1	1	120	11.1
	Asst. manager (Army)	120	11.1	Per optional office	Only in larger programs	0	0	0.0	N/A			N/A		
	Asst. manager (Navy, AF)	80	7.4	Per optional office	Only in larger programs	N/A			0	0	0.0	1	80	7.4
	Front desk super (Army)	100	9.3	Per office	Typically one per Central Facility	1	100	9.3	N/A			N/A		
	Front desk super (Navy, AF)	80	7.4	Per office	Typically one per Central Facility	N/A			1	80	7.4	1	80	7.4
	Accounting	64	5.9	Per Person	Quantity to be determined by Service and facility needs	3	192	17.8	1	64	5.9	2	128	11.9
	Clerical	64	5.9	Per program	One person; typically combined with reservations and work space	1	64	5.9	0	0	0.0	1	64	5.9
	Reservations	64	5.9	Per 500 Program gst rm	40sf per person; typically combined with clerical and work space	2	128	11.9	0	0	0.0	2	128	11.9
	Work space	40	3.7	Per person in admin area	Typically combined with clerical and reservations	6	240	22.3	1	40	3.7	5	200	18.6
	Cash Room	80	7.4	Per Program	For front desk staff to reconcile shift cash	Required	80	7.4	Required	80	7.4	Required	80	7.4
Floor Support	Janitor Areas	25	2.3	Per Facility floor wing		Required	200	18.6	Required	200	18.6	Required	200	18.6
	Housekeeping Areas	200	18.6	Per 30 Facility gst rm	Accommodates two carts and storage	Required	2667	247.7	Required	1333	123.9	Required	2333	216.8
	Utility Rooms	16	1.5	Per Facility: communications room within 280ft of a gst rm	Comm rooms only; other utility rooms programmed by code and included in the multiplier	Required	128	11.9	Required	128	11.9	Required	128	11.9

Functional Program Area	Base Area[1]		Space Standard (planning factor)	Notes/explanation	Sample A			Sample B			Sample C		
	ft.²	m²			Option/Quan	ft.²	m²	Option/Quan	ft.²	m²	Option/Quan	ft.²	m²
Training Room	250	23.2	Optional space at 250sf <100 Central Facility gst rms +25sf ea addl 50 gst rms	Accommodates staff training	No			No			Yes	375	34.8
Training Office	80	7.4	Per optional private office/storage closet	Accommodates training staff personnel and/or training material storage	No			Yes	80	7.4	Yes	80	7.4
Central Janitor Areas	80	7.4	Per Facility	Serves first floor public and administrative spaces	Required	80	7.4	Required	80	7.4	Required	80	7.4
Housekeeping Manager (Army)	120	11.1	Per Program	Typically one per Facility	1	120	11.1	N/A			N/A		
Housekeeping Manager (Navy, AF)	80	7.4	Per Program	Typically one per Facility	N/A			1	80	7.4	1	80	7.4
Housekeeping Assistant	100	9.3	Per optional office for large programs	Office quantity variable based on program size	0			0			0		
Soiled Linen Storage	145	13.5	100sf +15sf per 40 Facility gst rm	Includes carts and sorting space; one cart per 40 gst rm	Required	250	23.2	Required	175	16.3	Required	231	21.5
Clean Linen Storage	150	13.9	25sf per 16 Facility gst rm	Shelving	Required	625	58.1	Required	313	29.0	Required	547	50.8
Receiving	150	13.9	150sf <150 Program gst rm + 1sf per ea addl gst rm	Loading dock	Required	400	37.2	Required	200	18.6	Required	350	32.5
Receiving/supply Office	80	7.4	Per program	Office	Required	80	7.4	Required	80	7.4	Required	80	7.4
Linen Laundry	450	41.8	Optional central facility space at 450sf <100 Program gst rm + 1sf per ea addl gst rm	Includes space for extractors, dryers and folding activities	Yes	750	69.7	No			No		
Addl space for folding machine	60	5.6	Per optional folding machine	Additional laundry room space for optional folding machine	Yes	60	5.6	No			No		
Supply Areas/general Storage	600	55.7	600sf <300 Program gst rm + 1sf ea addl gst rm	Includes separate cleaning fluid storage	Required	700	65.0	Required	600	55.7	Required	650	60.4
Guest Bulk Storage, Opt 2	100	9.3	Per optional space	For guest temporary use; only provided at training bases	No			No			No		
Central Staff Break	150	13.9	150sf <100 Central Facility gst rm + 1sf per ea addl gst rm	Base area typically includes 4-top tables, other seating, kitchenette, and staff lockers	Required	450	41.8	Required	250	23.2	Required	400	37.2
Staff Lockers													
Addl space if training function	300	27.9	Per optional training module	Additional break room space if this area is to dual function as a training room	No			Yes	300	27.9	No		
Satellite Staff Area w/ Lockers	150	13.9	150sf <100 Satellite gst rm + .25sf per ea addl gst rm	Base area typically includes 4-top tables, kitchenette, and lockers	N/A			N/A			N/A		
Staff Toilets	100	9.3	100sf <150 Facility gst rm + 100sf ea addl 150 gst rm	Each 100 sf module includes 50sf for each gender	Required	267	24.8	Required	167	15.5	Required	233	21.7
Maintenance Workshop	150	13.9	150sf <100 Program gst rm + .5sf per ea addl gst rm	Work and tool storage space	Required	300	27.9	Required	200	18.6	Required	275	25.5
Grounds Equipment Storage	40	3.7	Per optional Program space	Small shed or exterior closet	N/A			Yes	40	3.7	No		
Grounds Equipment Storage (Army)	400	37.2	Per program space	Required for Army	Yes	400	37.2	N/A			N/A		
				Sample Subtotal		**142,285**	**13218.3**		**69,960**	**6499.2**		**123,085**	**11434.6**
				Net-to-Gross Factor @	30%	42,686	3965.5		20,988	1949.8		36,926	3430.4
				Sample Total		**184,971**	**17183.8**		**90,947**	**8449.0**		**160,011**	**14865.0**

[1] Base area assumes a 100 gst rm Facility

Sample A: Army 400-room, 4-floor Central Facility in a 400-rm Program on a training base, 10% suites
Sample B: Navy 200-room, 4-floor Central Facility in a 200-room Program, 5% suites
Sample C: Air Force 350-room, 4-floor Central Facility in a 350-rm Program, 5% suites

FC 4-721-02F
1 April 2015

FACILITIES CRITERIA (FC)

AIR FORCE
LEVEL I CONFINEMENT FACILITY



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AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location
1		

FOREWORD

Facilities Criteria (FC) provide functional requirements (i.e., defined by users and operational needs of a particular facility type) for specific DoD Component(s), and are intended for use with unified technical requirements published in DoD Unified Facilities Criteria (UFC). FC are applicable only to the DoD Component(s) indicated in the title, and do not represent unified DoD requirements. Differences in functional requirements between DoD Components may exist due to differences in policies and operational needs.

All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the FC, the SOFA, the HNFA, and the BIA, as applicable.

Because FC documents are coordinated with unified DoD technical requirements, they form an element of the DoD UFC system applicable to specific facility types. The UFC system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applicable to the Military Departments, Defense Agencies, and the DoD Field Activities. The UFC System also includes technical requirements and functional requirements for specific facility types, both published as UFC documents and FC documents.

FC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing criteria for military construction. HQ U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Requirements. The form is also accessible from the Internet site listed below.

FC are effective upon issuance and are distributed only in electronic media from the following source: Whole Building Design Guide web site http://dod.wbdg.org/.

Refer to UFC 1-200-01, *General Building Requirements*, for implementation of new issuances on projects.

AUTHORIZED BY:



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Director
Air Force Civil Engineer Center

FACILITIES CRITERIA (FC)
NEW SUMMARY SHEET

Document: FC 4-721-02F, *Air Force Level I Confinement Facility*

Superseding: None

Description: This FC provides requirements for evaluating, planning, programming, and designing Level I confinement facilities, separate from the Security Forces Operations Center. The information in this FC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental United States (CONUS) and outside the continental United States (OCONUS). It also applies to the procurement of design-build services for the above-noted projects. Alteration and renovation projects should update existing facilities to meet the guidance and criteria within budgetary constraints.

Reasons for Document: This FC is the initial release to establish requirements for a Level 1 confinement facility. It defines the criteria for determining appropriately sized, flexible, cost-optimized, durable, quality-designed facilities on a life cycle basis to support the mission. The plans presented in this FC are concepts only and are primarily intended to communicate functional user and adjacency requirements. A thorough compliance check of all other applicable criteria is required.

Impact: This FC will facilitate and standardize the design of Level 1 confinement facilities throughout the Air Force. It will provide more complete and consistent project requirements and will expedite the programming and design of facilities and reduce initial design cost.

Unification Issues: None

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CHAPTER 1 INTRODUCTION

1-1 GENERAL INFORMATION.

1-1.1 Purpose

This standard facility prototype design was developed to assist Air Force programmers in preparing and validating DD Form 1391 requirements and to assist architect-engineer (A-E) design professionals with approved project-specific design requirements. It is a source of basic programming and functional information for Level 1 confinement facilities. This standard is consistent with the Air Force Corporate Facilities Standards (AFCFS), Unified Facilities Criteria (UFC), and existing design guides. This standard, in conjunction with the AFCFS, defines Air Force expectations for project programming and A-E design decisions.

1-1.2 Objective

The standard facility prototype design program defines consistent facility requirements across the Air Force enterprise to expedite delivery of a facility. This FC was designed in compliance with AFMAN 32-1084. The objective is to deliver right-sized, flexible, cost-optimized, durable, quality-designed facilities on a life cycle basis to support the Air Force mission.

1-2 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, which provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements (comprehensive requirements are detailed in UFC 1-200-02), and safety. Use this FC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-3 REFERENCES.

Appendix A contains a list of related documents and references to use with this FC. In general, use the latest available issuance of the reference.

1-4 INSTRUCTIONS.

1-4.1 Method

This standard facility prototype was developed by determining personnel counts, allowable room sizes, adjacency diagrams between functional spaces, and overall facility space requirements. The standard facility prototype establishes Air Force criteria for the facility type. Use these criteria in conjunction with Air Force ETLs, departmental publications, and UFCs when programming and designing this facility type. Supplement this FC with thorough reviews by individual program managers and operations staff.

1-4.2 Standard Facility Prototype Tools.

This standard facility prototype consists of three parts to be used by programmers and A-Es:

- Facilities criteria standard prototype (this FC document)
- Interactive programming sheet
- Facility Building Information Modeling (BIM) drawings

1-4.3 Facilities/Design Criteria.

This FC consists of three primary components:

- Notional site
- Composite/standard floor plans and facility adjacency diagrams
- Modules with associated room data sheets

1-4.3.1 Notional Site.

The notional site plan diagram presents key site development criteria and is not a site-specific solution. The information represents the land requirements to construct this facility and includes associated antiterrorism (AT) standoff distances and parking. Utilization of existing or shared parking is allowable and may reduce the total acreage required for the facility. Adapt the requirements to the specific site and location and comply with the applicable Installation Development Plan (IDP) and Area Development Plan (ADP) for facility siting. Comply with UFC 3-600-01 regarding minimum separation from other structures.

1-4.3.2 Composite Floor Plans.

The composite floor plans are conceptual solutions that illustrate functional user and adjacency requirements. Plan variations may be rotated, flipped, or reversed to fit the actual site. A thorough compliance check of all other applicable criteria is required even when using the conceptual solutions provided in this FC.

1-4.3.3 Modules.

Spaces and rooms that are integrally related with a specific functional connection or operational flow are grouped into a module. Modules and the associated room data sheets identify specific criteria and additional detail for each functional area of the facility as outlined in the space program sheets in Appendix B. Information is provided in a standard presentation and data sheet format and the required space adjacencies and modules are illustrated in figures.

The resulting shape of the facility assembled from the facility prototype modules must provide construction efficiencies obtained from building proportions and overall configuration. The building footprint shall be organized and well composed. The building

design must comply with the installation facility standards (architectural compatibility plan) and the AFCFS. Modules shall not be deconstructed or altered except as indicated in paragraph 1-4.3.4.

1-4.3.4 Module Flexibility/Adjustments.

Utilization of the modules provided is highly recommended to maintain functional relationships, adjacencies, and allowed program areas. Modules contain fixed attributes that are essential to functional requirements. Modules may be rotated, flipped, and reversed to accommodate an overall composition or site issue. When the modules cannot be arranged to produce a constructible floor plan due to site constraints, their proportions may be adjusted to create a constructible plan. Manipulating the module shape must not result in an overall increase in square feet and/or reduce the functionality of any module or the required adjacencies in the composite plan.

Some modules are linked to space requirements that increase or decrease in size based on the personnel count and equipment for a particular mission. In these cases, increase or decrease the size of the module to match the revised scope calculation. This may sometimes require minor adjustments in other adjacent modules so they properly fit together to create a constructible facility floor plan. Spaces must comply with any critical dimensions indicated on module plans. Manipulate as few modules as possible to create a constructible facility. The resulting composite plan must respect the established module’s adjacencies and must not exceed the authorized project scope.

1-4.3.5 Room Data Sheets.

Specific requirements for each room, space, or area are provided on room data sheets that are located following their respective module. Information contained on the data sheets defines the functional and physical requirements for each space within the facility type.

1-4.4 Programming Spreadsheet(s).

This tool is provided in two formats in Appendix B. A PDF programming sheet is provided as a reference and reflects the baseline standard facility program. The interactive programming sheet provides a tool for planners and programmers. It allows the input of authorized personnel positions and special purpose spaces. Updated inputs are automatically calculated and provide new required square footage for each space and the overall facility size. A link is provided in Appendix B to provide access to the interactive tool.

1-4.5 Facility Drawings – BIM.

The facility drawings component of the facility prototype tools includes both a PDF version and a Revit version of the modules, rooms, and composite floor plan. The spaces, rooms and modules shown reflect the baseline (eight cells) standard facility program spreadsheet in Appendix B. The drawings in this FC are copies of the BIM drawings and comply with the program scope. The BIM drawings provide a starting

point for the digitization of building data and a starting point in the design and construction of a facility. BIM drawings are found at the link provided in Appendix B.

1-4.6 Additions and Alterations.

For additions and alterations to existing facilities, use the adjacencies, sizing/scope, and detailed requirements contained in the site diagrams, module drawings, and room data sheets to the maximum extent possible. The functionality and adjacency of the modules are still valid but may require some manipulation to accommodate the existing structure. Move non-structural walls to the greatest extent possible to open up space in existing facilities to make them more receptive to the placement of the modules. The planner and designer shall determine the most efficient means to balance the placement of modules within existing spaces or as a facility addition.

1-4.7 A-E Design Professionals.

The requirements set forth in this FC are the approved space programming and functional layouts in accordance with AFCFS. The Air Force Security Forces Center (AFSFC) must approve variations to functional and operational issues and deviations from core requirements.

CHAPTER 2 SITE & OVERALL ADJACENCY

2-1 GENERAL FACILITY OVERVIEW.

A Level 1 confinement facility is typically a one-story structure. The confinement cells can either be part of the Security Forces (SF) operations center or a stand-alone facility. It is operated by the Air Force and consists of confinement spaces, control room, administration area, entry/visitor spaces, and building support. The facility houses confinees 24/7 and is open to visitors only a few hours per week as administered by the base command and SF directives.

2-2 FACILITY USERS/OCCUPANTS.

Occupants of the facility primarily include pretrial and post-trial confinees (referred to as “confinees”) and the SF guard staff. It may house maximum-custody confinees for short periods while awaiting trial or post-trial transfers to another facility. Visitors of confinees have access to limited areas of the facility on a controlled basis.

2-3 SIZE DETERMINANTS.

Confinement facility size is generally driven by the intended military population. Some facilities serve multiple installations due to proximity benefits.

2-3.1 Level I Confinement Facility Size.

Level I confinement facility sizes vary from four-cell to twelve-cell facilities, in increments of four. For the purpose of this FC the following sizes were analyzed but the eight-cell facility has been selected as standard:

- Four-cell facility
- Eight-cell facility
- Twelve-cell facility

The space program for confinement facilities is developed based on the size of the assigned population and historical data from AFSFC. Facility size changes must be approved/authorized by AFSFC.

Critical to facility size is the required size of cells. They must comply with Adult Correctional Institutions (ACI) requirements as follows: total of 80 square feet of floor space per single occupancy cell, of which 25 square feet is unencumbered.

2-4 OPERATIONAL ASPECTS.

The facility will house both pre-trial and post-trial confinees. Door hinges and peens must be on the side opposite of confinee access to prevent barricading or peen removal.

2-5 NOTIONAL SITE.

The site diagram (Figure 2-1) represents a notional layout to reflect site development requirements/criteria only—it is not an actual site design. Siting must comply with the IDP and ADP.

2-6 LOCATION DETERMINANTS (SITE SELECTION) OR SITE LOCATION AND ORIENTATION.

Several factors determine the most appropriate and cost-effective location for a confinement facility. Analyze the availability and capacity of required utilities and the mass/scale of the facility relative to adjacent structures and noise issues. Open space surrounding the facility is desirable. Locate away from schools, dormitories, housing, industrial, and retail areas. Comply with UFC 3-600-01 regarding minimum separation from other structures.

2-6.1 Access.

The confinement facility's ideal location is in the vicinity of the main SF squadron facility and with main road access. Locate the facility away from any active pedestrian or populated areas. Provide parking as close to the facility as possible while complying with AT requirements in UFC 4-010-01.

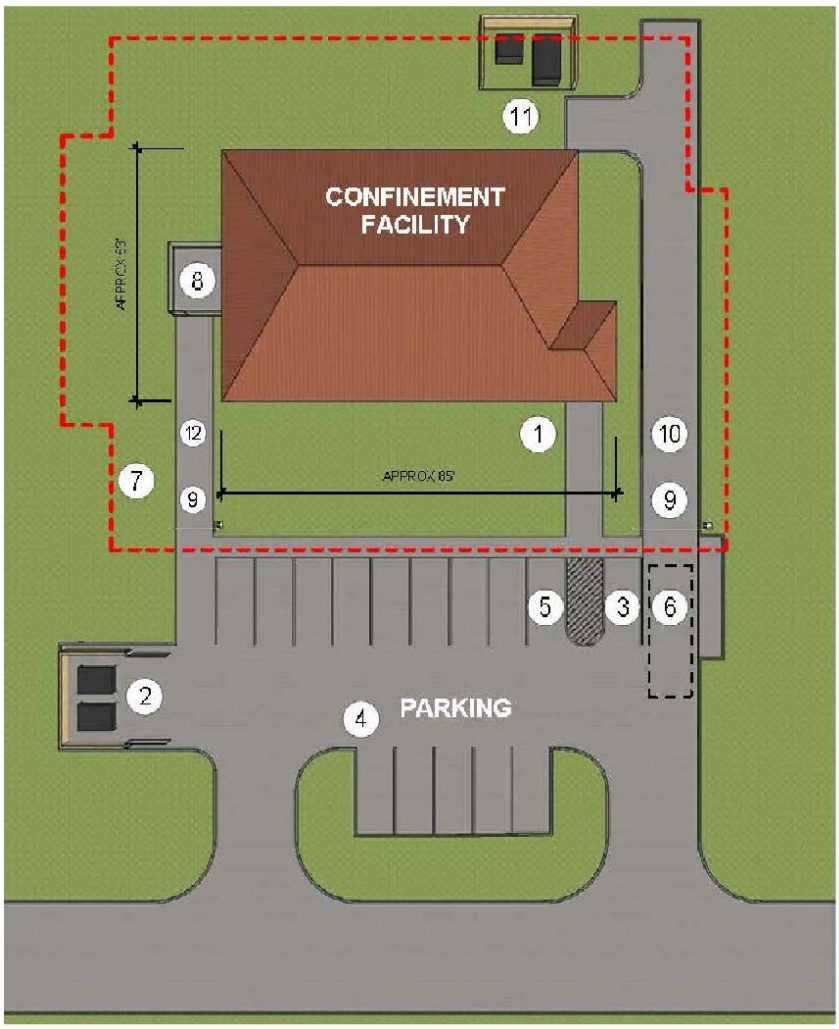
2-6.2 Parking and Access Drives.

Provide parking for both staff and visitors with access drives as indicated in the space program. Coordinate with local units if adjacent properties may share visitor parking. Comply with UFC 3-201-01. In general, provide two privately owned vehicle (POV) spaces for every three confinees.

2-6.3 Existing Facility Alteration.

Analyze the site of the existing facility and its limitations. Use permanent facilities for conversion to a confinement function. Assess existing buildings as to whether or not they can support the core and other functional areas and dimensional requirements of the program. The building must be able to accommodate durable cells and have adequate floor-to-ceiling heights.

Figure 2-1 Notional Site Diagram (8 Cell Facility)



SITE PLAN KEYNOTE LEGEND	
1.	PRIMARY BUILDING ENTRANCE
2.	SCREENED DUMPSTER ENCLOSURE
3.	HANDICAPPED PARKING SPACE
4.	STAFF / VISITOR PARKING SPACES - 13 TOTAL SPACES; TWO SPACES FOR EACH 3 CELLS AND EACH STAFF MEMBER MINIMUM
5.	LAW ENFORCEMENT PARKING SPACE (ONE DEDICATED SPACE REGARDLESS OF FACILITY SIZE)
6.	15 PASSENGER BUS PARKING SPACE WITH LOADING / UNLOADING AREA (ONE DEDICATED SPACE REGARDLESS OF FACILITY SIZE)
7.	STANDOFF DISTANCE - NOTIONAL
8.	FENCED OUTDOOR RECREATIONAL / EXERCISE YARD WITH DOUBLE-LEAF GATE
9.	ACCESS CONTROL GATE
10.	SERVICE DRIVE - MECHANICAL EQUIPMENT ACCESS
11.	SCREENED EQUIPMENT YARD
12.	WIDE SIDEWAIK FOR VEHICLE ACCESS TO EXERCISE YARD (DOUBLE-LEAF GATE AT FENCE)

2-7 COMPOSITE FACILITY ADJACENCY.

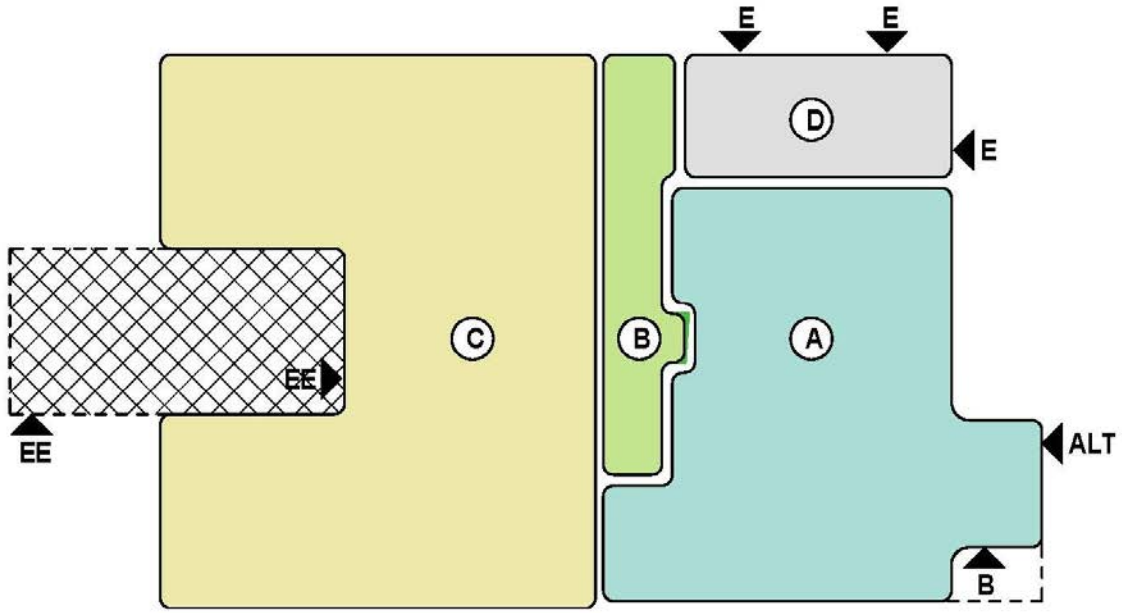
The space program for the Level 1 confinement facility is developed based upon the actual base population and the intended population of the base.

The space program developed through the base planning team generally represents the maximum space allowed. The final space program for a new confinement facility must be carefully determined by installation representatives and the appropriate service program office guided by the criteria in this FC. Additional information is found in Appendix B.

The required space adjacencies are illustrated in Figure 2-2. All program spaces are assigned a module designator. Functional spaces that must be located next to each other or share an important operational flow are grouped into one module with the intent that the module will remain intact during final design. The facility is composed of three primary functional areas: 1) secure area; 2) semi-secure area; and 3) controlled spaces/area (or administrative/visitor).

Composite plans represent conceptual solutions for Level 1 confinement project requirements. These composite facility plans convey an AFSFC-approved solution. The building shape may be adjusted in response to site requirements or unusual or specific installation issues if approved in accordance with the procedures in Chapter I. See Appendix B for conceptual facility floor plans. Three concept plans and the related BIM drawings are included in Appendix B.

Figure 2-2 Functional Adjacency Diagram



MODULES	
A	ADMINISTRATION/VISITOR AREAS
B	CONTROLLED AREAS
C	SECURED AREAS
D	BUILDING SUPPORT

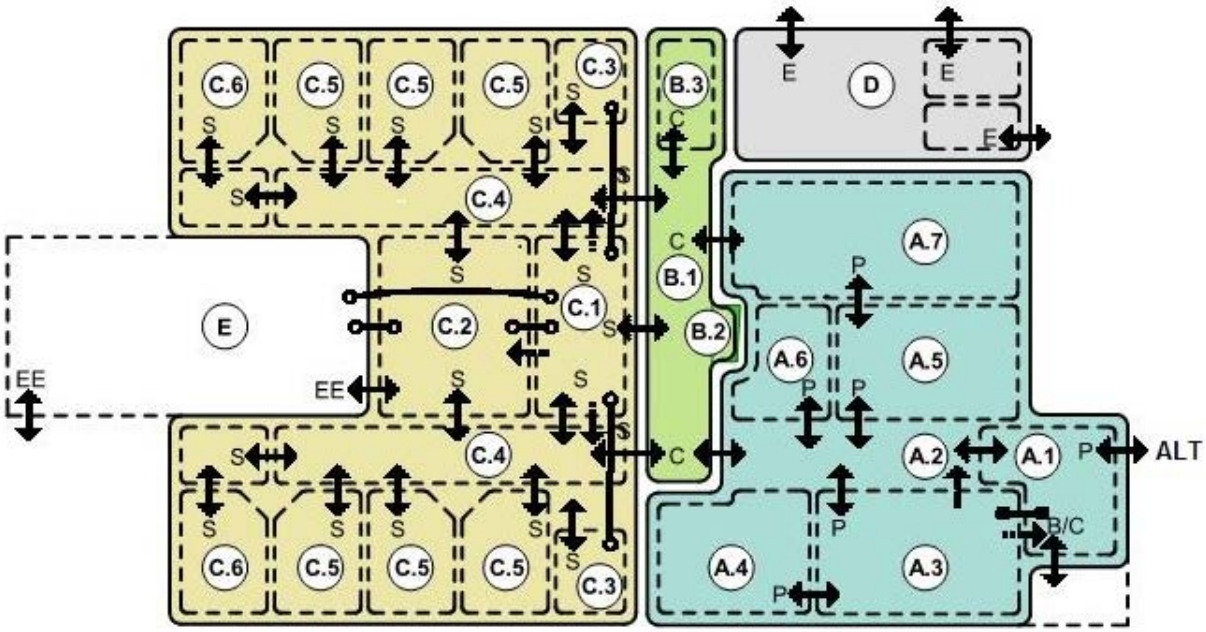
▲ LEGEND ENTRY/EXIT	
ALT	ALTERNATE ENTRY/ADDITION TO EXISTING FACILITY
B	BUILDING ENTRY
E	EQUIPMENT ENTRY
EE	EMERGENCY ENTRY

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CHAPTER 3 FACILITY REQUIREMENTS & CRITERIA MODULES

3-1 ADJACENCY DIAGRAM.

Figure 3-1 Module Adjacency Diagram



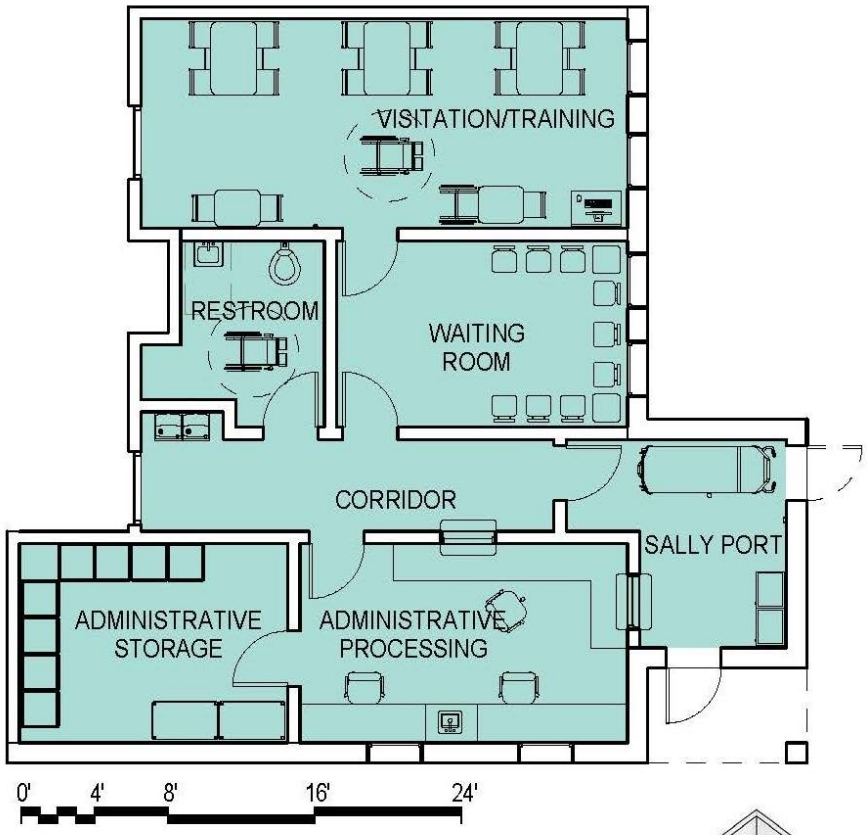
MODULES ROOM SCHEDULE	
A.1	SALLY PORT
A.2	CORRIDOR
A.3	ADMINISTRATIVE PROCESSING
A.4	ADMINISTRATIVE STORAGE
A.5	WAITING ROOM
A.6	RESTROOM
A.7	VISITATION / TRAINING
B.1	CONTROLLED CORRIDOR
B.2	LAUNDRY ALCOVE
B.3	JANITOR'S CLOSET
C.1	CONTROL ROOM
C.2	DAY ROOM
C.3	SHOWER
C.4	SECURED CORRIDOR
C.5	CELL
C.6	SEGREGATED CELL / CORRIDOR
D	BUILDING SUPPORT
E	OUTDOOR RECREATIONAL EXERCISE YARD

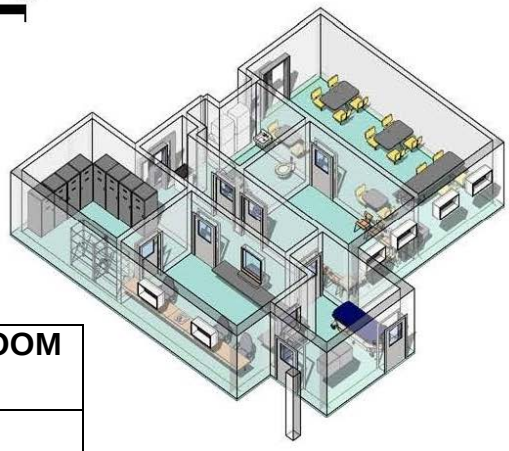
ADJACENCY RELATIONSHIP	
↔	DIRECT ACCESS
⊶	PROXIMITY
●	PRIMARY ADJACENCY
▭	MODULE BOUNDARY
[ ]	ENCLOSED AREA
◡	DAYLIGHTING
←···	DIRECT VIEW

LEGEND ENTRY/EXIT	
ALT	ALTERNATE ENTRY / ADDITION TO EXISTING FACILITY
B	BUILDING ENTRY
C	CONTROLLED PERSONNEL ENTRY
E	EQUIPMENT ENTRY
EE	EMERGENCY EXIT
P	PERSONNEL ENTRY
S	SECURED PERSONNEL ENTRY

3-2 MODULE A: ADMIN/VISITOR AREAS.

Figure 3-2 Floor Plan and Axonometric





MODULE A – ADMIN/VISITOR AREA ROOM SCHEDULE	
ROOM NAME	**AREA**
ADMINISTRATIVE	**See Appendix-B Programming Worksheets**
ADMINISTRATIVE STORAGE	
CORRIDOR	
RESTROOM	
SALLY PORT	
VISITATION/TRAINING	
WAITING ROOM	

***NOTE: DAYLIGHTING TO BE DESIGNED PER UFC 1-200-02**

Figure 3-3 Administrative Processing Data Sheet

Description/Usage		General administrative functions for two staff members. Place for redundant controls/systems from control room and override capability for electronics and video monitors.
Ceiling Height		9’-0” minimum
Windows		Exterior wired, tempered glass clerestory
Doors	**Type**	3’-0” x 7’-0” hollow metal, security-rated doors and frame
	Security/ Hardware	Access controlled; keyed lockset
	View Panels/ Kick-Plates	Kick plates
Finishes	**Walls**	Painted CMU or concrete with impact-resistant gypsum on furring
	Floor	Tile, epoxy, or sealed concrete
	Base	Tile, epoxy, or vinyl
	Ceiling	Concrete with acoustical ceiling tile (no drop ceiling)
Plumbing		Bar sink with hot and cold water
HVAC		Air conditioned and heated year round
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets; quad receptacles adjacent to each workstation; dedicated outlet for printers; dedicated
Lighting		Per UFC 3-530-01
Communication	**Tele.**	One per workstation
	Data	NIPR
	CCTV	Monitoring of facility
	CATV	N/A
	Security	Door control master station
Acoustical		Minimum STC of 46
Furnishings, Equipment, and Casework		Lockable security drawer or safe; two systems workstations with chairs; two drawer type pass-through windows with integrated speaker capability; copier; under-counter refrigerator; microwave; built-in shelving for radio/flashlight charger station; coffee maker; SF counter with base and upper cabinets for clothing shakedown of confinees
Special Requirements		Lockable door to administrative storage; pass-through windows to sally port and public corridor; access control system for facility; 4’ x 4’ wall-mounted peg board for handcuffs and body cuffs

Figure 3-4 Administrative Storage Data Sheet

Description/Usage		Storage for confinees' dress uniforms and other personal belongings as well as administrative and building supplies (e.g., blankets, sheets, pillows, spare toiletries). Location for recording hardware for monitoring devices.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	3'-0" x 7'-0" hollow metal
	Security/ Hardware	Keyed lockset
	View Panels/ Kick-Plates	Kick plates
Finishes	**Walls**	Painted CMU or concrete with gypsum board on furring
	Floor	Epoxy or sealed concrete
	Base	Epoxy or vinyl
	Ceiling	Concrete with acoustical ceiling tile (no drop ceiling)
Plumbing		N/A
HVAC		Ventilated
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets
Lighting		Per UFC 3-530-01
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		N/A
Furnishings, Equipment, and Casework		2'-0" x 2'-0" single-tiered lockers (one per cell minimum); 24" x 36" x 72" open shelving for administration supplies (number of cells plus two)
Special Requirements		Controlled access direct from administrative processing

Figure 3-5 Public Corridor Data Sheet

Description/Usage		Provide main circulation in the administrative and visitor areas and space for processing confinees.
Ceiling Height		9’-0” minimum
Windows		N/A
Doors	**Type**	3’-0” x 7’-0” hollow metal, security-rated doors and frames; sliding detention
	Security/ Hardware	Controlled access
	View Panels/ Kick-Plates	Kick-plates; 6” x 30” security-rated view panels
Finishes	**Walls**	Painted CMU or concrete
	Floor	Tile, epoxy, or sealed concrete
	Base	Tile, epoxy, or vinyl
	Ceiling	Concrete with acoustical ceiling tile (no drop ceiling)
Plumbing		Electric water cooler
HVAC		Air conditioned and heated year round
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		Convenience receptacle
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Integrated with security camera
	Data	N/A
	CCTV	Dual monitored, recorded
	CATV	N/A
	Security	Video camera
Acoustical		N/A
Furnishings, Equipment, and Casework		Secure pass-through drawer window with integrated speaker capability
Special Requirements		N/A

Figure 3-6 Restroom Data Sheet

Description/Usage		Restroom facilities for staff and visitors.
Ceiling Height		9’-0”
Windows		N/A
Doors	**Type**	3’-0” x 7’-0” hollow metal
	Security/ Hardware	Keyed lockset; privacy lock
	View Panels/ Kick-Plates	Kick plates
Finishes	**Walls**	Painted CMU with gypsum board on furring and tile wainscot
	Floor	Tile, epoxy, or sealed concrete
	Base	Tile or vinyl
	Ceiling	Painted concrete with gypsum ceiling
Plumbing		Connections for water closet and counter-mounted lavatory; connection to electric water cooler in corridor; floor drain
HVAC		Ventilated
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		GFI convenience duplex outlet
Lighting		Per UFC 3-530-01
Communication	**Tele.**	N/A
	Data	N/A
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		N/A
Furnishings, Equipment, and Casework		Water closet, lavatory, mirror (non-glass), grab bars, toilet paper dispenser, toilet seat cover dispenser, soap dispenser, paper towel dispenser with waste receptacle
Special Requirements		Room and all accessories shall comply with ABA accessibility requirements

Figure 3-7 Sally Port Data Sheet

Description/Usage		Secure entry point for law enforcement officials to perform pat searches, confiscate property, and complete pre-booking paperwork. Serves as the controlled entry and exit point for all visitors and confinees.
Ceiling Height		9’-0” minimum
Windows		No exterior windows allowed
Doors	**Type**	3’-0” x 7’-0” hollow metal, security-rated doors and frames; interlocking
	Security/ Hardware	Controlled access
	View Panels/ Kick-Plates	Kick-plates; 6” x 30” security-rated view panels to public corridor and at exterior door
Finishes	**Walls**	Painted CMU or concrete
	Floor	Tile, epoxy, or sealed concrete
	Base	Tile, epoxy, or vinyl
	Ceiling	Concrete with acoustical ceiling tile (no drop ceiling)
Plumbing		N/A
HVAC		Air conditioned and heated year round
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		Exterior convenience outlet near entry
Lighting		Per UFC 3-530-01
Communication	**Tele.**	Integrated with security camera
	Data	N/A
	CCTV	Dual monitored in administrative processing and control room, recorded
	CATV	N/A
	Security	Video camera (infrared capable) inside sally port and at exterior entrance; controlled from administrative processing
Acoustical		N/A
Furnishings, Equipment, and Casework		12” x 18” double-tiered lockers for visitor personal effects (one per cell minimum); pass-through drawer and window with speaker to administrative processing; one-way glass from administrative processing
Special Requirements		• Sally port must accommodate a stretcher • “Door call” button and intercom connected to control room and administrative processing • Exterior Knox Box mounted 90” above finish floor in inconspicuous location

Figure 3-8 Visitation/Training Room Data Sheet

Description/Usage		Room for confinees to visit with attorneys, family, and other visitors. Also serves as guard training and meeting room and worship center.
Ceiling Height		9'-0" minimum
Windows		Exterior wired, tempered glass clerestory window
Doors	**Type**	Hollow metal security-rated at waiting; sliding detention at semi-secure corridor
	Security/ Hardware	Keyed locksets
	View Panels/ Kick-Plates	Tempered wired security view panels; 6" x 30" one-way view panels for guard supervision; kick plate
Finishes	**Walls**	Painted CMU or concrete
	Floor	Tile, epoxy, or sealed concrete
	Base	Tile, epoxy, or vinyl
	Ceiling	Painted concrete with gypsum ceiling (no drop ceiling)
Plumbing		N/A
HVAC		Air conditioned and heated year round
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets, tamper-proof
Lighting		Per UFC 3-530-01; surface-mounted security level (jail type)
Communication	**Tele.**	Phone, wall-mounted
	Audio	Intercom with call button to semi-secure corridor
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		N/A
Furnishings, Equipment, and Casework		Built-in jail-type table and benches (two seats per cell); optional stand-alone computer and printer workstation
Special Requirements		Door to semi-secure corridor must have vision panel for guard supervision; direct access from waiting area for visitors and from semi-secure corridor for confinees; computer station must not have Internet access

Figure 3-9 Waiting Room Data Sheet

Description/Usage		Visitor waiting area prior to meeting with confinees in the visitation/training room. Outer door to corridor remains open during meetings.
Ceiling Height		9’-0”
Windows		Exterior wired, tempered glass clerestory
Doors	**Type**	3’-0” x 7’-0” hollow metal, security-rated doors and frames
	Security/ Hardware	Hold-open function on outer door
	View Panels/ Kick-Plates	Kick-plates
Finishes	**Walls**	Painted CMU or concrete with impact-resistant gypsum board on furring
	Floor	Tile, epoxy, or sealed concrete
	Base	Tile, epoxy, or vinyl
	Ceiling	Concrete with acoustical ceiling tile (no drop ceiling)
Plumbing		N/A
HVAC		Air conditioned and heated year round
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets
Lighting		Per UFC 3-530-01
Communication	**Tele.**	One wall-mounted phone
	Data	N/A
	CCTV	Monitored
	CATV	N/A
	Security	Camera
Acoustical		Minimum STC rating of 46 at wall between waiting room and visitation/training room
Furnishings, Equipment, and Casework		Chairs (one per cell); side tables (one per four chairs)
Special Requirements		N/A

3-3 MODULE B: SEMI-SECURE AREAS.

Figure 3-10 Floor Plan and Axonometric

MODULE B – SEMI SECURE AREA ROOM SCHEDULE	
ROOM NAME	**AREA**
CONTROLLED CORRIDOR	**See Appendix-B Programming Worksheets**
JANITOR CLOSET	
LAUNDRY ALCOVE	

***NOTE: DAYLIGHTING TO BE DESIGNED PER UFC 1-200-02**

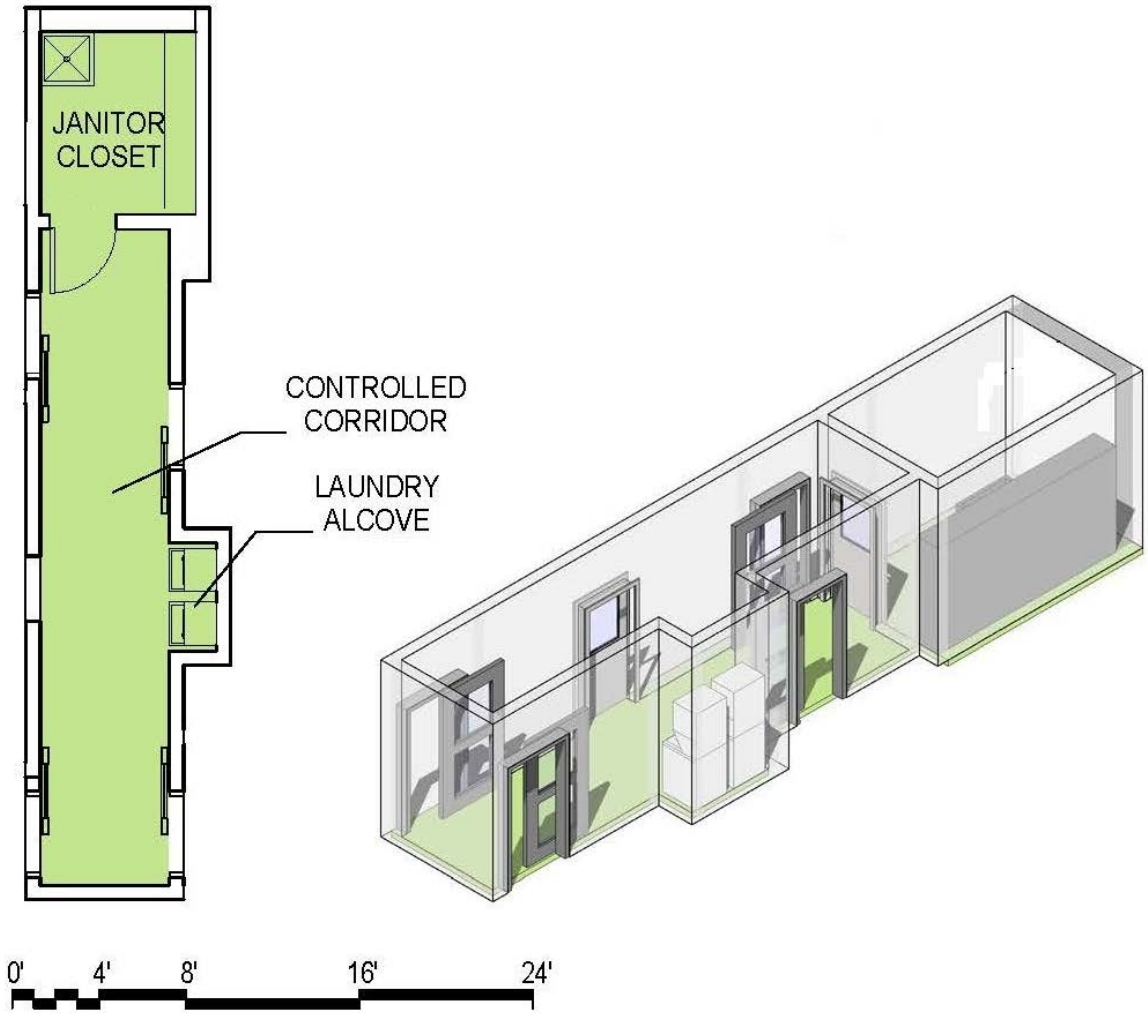


Figure 3-11 Controlled Corridor Data Sheet

Description/Usage		Main circulation point between corridor, visitation, and secure corridor. Minimum width is 5’-0” clear.
Ceiling Height		9’-0”
Windows		N/A
Doors	**Type**	Sliding detention
	Security/ Hardware	Keyed locksets
	View Panels/ Kick-Plates	Tempered wired security view panels
Finishes	**Walls**	Painted CMU or concrete
	Floor	Epoxy
	Base	Integral epoxy cove
	Ceiling	Painted concrete
Plumbing		N/A
HVAC		Air conditioned and heated year round
Fire Protection		Tamper-resistant automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets; tamper-proof
Lighting		Per UFC 3-530-01; surface-mounted security level (jail type)
Communication	**Tele.**	N/A
	Audio	Intercom from visitation
	CCTV	Dual monitored at control room and administrative processing
	CATV	N/A
	Security	Camera
Acoustical		Minimum STC of 50
Furnishings, Equipment, and Casework		N/A
Special Requirements		N/A

Figure 3-12 Janitor Closet Data Sheet

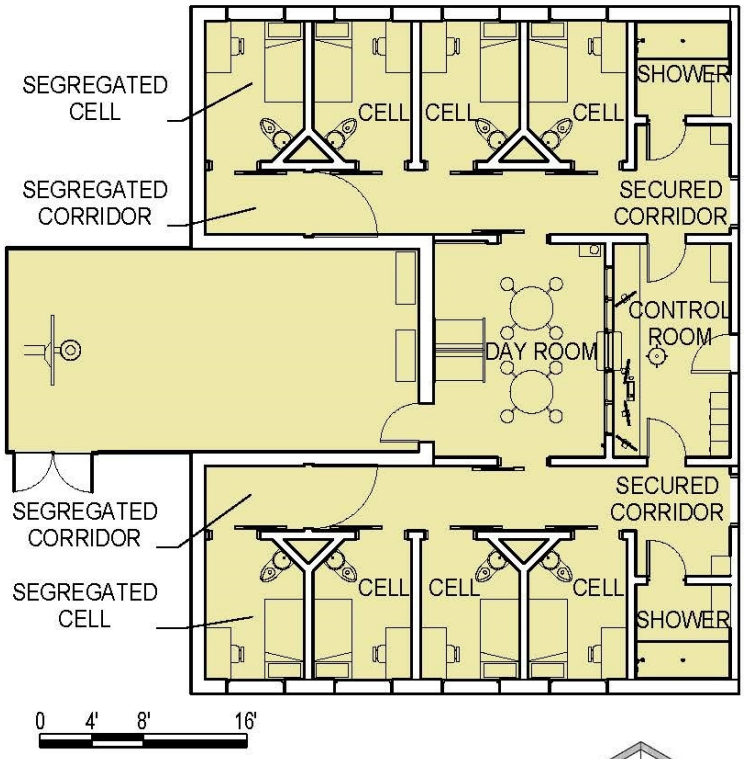
Description/Usage		Miscellaneous building storage, cleaning and laundry supplies. Confinee has access under guard supervision.
Ceiling Height		9'-0" minimum
Windows		N/A
Doors	**Type**	Hollow metal, security rated
	Security/ Hardware	Keyed lockset; alarmed; concealed hinges
	View Panels/ Kick-Plates	Kick plates
Finishes	**Walls**	Painted CMU
	Floor	Epoxy
	Base	Integral epoxy cove
	Ceiling	Painted concrete
Plumbing		Hot and cold water connection for mop sink; floor drain
HVAC		Ventilated
Fire Protection		Tamper-resistant automatic sprinkler system (see UFC 3-600-01)
Power		One duplex outlet; tamper-proof
Lighting		Per UFC 3-530-01; surface-mounted security level (jail type)
Communication	**Tele.**	N/A
	Audio	N/A
	CCTV	N/A
	CATV	N/A
	Security	Monitored from control room and administrative processing, with motion detector in room and door alarmed
Acoustical		N/A
Furnishings, Equipment, and Casework		Mop sink; shelving with integral mop holder; shelving for supplies
Special Requirements		Door must swing out

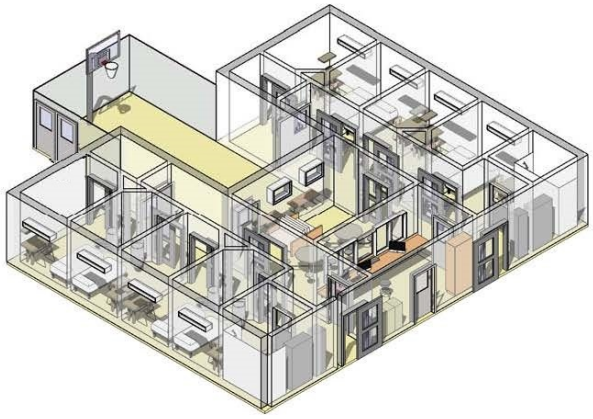
Figure 3-13 Laundry Alcove Data Sheet

Description/Usage		Laundry facilities for use by confinees under guard supervision.
Ceiling Height		9’-0” minimum
Windows		N/A
Doors	**Type**	N/A
	Security/ Hardware	N/A
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Painted CMU or concrete
	Floor	Epoxy
	Base	Integral epoxy cove
	Ceiling	Painted concrete
Plumbing		Connection for washer
HVAC		Dryer exhaust; ventilated
Fire Protection		Tamper-resistant automatic sprinkler system (see UFC 3-600-01)
Power		Provide appropriate power for utilities; provide secure plug to prevent confinee access
Lighting		Per UFC 3-530-01; surface-mounted security level (jail type)
Communication	**Tele.**	N/A
	Audio	N/A
	CCTV	Dual monitored, recorded
	CATV	N/A
	Security	Camera (infrared-capable)
Acoustical		N/A
Furnishings, Equipment, and Casework		Washer and dryer; secure units to floor or walls and prevent confinee access to vent
Special Requirements		N/A

3-4 MODULE C: SECURE AREAS – 8 CELL.

Figure 3-14 Floor Plan and Axonometric





MODULE C – SECURE AREA	
ROOM NAME	**AREA**
CELL	**See Appendix-B Programming Worksheet**
CELL	
CELL	
CELL	
CELL	
CELL	
CONTROL ROOM	
DAY ROOM	
SECURED CORRIDOR	
SECURED CORRIDOR	
SEGREGATED CELL	
SEGREGATED CELL	
SEGREGATED CORRIDOR	
SEGREGATED CORRIDOR	
SHOWER	
SHOWER	

Figure 3-15 Cell Data Sheet

Description/Usage		Secure room for confinee.
Ceiling Height		8’-0” minimum
Windows		Exterior clerestory windows; minimum of 3 SF of glazing for natural light
Doors	**Type**	Sliding detention; hollow metal security-rated at segregated corridor, inset/flush to wall when open
	Security/ Hardware	Access controlled
	View Panels/ Kick-Plates	6” x 30” view panel
Finishes	**Walls**	Painted CMU or prefabricated steel (special color required for segregation cells)
	Floor	Epoxy
	Base	Integral epoxy cove
	Ceiling	Painted concrete or prefabricated steel
Plumbing		Connection for toilet and sink; provide pre-mixed cold and tepid water; Muffin Monster in sewer line
HVAC		Ventilation min. of 15 CFM of outside or recirculated filtered air per occupant for cells/rooms, officer stations, and dining areas; separate exhaust system for cells; reference ACA
Fire Protection		Tamper-resistant automatic sprinkler system (see UFC 3-600-01)
Power		Not allowed
Lighting		Per UFC 3-530-01; surface-mounted security level (jail type); controlled from administrative processing and control room
Communication	**Tele.**	N/A
	Audio	Call button to administrative processing and control room; alarm indicates which cell activated the switch
	CCTV	N/A
	CATV	N/A
	Security	Camera in segregated cells
Acoustical		Minimum STC of 50
Furnishings, Equipment, and Casework		Built-in jail-type bed; built-in jail-type table and chair; stainless-steel integrated toilet and sink; stainless-steel mirror; stainless-steel shelf 12” D x 24” L and 18” above desk: two break-away hooks per cell
Special Requirements		Provide built-in jail-type beds; fiberglass bed with integrated storage. Do not use metal beds. Toilet and vanity unit to be stainless-steel mirror above sink in segregated cells. Porcelain, jail-type toilet and vanity unit preferred in standard cells. No glass mirrors allowed in cells. Ensure surfaces are smooth everywhere. Reference ACA standards.

Figure 3-16 Control Room Data Sheet

Description/Usage		Direct supervision of day room and showers; serves as control center for security cameras and doors throughout facility. Unobstructed views required of day room and shower doors.
Ceiling Height		9’-0”
Windows		One-way security-rated window units to day room with drawer type pass-through window to day room
Doors	**Type**	3’-0” x 7’-0” hollow metal, security-rated
	Security/ Hardware	Keyed lockset; access/door control and annunciator panel
	View Panels/ Kick-Plates	6” x 24” vertical view panels with one-way security-rated glazing for all doors
Finishes	**Walls**	Painted CMU or concrete with impact-resistant gypsum on furring; need sound-abatement material to reduce echo effect
	Floor	Epoxy, tile, or sealed concrete
	Base	Integral epoxy cove; tile or vinyl
	Ceiling	Painted concrete with gypsum ceiling (no drop ceiling)
Plumbing		N/A
HVAC		Air conditioned and heated year round
Fire Protection		Automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets; dedicated 20 A quad receptacle adjacent to work area receptacle for fridge under counter
Lighting		Per UFC 3-530-01; surface-mounted security level (jail type); dimmable
Communication	**Tele.**	Connection to administrative processing
	Data	Connectivity
	CCTV	Security camera monitors
	CATV	N/A
	Security	Counter-mounted security camera monitors
Acoustical		Minimum STC rating of 50
Furnishings, Equipment, and Casework		Wall-mounted fire extinguisher; built-in counter 48” A.F.F; sound wire management features; wall-mounted lockable key box; 20” deep open cabinet with shelving for PPE and board games; 12” x 12” lockable cabinet for medical supplies; 12” x 48” double-tiered lockers for guards; under-counter refrigerator; elevated chair; computer station with 3 monitors; security camera monitors, access/door control annunciator panel
Special Requirements		• Break-away coat hook • PA to day room • Houses lighting controls for all cells

Figure 3-17 Day Room Data Sheet

Description/Usage		Recreational room for confinees.
Ceiling Height		9’-0” minimum
Windows		Exterior wired, tempered-glass clerestory window with minimum 12 SF of glazing
Doors	**Type**	Hollow metal, security-rated to exterior; sliding detention from secure corridor
	Security/ Hardware	Access/door control; electronic with manual release
	View Panels/ Kick-Plates	6” x 30” security-rated view panels in doors; unobstructed guard supervision of day room from control room via one-way security-rated window units; kick plates
Finishes	**Walls**	Painted CMU or concrete
	Floor	Epoxy or sealed concrete
	Base	Integral epoxy cove
	Ceiling	Painted concrete
Plumbing		Connection for electric water cooler
HVAC		Air conditioned and heated year round
Fire Protection		Tamper-resistant automatic sprinkler system (see UFC 3-600-01)
Power		General-purpose duplex outlets and power and cable connection to TV; all tamper-resistant
Lighting		Per UFC 3-530-01; surface-mounted security level (jail type)
Communication	**Tele.**	Wall-mounted jail-type phone
	Audio	PA from control room; call button into control room
	CCTV	Dual monitored, recorded
	CATV	Wall-mounted TV connection, flush with no protruding edges
	Security	Electric locks; cameras
Acoustical		N/A
Furnishings, Equipment, and Casework		Cardio exercise equipment (in cold climates; one treadmill in 4 cell, two treadmills in 8 or 12 cell); built-in jail-type table and attached chairs (one per cell); molded jail-type couch; wall-mounted TV with protective cage (provide space/recess, wiring/conduits and enclosure cover); wall-mounted jail-type phone; electrical water cooler
Special Requirements		N/A

Figure 3-18 Secure Corridor Data Sheet

Description/Usage		Main circulation point between day room, cells, showers, and control room.
Ceiling Height		9’-0”
Windows		N/A
Doors	**Type**	Sliding detention to cells; hospital-type flush open door to near segregation cell for sight and sound control
	Security/ Hardware	Keyed locksets; kick plate on sight/sound door
	View Panels/ Kick-Plates	Tempered wired security view panels; no view panels in segregation sight and sound door
Finishes	**Walls**	Painted CMU or concrete
	Floor	Epoxy or sealed concrete
	Base	Integral epoxy cove
	Ceiling	Painted concrete
Plumbing		Access panels to plumbing chase areas from corridor; tamper-proof
HVAC		Air conditioned and heated year round
Fire Protection		Tamper-resistant automatic sprinkler system (see UFC 3-600-01)
Power		120V convenience outlets; tamper-proof
Lighting		Per UFC 3-530-01; surface-mounted security level (jail type)
Communication	**Tele.**	N/A
	Audio	N/A
	CCTV	Dual monitored, recorded
	CATV	N/A
	Security	Camera
Acoustical		Minimum STC of 50 at both walls and doors
Furnishings, Equipment, and Casework		12” x 12” x 12” single-tiered lockers in secure corridor (one per cell)
Special Requirements		Place/locate cells/cell doors to avoid direct views through view panels into day room

Figure 3-19 Shower Data Sheet

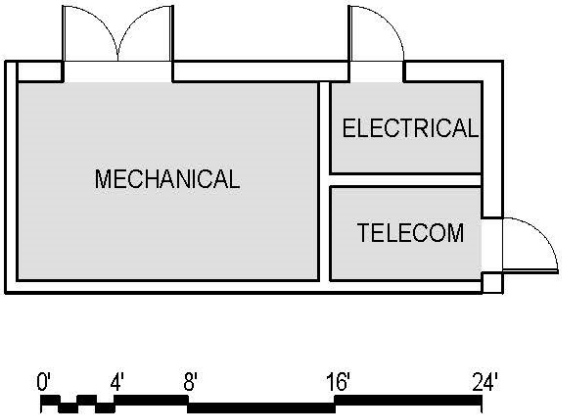
Description/Usage		Shower for confinee daily use. One male and one female per facility (in opposite secure corridors); up to a 12 cell facility. Controlled access to showers.
Ceiling Height		8’-0” minimum
Windows		N/A
Doors	**Type**	Coordinate type with AFSFC and size to meet changing regulations
	Security/ Hardware	Coordinate type with AFSFC and size to meet changing regulations
	View Panels/ Kick-Plates	Coordinate type with AFSFC and size to meet changing regulations
Finishes	**Walls**	Painted CMU; tile in shower
	Floor	Epoxy, slip-resistant floor finish
	Base	Integral epoxy cove
	Ceiling	Painted concrete
Plumbing		Provide water pre-mixed and tepid for shower use at 100–120 °F; floor drain in shower only
HVAC		Ventilated, exhaust
Fire Protection		Tamper-resistant automatic sprinkler system (see UFC 3-600-01)
Power		N/A
Lighting		Per UFC 3-530-01; surface-mounted security level (jail type), rated for wet location
Communication	**Tele.**	N/A
	Audio	Call button to control room and administrative processing
	CCTV	N/A
	CATV	N/A
	Security	Occupancy motion detector monitored from control room and administrative processing
Acoustical		N/A
Furnishings, Equipment, and Casework		Built-in bench; stainless steel mirror (no glass); two breakaway towel hooks (one for towel, other for clothes)
Special Requirements		Breakaway curtain rod, shower head, and clothes hooks

Figure 3-20 Outdoor Recreational/Exercise Yard Data Sheet

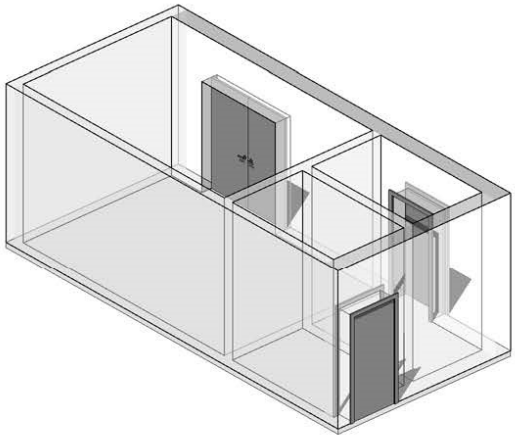
Description/Usage		Exterior secured area connected to the facility used as an exercise yard for confinees and as an emergency refugee area. Minimum size is 500 SF. Half of area is to be covered from the weather. Access directly from day room.
Ceiling Height		12'-0" minimum; nothing on the building can be lower than 12' within the covered yard area
Windows		N/A
Doors	**Type**	Gate for emergency exit; guard supervised/escorted for confinees; door from day room to recreational yard is to be opened electronically from guard room or by key for safety
	Security/ Hardware	N/A
	View Panels/ Kick-Plates	N/A
Finishes	**Walls**	Metal perforated wall minimum 12' high
	Floor	Asphalt or concrete
	Base	N/A
	Ceiling	Provide shaded covered area of at least half the total area
Plumbing		Not required
HVAC		Not required
Fire Protection		Tamper-resistant automatic sprinkler system (see UFC 3-600-01)
Power		Not required
Lighting		Per UFC 3-530-01; HID wall packs
Communication	**Tele.**	None required
	Audio	None required
	CCTV	None required
	CATV	None required
	Security	Security cameras monitored from control room
Acoustical		N/A
Furnishings, Equipment, and Casework		Optional basketball hoop; optional benches
Special Requirements		Place benches 3 to 5 feet away from walls or fences. Ensure basketball backboard is anchored and 6 to 8 feet away from walls or fences. No downspouts or vertical support allowed inside fence to prevent access to the roof. Provide locked double-leaf gate for emergency personnel or fire truck access.

3-5 MODULE D: BUILDING SUPPORT.

Figure 3-21 Floor Plan and Axonometric



MODULE D – SUPPORT AREA ROOM SCHEDULE	
ROOM NAME	**AREA**
ELECTRICAL	**See Appendix-B Programming Worksheets**
MECHANICAL	
TELECOM	



AREA OF MODULE TO BE SIZED PER CLIMATIC AND SYSTEMATIC REQUIREMENTS

Figure 3-22 Building Support Data Sheet

Description/Usage		Space for mechanical, electrical, and telecommunications systems. Three separate rooms with exterior access for civil engineering, mechanical, electrical and telecom. Possibly fire pump room where required.
Ceiling Height		9’-0” minimum
Windows		N/A
Doors	**Type**	Hollow metal 3’ x 7’ leafs
	Security/ Hardware	Keyed lock set
	View Panels/ Kick-Plates	Kick-plate
Finishes	**Walls**	Painted CMU or concrete
	Floor	Sealed concrete
	Base	Vinyl
	Ceiling	Open to structure for M&E; painted; painted gypsum board for telecom; needs a ceiling as it is conditioned
Plumbing		As needed for HVAC equipment and water heaters, etc.
HVAC		Ventilated; telecom room has dedicated HVAC unit
Fire Protection		Automatic sprinkler system
Power		Specific local UPS in comm room; outlets and service as needed for equipment; general maintenance receptacles for CE service. For telecom: two dedicated quad receptacles per rack; two dedicated duplex outlets on wall; convenience receptacles on each wall
Lighting		Per UFC 3-530-01; weather-rated/cold
Communication	**Tele.**	Main terminal
	Data	Main terminal
	CCTV	N/A
	CATV	N/A
	Security	N/A
Acoustical		Minimum STC rating of 50 at mechanical room walls
Furnishings, Equipment, and Casework		Mechanical, electrical, and telecommunication equipment
Special Requirements		Design each system per appropriate UFC. Room sizes may vary per climate and system design. Provide additional weather protection for telecom room door to prevent dust and water intrusion.

CHAPTER 4 TECHNICAL CRITERIA

4-1 GENERAL.

Comply with all applicable UFCs and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, anti-terrorism, security, high-performance and sustainability requirements, security and safety. Use this FC in addition to UFC 1-200-01. This chapter provides specific criteria/requirements for the program and includes references to technical design criteria documents.

4-2 STRUCTURE.

4-2.1 Foundation.

The foundation design and type is site-specific and must be designed based on geotechnical recommendations provided by a licensed geotechnical engineer knowledgeable of the local conditions.

4-2.2 Superstructure.

Construction type must not be less than Type I-A as defined in the IBC. The preferred superstructure is CMU, fully grouted, with concrete roof. Other hardened structures may be considered based on local site requirements. Much of the roof area shall be hardened to control escape attempts.

4-3 EXTERIOR DESIGN.

In general, the building’s image, theme, and fixtures must be consistent with the programs offered and the architecture established on base. Reflect the local geographical and cultural environment in the design and comply with AFCFS and installation architectural standards. Provide a visually attractive, safe, and welcoming appearance. Consider grouping high bay spaces together. Do not allow the building massing to dominate or overwhelm surrounding structures.

4-3.1 Entrances/Exit.

Provide a covered entry. The main facility entrance to the sally port serves as a control and transition point.

4-3.2 Doors and Windows.

Natural light must be provided in cells and dayroom areas in sizes/areas indicated in the data sheets. Provide clerestory, wired, tempered-glass windows to allow natural light into the facility. Use hollow metal frames and doors for general-purpose doors. Provide electronic locking for all exterior doors and interior hallway doors. Units shall comply with AT requirements in UFC 4-010-01 and fire protection requirements in UFC 3-600-01.

4-3.3 Exterior Signage.

Provide an attractive, clearly visible sign at the front entrance to show the program visitor hours of operation. Comply with installation standards and UFC 3-120-01. Wording shall be as directed by local command; however, all signs shall include at least the following:

- No weapons or ammunition allowed
- No drugs or other illegal substances allowed

4-4 INTERIOR DESIGN.

Support the function and theme of confinement with finishes (walls, floor, and ceiling). Provide the same sense of safety, security, and professionalism that can be found in comparable commercial facilities.

4-4.1 Interior Construction.

Interior construction must be extremely durable. The use of hollow core wood doors is prohibited. All interior glass must be tempered safety glass. Mirrors must be standard stainless-steel jail-type mirrors; glass mirrors are not allowed. All hardware must be jail-type (i.e., resistant to confinee destruction). Gypsum board for walls shall be impact-resistant type.

Provide counters, casework, and cabinets of high-quality and extremely durable construction. Specify Premium or Custom grade for finishes per *Architectural Woodwork Standards*. All countertops shall be solid surface/solid composite plastics or composite stone or stainless steel. Items and fixtures in the cells and confinee showers and day room must be heavy-duty, non-breakable stainless-steel or fiberglass (jail type).

4-4.2 Finishes.

Finishes shall be highly durable and low maintenance. Acoustical ceiling tiles provide acoustical noise reduction for the administrative, waiting, and visitor areas. The interior design shall be coordinated with *US Air Force Interior Design Standards* and installation design standards. Use low-maintenance, easy-to-clean gloss, semi-gloss, or other coatings; stained concrete, sealed concrete. Minimize the variety of finishes to simplify maintenance and create continuity in this small facility. All interior finishes must comply with UFC 3-600-01.

Segregated cells must be painted pastel pink (for the calming effect; coordinate exact shade with AFSFC).

4-4.3 Window Treatments.

Include window treatments (shading systems) in the administrative and waiting areas not accessible to the confinees. Analyze solar conditions when selecting a window treatment. Dual fabric solar roller shade systems with manual roll chain operation are recommended.

4-4.4 Interior Signage.

Provide stencil-type graphics and interior signage to complement the architectural and finish materials. Provide interior signage as an integral part of the construction contract. Provide interior signage at each room in the public area; no removable signage is to be accessible to confinees. Coordinate with AFSFC and local command for exact wording.

4-5 SERVICES.

See paragraph 4-9 for sustainable design requirements.

4-5.1 Plumbing.

Comply with UFC 3-420-01. Use a Muffin Monster-type grinder pump between floor drains and sewer main for the plumbing system. Showers must receive water pre-mixed and made tepid at a temperature from 100 to 120 °F. Cell sinks must receive pre-mixed tepid water only. Cells shall not have floor drains. Provide heavy-duty, jail-type fixtures only. Provide toilet and vanity unit with pre-mixed cold and tepid water. Plumbing chases must have access for maintenance from the corridor. Segregated cells must have stainless-steel toilets/bubblers; other cells may use porcelain if cost-effective.

4-5.2 Heating, Ventilating, and Air Conditioning (HVAC).

Design the HVAC system to meet the requirements of UFC 3-410-01, UFC 3-410-02, and UFC 3-600-01. Comply with AT requirements in the HVAC system design (see paragraph 4-8). Supply and return air registers and ductwork shall be jail type, with security grills and tamperproof screws. Shower areas shall have localized exhaust fans to prevent accumulation of steam produced by a hot shower with a minimum ten air changes per hour. Provide a minimum of 15 cubic feet per minute (CFM) of outside air per occupant.

4-5.3 Fire Protection and Life Safety.

UFC 1-200-01 shall be utilized to determine the applicable design codes and standards required for the building construction and life safety features of the facility. UFC 3-600-01 provides the specific fire protection features required for the facility, including fire detection, alarm, and fire suppression systems.

Design and installation of a mass notification system shall be in accordance with UFC 4-021-01.

4-5.4 Electrical.

Provide electric service and distribution equipment, wiring receptacles and grounding, interior and exterior lighting and control, security lighting, exit and egress lighting, telephone, communication systems, fire alarm, other health and safety alarms, and intrusion systems in accordance with NFPA 70, UFC 3-520-01, and installation design requirements. Power distribution shall support all equipment, furniture, and systems for

this building. Provide a connection point for a temporary emergency generator to support all life safety and critical security equipment. Provide a self-contained uninterruptible power supply (UPS) for the cell door controls. The location of electrical receptacles shall be coordinated so they are adjacent to data receptacles in areas where data are provided. No outlets (or plumbing faucets) are allowed within the exercise yard area.

Electrical system and all wiring methods must meet current NFPA 70 requirements. All service equipment must be Underwriters Laboratories (UL) listed. No outlets and switches are to be provided in cells. Outlets accessible to confinees must be vandal-proof GFI type.

4-5.4.1 Lighting.

Comply with UFC 3-530-01 for lighting and control systems throughout the facility. Pay particular attention to issues such as glare, heat generation, and impact protection. The fixtures in areas accessible to the confinees shall be jail-type.

4-5.4.2 Communications and Data.

Telephone and data outlets may be independent of each other or combined into a single junction box. If the hard-wired connections can be combined into a single junction box then the cover plate to that junction box must allow for multiple connections. In some unique situations, the cable television (CATV)/internal video connection can also be combined into a single junction box with the appropriate cover plate. Identify the preference for individual or combined telephone/data/video outlets with the functional data sheets in Chapter 3. Coordinate with AFSFC to determine the actual scope of the security system and closed circuit television (CCTV) system. Specify the need for a public address (PA) system and a CCTV system for each individual space. Provide a PA master control in the control room and secondary control in the administrative processing office. Provide all CCTV security monitors in the control room with integral digital video recording (DVR). Fire alarm notification must comply with UFC 3-600-01.

4-5.4.3 Alarm System.

Provide an alarm system to acknowledge unauthorized opening/closing of interior doors and exit doors. Provide a motion detector in the janitor closet and showers to be monitored from the control room. Provide access control and alarms for all confinement areas (excludes IT, mechanical, and telecom rooms), interior doors (including module to module), both sally port doors, and cell doors. All interior doors will have key (mechanical) override capability in case of power loss. All interior doors except the storage room and restroom need electric unlocking to allow the guard to open (buzz in) the door. All doors are considered locked unless electronically or mechanically opened, except the storage room and restroom, which are mechanical only. Audible and panel light alarms shall annunciate if a door is opened without being previously cleared from the panel. Confinee showers and cells shall have a call button alarm terminating in the control room and administrative processing to request opening.

Provide a redundant door control system with master controls in both the control room and administrative processing. Primary control will be in the control room. Provide a switch in administrative processing to disable the control room in case of disturbance.

4-6 SITE DESIGN AND ORGANIZATION.

The site design and all exterior features must comply with the AT standards in UFC 4-020-01 (including standoff and access road requirements) and the local base planning documents. Also provide minimum separation from other structures in accordance with UFC 3-600-01.

4-6.1 Landscaping and Irrigation.

Refer to UFC 3-201-02, the *USAF Landscape Design Guide*, and installation standards. Comply with UFC 1-200-02, UFC 3-210-10, and UFC 4-020-01. Provide a water-efficient irrigation system. Ensure that there are no loose rocks or other objects that can be used as missile material.

4-6.2 Service Drive.

Verify the size of required service vehicles prior to planning the service access areas. Provide a back-up spur for dead-end and service drives that exceed 30 meters (100 feet) in length. Access shall be near the serviced areas: receiving area, garbage dumpster/storage (indoor or outdoor), and mechanical room. Provide a service vehicle apron and consolidate service access when possible. Screen or separate the service area from public use or traffic areas with attractive walls, fences, depressions, berms, and landscaping. Ensure proper drainage if depressions are used. Do not cross outdoor activity areas with service access. Ensure compliance with UFC 4-020-01, particularly for dumpster separation and access control.

4-6.3 General Site Lighting.

Ensure that parking areas and the facility have lighting for safety, evacuation, and security measures. Illuminate the entire perimeter fence of the recreation yard. Comply with UFC 3-530-01 and IESNA *Lighting Handbook*. CCTV cameras may be mounted on selected poles for complete coverage.

4-7 BARRIER-FREE DESIGN.

Refer to UFC 1-200-01 for barrier-free design requirements. Confinees and staff personnel will be considered “able-bodied.” Only areas accessible by visitors will be barrier-free and handicapped-accessible. The sally port, corridor, restroom, waiting area, and visitation area shall comply with the ABA Accessibility Standard for Department of Defense Facilities. Physically challenged confinees will be housed in local civilian facilities.

4-8 ANTITERRORISM.

Refer to UFC 4-020-01 for AT requirements.

4-9 SUSTAINABLE DESIGN.

Meet the requirements of UFC 1-200-02 and achieve green building certification in accordance with the current Air Force Sustainable Design and Development (SDD) Implementing Guidance.

APPENDIX A REFERENCES

Use the latest available issuance of the reference.

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NFPA 220, *Standard on Types of Building Construction*, http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=220

NFPA 70, *National Electrical Code*, http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=70

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OSHA regulations, https://www.osha.gov/law-regs.html

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USGBC LEED-NC, *LEED 2009 for New Construction and Major Renovations Rating System* (U.S. Green Building Council), http://www.usgbc.org/Docs/Archive/General/Docs5546.pdf

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Architectural Woodwork Standards, http://www.woodworkinstitute.com/publications/aws_ed01.asp]

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APPENDIX B BEST PRACTICES

B-1 U.S. AIR FORCE SECURITY FORCES DYNAMIC PROTOTYPE PROGRAMMING WORKSHEETS.

The Interactive Programming Sheet can be found on the Whole Building Design Guide website: http://www.wbdg.org/references/afbim_tools.php.

Figure B-1 Confinement Facility (4 Cell – Standard)

Confinement Facility (4 Cell - Standard)

MODULE NO.	AREA	NO. OCCUP	SF PER USER	NO. OF ROOMS REQD	INDIVIDUAL ROOM RQRMNTS	NET USER REQUIREMENTS		COMMENTS
					SF	SF	SM	
A	Public Areas							
A.1	Sally Port	2		1	125	125	11.61	1
A.2	Corridor	0		1	100	100	9.29	1
A.3	Administrative Processing	2		1	200	200	18.58	1
A.4	Administrative Storage	0		1	125	125	11.61	1
A.5	Waiting Room	6		1	120	120	11.15	1
A.6	Restroom	1		1	75	75	6.97	1
A.7	Visitation / Training	10		1	175	175	16.26	1
	SUBTOTAL ADMINISTRATION AREA					920	85.47	
B	Semi-Secure Areas							
B.1	Controlled Corridor	0		1	150	150	13.94	1
B.2	Laundry Alcove	0		1	15	15	1.39	1
B.3	Janitor's Closet	0		1	75	75	6.97	1
	SUBTOTAL ARMS RANGE AREA					240	22.30	
C	Secure Areas							
C.1	Control Room	2		1	130	130	12.08	1
C.2	Day Room	4		1	180	180	16.72	1
C.3	Shower	1		2	60	120	11.15	1
C.4	Secure Corridor	0		2	125	250	23.23	1
C.5	Cell	1	80	2	80	160	14.86	1
C.6	Segregated Cell / Corridor	1		2	125	250	23.23	1
	SUBTOTAL TRAINING AREA					1090	101.26	
D	Building Support							
D.1	Mechanical	0		1	150	150	13.94	2
D.2	Electrical	0		1	50	50	4.65	2
D.3	Telecommunications	0		1	50	50	4.65	2
	SUBTOTAL BUILDING SUPPORT AREA					250	23.23	
	TOTAL FACILITY NET FLOOR AREA					2,500.00	232.25	
	NET TO GROSS	20%						3
	TOTAL FACILITY GROSS AREA					3,000	279	
	Exterior Elements							
	Exterior Covered Entry			1	22	22	2	4
	Outdoor Recreational Exercise Yard	8		1	250	250	23	4
	SUBTOTAL EXTERIOR ELEMENTS					272	25	
	TOTAL EXTERIOR FACILITY ELEMENTS					272	25	

COMMENTS:

1 Facilities areas are based upon specific requirements per National Institute of Corrections Jail Design Guide and AFSF

2 Building Support areas may differ per climatic and systematic requirements

3 Net to Gross Area includes circulation and walls; Walls are to be constructed of concrete masonry units or cast-in-place concrete to meet minimum security requirem

4 Exterior Covered Entry and Outdoor Recreational Exercise Yard are covered exterior spaces and are calculated at 1/2 square footage

Figure B-2 Confinement Facility (8 Cell)

Confinement Facility (8 Cell)

MODULE NO.	AREA	NO. OCCUP	SF PER USER	NO. OF ROOMS REQD	INDIVIDUAL ROOM RQRMNTS	NET USER REQUIREMENTS		COMMENTS
					SF	SF	SM	
A	Administration / Visitor Areas							
A.1	Sally Port	2		1	125	125	11.61	1
A.2	Corridor	0		1	100	100	9.29	1
A.3	Administrative Processing	2		1	200	200	18.58	1
A.4	Administrative Storage	0		1	175	175	16.26	1
A.5	Waiting Room	8		1	160	160	14.86	1
A.6	Restroom	1		1	80	80	7.43	1
A.7	Visitation / Training	16		1	300	300	27.87	1
	SUBTOTAL ADMINISTRATION AREA					**1140**	**105.91**	
B	Semi-Secure Areas							
B.1	Controlled Corridor	0		1	200	200	18.58	1
B.2	Laundry Alcove	0		1	15	15	1.39	1
B.3	Janitor's Closet	0		1	80	80	7.43	1
	SUBTOTAL ARMS RANGE AREA					**295**	**27.41**	
C	Secure Areas							
C.1	Control Room	2		1	150	150	13.94	1
C.2	Day Room	8		1	225	225	20.90	1
C.3	Shower	1		2	60	120	11.15	1
C.4	Secure Corridor	0		2	175	350	32.52	1
C.5	Cell	1	80	6	80	480	44.59	1
C.6	Segregated Cell / Corridor	1		2	125	250	23.23	1
	SUBTOTAL TRAINING AREA					**1575**	**146.32**	
D	Building Support							
D.1	Mechanical	0		1	150	150	13.94	2
D.2	Electrical	0		1	50	50	4.65	2
D.3	Telecommunications	0		1	50	50	4.65	2
	SUBTOTAL BUILDING SUPPORT AREA					**250**	**23.23**	
	TOTAL FACILITY NET FLOOR AREA					**3,260.00**	**302.85**	
	NET TO GROSS	20%						3
	TOTAL FACILITY GROSS AREA					**3,912**	**363**	
	Exterior Elements							
	Exterior Covered Entry	0		1	22	22	2	4
	Outdoor Recreational Exercise Yard	8		1	250	250	23	4
	SUBTOTAL EXTERIOR ELEMENTS					**272**	**25**	
	TOTAL EXTERIOR FACILITY ELEMENTS					**272**	**25**	

COMMENTS:

1. Facilities areas are based upon specific requirements per National Institute of Corrections Jail Design Guide and AFSF
2. Building Support areas may differ per climatic and systematic requirements
3. Net to Gross Area includes circulation and walls; Walls are to be constructed of concrete masonry units or cast-in-place concrete to meet minimum security requirem
4. Exterior Covered Entry and Outdoor Recreational Exercise Yard are covered exterior spaces and are calculated at 1/2 square footage

Figure B-3 Confinement Facility (12 Cell - Standard)

Confinement Facility (12 Cell - Standard)

MODULE NO.	AREA	NO. OCCUP	SF PER USER	NO. OF ROOMS REQD	INDIVIDUAL ROOM RQRMNTS SF	NET USER REQUIREMENTS SF	NET USER REQUIREMENTS SM	COMMENTS
A	Public Areas							
A.1	Sally Port	2		1	125	125	11.61	1
A.2	Corridor	0		1	100	100	9.29	1
A.3	Administrative Processing	2	90	1	200	200	18.58	1
A.4	Administrative Storage	0		1	200	200	18.58	1
A.5	Waiting Room	12		1	200	200	18.58	1
A.6	Restroom	1		1	80	80	7.43	1
A.7	Visitation / Training	20		1	375	375	34.84	1
	SUBTOTAL ADMINISTRATION AREA					**1280**	**118.91**	
B	Semi-Secure Areas							
B.1	Controlled Corridor	0		1	200	200	18.58	1
B.2	Laundry Alcove	0		1	15	15	1.39	1
B.3	Janitor's Closet	0		1	80	80	7.43	1
	SUBTOTAL ARMS RANGE AREA					**295**	**27.41**	
C	Secure Areas							
C.1	Control Room	2		1	150	150	13.94	1
C.2	Day Room	12		1	350	350	32.52	1
C.3	Shower	1		2	60	120	11.15	1
C.4	Secure Corridor	0		2	275	550	51.10	1
C.5	Cell	1	80	10	80	800	74.32	1
C.6	Segregated Cell / Corridor	1		2	125	250	23.23	1
	SUBTOTAL TRAINING AREA					**2220**	**206.24**	
D	Building Support							
D.1	Mechanical	0		1	200	200	18.58	2
D.2	Electrical	0		1	60	60	5.57	2
D.3	Telecommunications	0		1	60	60	5.57	2
	SUBTOTAL BUILDING SUPPORT AREA					**320**	**29.73**	
	TOTAL FACILITY NET FLOOR AREA					**4,115.00**	**382.28**	
	NET TO GROSS	20%						3
	TOTAL FACILITY GROSS AREA					**4,938**	**459**	
	Exterior Elements							
E.2	Exterior Covered Entry			1	22	22	2	4
E.3	Outdoor Recreational Exercise Yard	8		1	250	250	23	4
	SUBTOTAL EXTERIOR ELEMENTS					**272**	**25**	
	TOTAL EXTERIOR FACILITY ELEMENTS					**272**	**25**	
	TOTAL GROSS AREA					**5,210**	**484**	

COMMENTS:

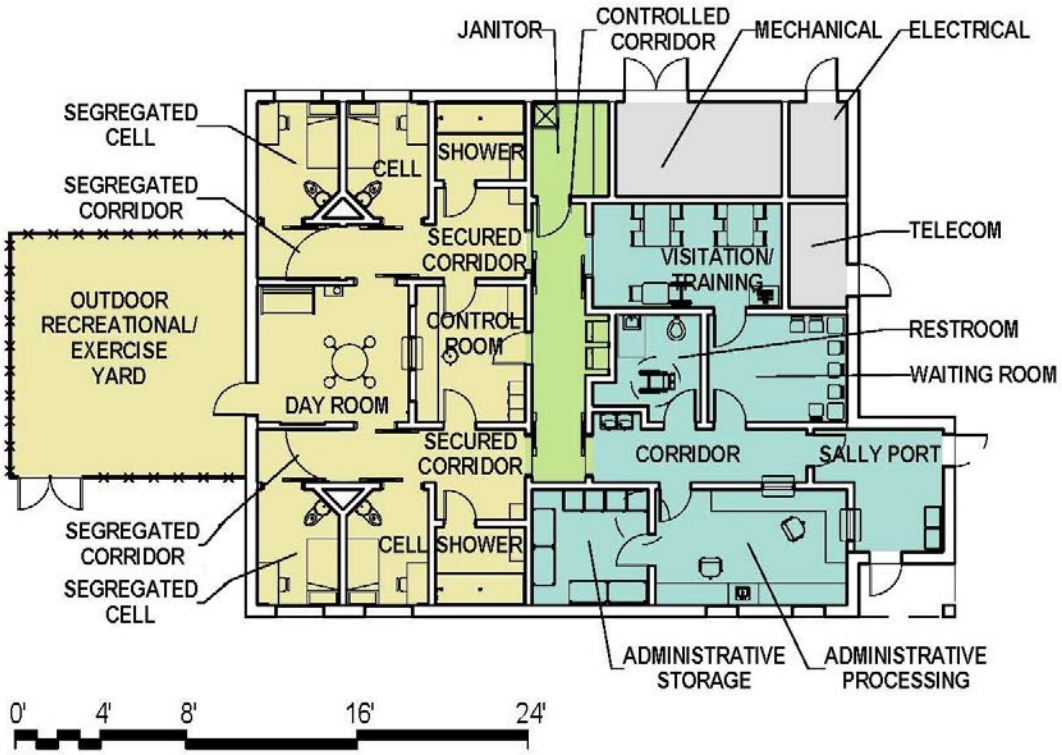
1 Facilities areas are based upon specific requirements per National Institute of Corrections Jail Design Guide and AFSF

2 Building Support areas may differ per climatic and systematic requirements

3 Net to Gross Area includes circulation and walls; Walls are to be constructed of concrete masonry units or cast-in-place concrete to meet minimum security requirem

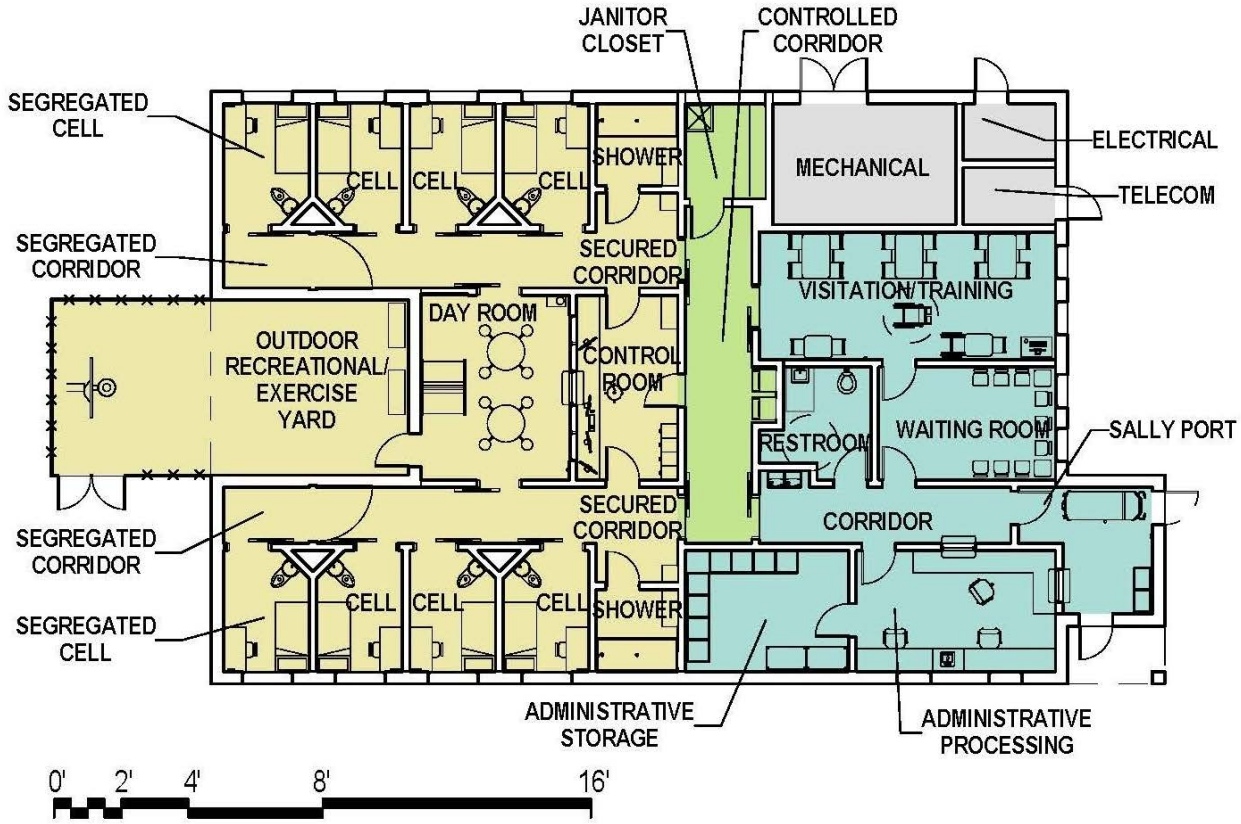
4 Exterior Covered Entry and Outdoor Recreational Exercise Yard are covered exterior spaces and are calculated at 1/2 square footage

Figure B-4 Proof of Concept – 4-Cell Facility



FC - 4 CELL FACILITY ROOM SCHEDULE	
ROOM NAME	**AREA**
ADMINISTRATIVE PROCESSING	**See Appendix-B Programming Worksheet**
ADMINISTRATIVE STORAGE	
CELL	
CELL	
CONTROL ROOM	
CONTROLLED CORRIDOR	
CORRIDOR	
DAY ROOM	
ELECTRICAL	
JANITOR	
MECHANICAL	
RESTROOM	
SALLY PORT	
SECURED CORRIDOR	
SECURED CORRIDOR	
SEGREGATED CELL	
SEGREGATED CELL	
SEGREGATED CORRIDOR	
SEGREGATED CORRIDOR	
SHOWER	
SHOWER	
TELECOM	
VISITATION/ TRAINING	
WAITING ROOM	

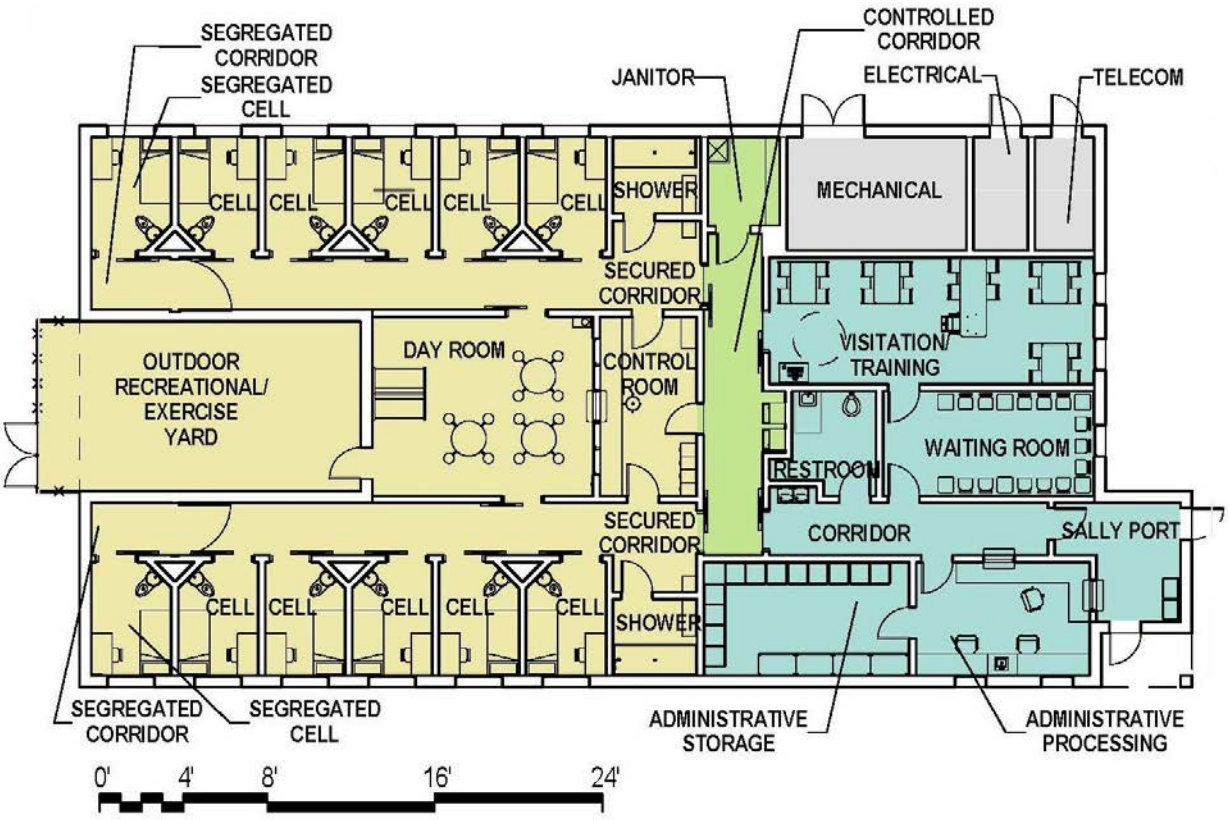
Figure B-5 Proof of Concept - 8-Cell Facility



FC - 8 CELL FACILITY ROOM SCHEDULE	
ROOM NAME	**AREA**
ADMINISTRATIVE PROCESSING	**See Appendix-B Programming Worksheet**
ADMINISTRATIVE STORAGE	
CELL	
CELL	
CELL	
CELL	
CELL	
CELL	
CONTROL ROOM	
CONTROLLED CORRIDOR	
CORRIDOR	
DAY ROOM	
ELECTRICAL	
JANITOR	
MECHANICAL	

FC - 8 CELL FACILITY ROOM SCHEDULE	
ROOM NAME	**AREA**
RESTROOM	**See Appendix-B Programming Worksheet**
SALLY PORT	
SECURED CORRIDOR	
SECURED CORRIDOR	
SEGREGATED CELL	
SEGREGATED CELL	
SEGREGATED CORRIDOR	
SEGREGATED CORRIDOR	
SHOWER	
SHOWER	
TELECOM	
VISITATION/TRAINING	
WAITING ROOM	

Figure B-6 Proof of Concept - 12-Cell Facility



FC - 12 CELL FACILITY ROOM SCHEDULE	
ROOM NAME	**AREA**
ADMINISTRATIVE PROCESSING	**See Appendix-B Programming Worksheet**
ADMINISTRATIVE STORAGE	
CELL	
CELL	
CELL	
CELL	
CELL	
CELL	
CELL	
CELL	
CELL	
CELL	
CONTROL ROOM	
CONTROLLED CORRIDOR	
CORRIDOR	
DAY ROOM	
ELECTRICAL	

FC - 12 CELL FACILITY ROOM SCHEDULE	
ROOM NAME	**AREA**
JANITOR	**See Appendix-B Programming Worksheet**
MECHANICAL	
RESTROOM	
SALLY PORT	
SECURED CORRIDOR	
SECURED CORRIDOR	
SEGREGATED CELL	
SEGREGATED CELL	
SEGREGATED CORRIDOR	
SEGREGATED CORRIDOR	
SHOWER	
SHOWER	
TELECOM	
VISITATION/TRAINING	
WAITING ROOM	

B-2 PDF FLOOR PLANS AND BIM DRAWINGS.

The PDF floor plans and BIM drawings can be found on the Whole Building Design Guide at http://www.wbdg.org/references/afbim_tools.php

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APPENDIX C GLOSSARY

°F	degrees Fahrenheit
A.F.F.	above finished floor
ABA	Architectural Barriers Act
ACA	American Correctional Association
ACI	American Concrete Institute
ADP	Area Development Plan
A-E	architect-engineer
AFCFS	Air Force Corporate Facility Standard
AFH	Air Force Handbook
AFMAN	Air Force Manual
AFSFC	Air Force Security Forces Center
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASTM	American Society of Testing and Materials
AT	antiterrorism
AWI	Architectural Woodwork Institute
AWS	American Welding Society
BIM	Building Information Modeling
CATV	cable television
CCTV	closed-circuit television
CMU	concrete masonry unit

EISA	Energy Independence and Security Act
EM	Engineer Manual
EPACT 2005	Energy Policy Act of 2005
ER	Engineer Regulation
ETL	Engineering Technical Letter
fc	foot-candle
GFI	ground fault circuit interrupter
HVAC	heating, ventilating, air conditioning
IBC	International Building Code
IDP	Installation Development Plan
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IESNA	Illuminating Engineering Society of North America
IFC	International Fuel Gas code
IMC	International Mechanical Code
IPC	International Plumbing Code
LEED	Leadership in Energy & Environmental Design
M&E	mechanical and electrical
MIL-HDBK	Military Handbook
NFPA	National Fire Protection Association
NIPR	Non-Classified Internet Protocol Router network
PA	public address system
PDF	Portable Document Format
PPE	personal protective equipment
SF	Security Forces

STC	Sound Transmission Class
TI	Technical Instruction
UFC	Unified Facilities Criteria
UPS	uninterruptible power supply
USGBC	U.S. Green Building Council
V	volt

FC 4-721-10N
19 May 2022

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This FC supersedes FC 4-721-10N, dated November 2012.

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FOREWORD

Facilities Criteria (FC) provide functional requirements (i.e., defined by users and operational needs of a particular facility type) for specific DoD Component(s), and are intended for use with unified technical requirements published in DoD Unified Facilities Criteria (UFC). FC are applicable only to the DoD Component(s) indicated in the title and do not represent unified DoD requirements. Differences in functional requirements between DoD Components may exist due to differences in policies and operational needs.

All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

Because FC are coordinated with unified DoD technical requirements, they form an element of the DoD UFC system applicable to specific facility types. The UFC system is prescribed by MILSTD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and are applicable to the Military Departments, Defense Agencies, and DoD Field Activities. The UFC System also includes technical requirements and functional requirements for specific facility types, both published as UFC documents and FC documents.

FC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent by the following electronic form: Criteria Change Request. The form is also accessible from the Internet site listed below.

FC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

The Navy and the Marine Corps will use this document. It presents basic design criteria guidance for Unaccompanied Housing (UH) for the Navy and the Marine Corps and applies to both enlisted and officer quarters. It also considers local program operations and requirements, in accordance with the latest construction standards established by the Office of the Secretary of Defense (OSD). Unaccompanied Housing serves permanent party, trainees, and students, and includes open bay housing, barracks, and dormitories. This facilities criteria (FC) includes planning and design criteria for renovation and new construction of Navy and Marine Corps UH. Planners and designers must incorporate the requirements of this document as applicable to their appropriate type of UH. This document does not apply to privatized UH, commonly referred to as public private venture (PPV) assets by the Navy and the Marine Corps. This document does not include criteria for Navy Gateway Inns & Suites (NGIS), Transient, or Visitors Quarters.

1-1.1 Quality of Life.

Providing our unaccompanied military personnel with adequate, comfortable housing is a major goal for the Navy and Marine Corps, and a critical element in attracting and retaining high caliber personnel. Thus, the minimum standards set forth in this document maintain the focus of providing housing for a comfortable living environment.

1-2 APPLICABILITY AND MINIMUM STANDARDS.

This FC establishes minimum UH design standards that must be followed. It provides UH criteria and is applicable to both new military construction (MILCON) as well as sustainment, restoration and modernization (RM, SRM) projects. It is applicable to UH projects whether inside the continental United States, (CONUS) or outside the continental United States (OCONUS). Use this FC in conjunction with Department of Defense (DoD) and other Department of Navy (DoN) criteria related guidance. This FC recognizes that local climates, geography, communities, mission needs, and changing programs necessitate some special requirements for Navy and Marine Corps UH. These standards provide criteria for determining site evaluation and planning, landscape design, facilities design, and interior design.

1-3 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01 which provides applicability of model building codes and Government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this FC in addition to UFC 1-200-01 and the UFCs and Government criteria referenced therein.

1-4 CYBERSECURITY.

Control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service Implementation Policy.

1-5 AUSTERE CONSTRUCTION.

Austere construction is intended for facilities in locations determined by Commander Navy Installations Command (CNIC) and approved by OPNAV to be eligible for austere facilities construction. The austere standards are intended to be applied flexibly and in varying degrees to all facilities at locations designated as austere. The flexibility should be allowed to ensure the criteria are appropriate for individual austere locations. Austere requirements are in APPENDIX C of this document and Planning requirements are in Appendix F of UFC 2-000-05N.

1-6 GLOSSARY.

Appendix D contains acronyms, abbreviations, and terms.

1-7 REFERENCES.

APPENDIX E contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

CHAPTER 2 PLANNING

2-1 PROJECT INITIATION AND PLANNING.

This FC provides information required for preparation of DD Form 1391, which initiates project development. This includes information about functions, space allowances, overall building size, site evaluation, and special factors to consider in developing overall scope and cost estimates. It provides data and criteria needed at each stage of NAVFAC planning, project engineering, and the design process. Additional documentation may be provided in accordance with Chief of Naval Operations (CNO) or Commandant of the Marine Corps (CMC) guidance.

2-1.1 Navy Requirements Determination.

Navy UH requirements are defined in annual Unaccompanied Housing Requirements Determination Report (R-19), within the enterprise Military Housing System (eMH). The R-19 identifies the "Permanent Party Program Requirements" (line 15) by comparing base loading (people) and projected inventory. "School Program Requirements" are identified in the R-19 on page two (line 33), by comparing student throughput demand and projected inventory.

2-1.1.1 Permanent Party (Navy).

E1-E3: Shared bedrooms, with a bathroom to be used by 2 persons maximum.

E4: Private bedroom, with a bathroom to be used by 2 persons maximum.

E4-E6 (at remote locations): Private bedroom, with a bathroom to be used by 2 persons maximum.

E7-E9, O1 and above (at remote locations): Private unit with living room, bedroom, kitchen, and bathroom.

2-1.1.2 Military Necessity/Mission Essential (Navy).

E1-E3: Shared bedrooms, with a bathroom to be used by 2 persons maximum.

E4-E6: Private bedroom, with a bathroom to be used by 2 persons maximum.

E7-E9, O1 and above: Private bedroom, private bathroom.

2-1.1.3 Students (Navy).

Training Necessity: Shared bedrooms, with a bathroom to be used by 2 persons maximum.

2-1.2 Marine Corps Requirements Determination.

Marine Corps UH requirements are defined in annual UH Requirements Worksheet generated by MCICOM GF to the Installations Permanent Party.

E1-E4: Shared bedroom, with a bathroom to be used by 2 persons maximum.

E5: Private bedroom, with a private bathroom.

2-1.2.1 Students (Marine Corps).

Recruit: use the Open Bay plan to house personnel engaged in duty that requires special housing in groups to accomplish their tasks. These include basic training, follow-on entry level training at the Schools of Infantry (East and West), Special Forces with special mission needs, or other special situations as approved.

Formal Training/Schools: marines undergoing Military Occupational Specialty (MOS) training at Marine Corps Formal schools will be billeted at the 2+0 standard, unless otherwise approved.

Officer Accession: Shared bedrooms, with a bathroom to be used by 2 persons maximum.

2-1.3 Site Selection.

Site selection is a key aspect of initial project development and requires thoughtful consideration. This is part of a comprehensive planning process. After site selection and approval, thorough site and field investigations are performed.

- For Navy projects, follow the Installation Development Plan in accordance with UFC 2-100-01.
- For Marine Corps projects, follow the site selection process in accordance with the Base Installation Master Plan.

2-1.4 Project Analysis and Engineering Phase.

After a project is initiated, it is analyzed and defined. During the project analysis stage, the project team meets to define the project to have a clear understanding of the project goals and objectives. The customer, CNIC/HQMC, design agent, and architect/engineer (A/E) team then develops the project documentation based on an analysis of unique customer needs, requirements, established criteria, and site and environmental constraints. Information gathered provides the basis for defining the preliminary design and supports the project engineering phase, parametric cost estimating (PCE), and programming process. Information required includes space planning, site design, selection of the appropriate plan, and building design, elements and concepts. Unique local requirements concerning building program and design criteria are included in the PCE.

- Antiterrorism requirements are established as part of the design program and are identified as a separate line item in the DD Form 1391 estimate.
- For Navy Modernization projects a Business Case Analysis (BCA) is required for OPNAV review and approval.

2-2 ASSIGNMENT STANDARDS.

Navy: Assignment standards for the Navy are described in Commander Navy Installations Command Unaccompanied Housing Operations Manual CNIC M-11103.2. Refer to DOD 4165.63-M for additional information.

Marine Corps: Assignment standards for Marine Corps personnel are described in Marine Corps Order (MCO) 11000.22. Refer to DOD 4165.63-M for additional information.

2-3 FACILITY FUNCTIONS.

Three basic functional activities must be addressed in Navy and Marine Corps UH: “Units” (Navy) and “Rooms” (Marine Corps); Building Common Areas; and Recreational and Community Areas.

2-3.1 Terminology: “Unit”, “Room”, “Plan”, “Open Bay”.

The basic UH living unit should be composed of bedroom, living area, personal storage closet, bathroom, sink/personal hygiene area, food preparation area, and telecommunications as applicable. Navy and Marine Corps terminology differs for the same entity.

- "Unit". Navy UH living spaces are referred to as "Units”. The ‘Unit’ will refer to any group of rooms sharing any common space, such that a ‘Navy 2+0 Unit’ is composed of only one room and bathroom, whereas a ‘Market Unit’ might include several bedrooms, bathrooms, kitchen and living/dining area.
- "Room" or "Plan". The Marine Corps uses the terms “Room” or “Plan” for their basic UH living spaces, resulting in the “Marine Corps 2+0 Room”, “SNCO/BOQ Room” and “Marine Corps Officer Plan”.

Both Navy and Marine Corps use the term "Open Bay".

2-3.2 Building Common Areas (Spaces).

Building Common Areas (Spaces) are spaces within the building that are not included within the Navy UH Unit or the Marines Corp UH Room or Plan. Examples of these spaces are: entrance, laundry facilities, bulk storage, utility space, circulation space, multipurpose space, vending areas, public toilets, supply storage rooms, and administration area. See Chapter 3 for general space requirements which apply to all plans, and Chapters 4 thru 6 for Common Areas which vary by plans.

- Allowances for Common Areas (Spaces) vary depending upon the plan used.
- Not all Common Areas (Spaces) are permitted or available for all plans.

2-3.3 Recreation and Community Areas (Spaces).

Recreation and Community Areas (spaces) are outdoor activity areas. See Chapter 3, paragraph 3-2.14 entitled “Outdoor Recreation” for a more detailed description.

2-4 ACCESSIBLE UNITS.

Comply with *Architectural Barriers Act* (most recent edition) for additional requirements at accessible units or rooms. To determine the quantity of accessible units or rooms required in a project, take into account the amount of rooms provided in other UH facilities which meet ABA standards and include the quantity of rooms in the current project to meet the total required. Provide accessible units or rooms on the ground floor. Accessibility requirements also apply to common spaces (such as administrative areas, lobby, multipurpose rooms and laundry rooms).

2-5 ADAPTABLE UNITS

Adaptable rooms allow flexibility to accommodate the temporary requirement to house Members who are temporarily unable to climb stairs or have only limited mobility. These type facilities are not intended to house wounded warriors who require long term medical care. Fully accessible rooms are not intended; rather to serve those who are temporarily unable to climb stairs. In new construction projects, provide a minimum of two easily “adaptable” rooms on the ground floor to allow assigned service members with minor injuries to remain with their Units. Functional spaces and minimum square footage requirements must be provided in adaptable rooms (such as 2 closets required in 2-person units).

“Adaptable unit” means dwelling units that include the features of adaptable design specified in 24 CFR 100.205(c) (2)-(3). These include:

- Doors designed to allow passage into and within premises are sufficiently wide to allow passage by handicapped persons in wheelchairs;
- An accessible route into and through the unit;
- Light switches, electrical outlets, thermostats, and other environmental controls in accessible locations;
- Reinforcements in bathroom walls to allow later installation of grab bars around the toilet, tub, shower, stall and shower seat; and
- Usable kitchens and bathrooms such that an individual in a wheelchair can maneuver about the space.

2-6 NAVY STANDARDS FOR CONSTRUCTION AND SUSTAINMENT, RESTORATION, AND MODERNIZATION.

Restoration and Modernization (RM) projects must be executed in accordance with the current version of OPNAVINST 11010.20. This document provides detailed guidance for the administration of facilities projects at Navy shore installations. The criteria standards for Construction, Sustainment, Restoration, and Modernization (SRM) for Navy UH are referred to as Permanent Party, Mission Essential, or Recruits/Trainees. The existing building shell should be considered and respected in re-design projects. Modernization projects which alter the configuration of the building require a Business Case Analysis (BCA) approved by Deputy Chief of Naval Operations (Facilities Readiness & Logistics).

2-6.1 Recruits.

Provide Open Bay UH plan for recruits.

2-6.2 Training Necessity.

New construction for Students in Officer Accessions (Officer Training Command) and Enlisted (E1-E4), "non-prior service" in Initial Skills training (such as "A" Schools, Accessions pipeline, and "C" Schools) must use the Naval Education and Training Command (NETC) 2+0 Dormitory Unit.

2-6.3 Mission Essential.

New construction for rotational Sailors outside their homeport must use the Navy 2+0 Unit or the Austere design (based upon location).

2-6.4 Permanent Party.

Construction for Permanent Party UH must use Market Units in accordance with CNIC M-11103.2. Students in training 20 weeks or longer with exception of Officer Accessions and Enlisted "A" School pipeline training will be housed as Permanent Party (Market Units). This requirement is not applicable to renovation projects. Note that the Navy no longer uses a 2+0 plan for new footprint Permanent Party construction.

2-7 MARINE CORPS STANDARDS FOR CONSTRUCTION AND SRM.

Restoration and Modernization (RM) projects must be executed in accordance with the current version of OPNAVINST 11010.20. The criteria standards for Construction, Sustainment, Restoration, and Modernization (SRM) for Marine Corps UH are referred to as Permanent Party, Transients, or Recruits/Trainees. The existing building shell should be considered and respected in re-design projects. Modernization projects which alter the structural configuration of the building require a Business Case Analysis (BCA) approved by the Marine Corps Office Facilities and Services Division (Code LF).

2-7.1 Permanent Party.

New Marine Corps construction for Permanent Party UH must use the Marine Corps 2+0 Room.

2-7.2 Recruits and Trainees.

Use the Open-Bay Plan for UH to house personnel engaged in duty that requires special housing in groups to accomplish their tasks. These include basic training, follow-on entry level training at the Schools of Infantry (East and West), Special Forces with special mission needs, or other special situations as approved by HQMC Facilities and Services Division (Code LF). Marines undergoing Military Occupational Specialty training at Marine Corps formal schools will be billeted at the 2+0 standard, unless otherwise approved by HQMC Facilities and Services Division (Code LF).

2-8 DESIGN LIMITATIONS.

Graphic illustrations in this document are the basic building blocks from which UH designs are developed. These illustrations are provided to promote uniformity in the design of projects. These designs may be altered, but the mandatory size limits require that any variations be small. Required Common Areas (Spaces) for each UH plan differ. Refer to the specific Unit or Plan within subsequent chapters for the detailed descriptions of required Common Areas (Spaces).

- While plan layouts may be altered to some degree, all of the detailed features and fixtures must be included as a mandatory minimum.
- The Net Living/Sleeping Areas must be met, and gross area maximums must not be exceeded. Net Living/Sleeping Area describes the actual usable space in each sleeping/living area. Refer to DOD 4165.63-M for additional descriptive information.
- Plan room dimensions are NOT fixed but must remain functional. Size bedrooms to accommodate two extra-long twin beds, two desks and chairs, and if closets are not provided, two chest of drawers and two wardrobes.

2-9 GROSS BUILDING AREA.

When calculating the Gross Building Area, measure from the outside face to the outside face of exterior walls.

2-9.1 Gross Building Area = Unit/Room + Common Area (Space).

The total gross building size of UH facilities is based on a gross square footage metric for each unit or room type used. This metric accounts for the rooms/plans in addition to the common area spaces. See Chapters 3 thru 6 for the Net square footage requirements of specific spaces for use during plan layouts. These planning-level metrics are included in Table 2-1 below.

Table 2-1 Planning Level Metrics per Unit/Plan

UNIT/PLAN	MAXIMUM ALLOWABLE GROSS BUILDING AREA, FT2 (M2)
Navy Market Unit	606 ft2 (56.3 m2) per bedroom, based on a two-bedroom Unit. This maximum is not applicable for one-bedroom Units.
Navy NETC 2+0 Dormitory Unit / Navy 2+0 Unit	595 ft2 (55.3 m2) per plan
Marine Corps 1+1E Room	817 ft2 (76 m2) per plan
Marine Corps 2+0 Room	595 ft2 (55.3 m2) per plan
Marine Corps Officer Plan	855 ft2 (79.4 m2) per plan
Open Bay Plans	140 ft2 (13 m2) per person housed

2-9.2 Building Area Calculation.

For information on performing a building area calculation refer to UFC 3-101-01. For detailed information on Facilities Planning criteria for Navy/Marine Corps shore installations, refer to UFC 2-000-05N.

In cases where covered balconies and covered exterior circulation walks serve as the primary circulation (i.e., serving exterior room entrances), they count towards building gross area at 100%.

2-9.3 High Rise Structures and Additional Gross Area.

Multi-level construction requires additional structural and mechanical support. Therefore, for buildings above 3 stories an additional area of 21.5 ft^2 (2 m^2) may be added to the allowable gross area per Navy Unit or Marine Corps Plan. This must be identified and justified as a separate item in the DD 1391 documentation.

2-9.4 Additional Gross Area Required by Climate or Local Conditions.

Climate and local conditions may require additional enclosed spaces which need to be accounted for in the planning of the gross area for UH facilities. Examples of conditions and features that may require additional enclosed space include:

- Fire pump room where local infrastructure is insufficient.
- Locating emergency generator in an enclosed space due to climate or protection reasons.
- Requirements for a water treatment building where local water quality is inadequate.

2-9.5 Exterior Covered Areas

For covered outdoor facilities with no exterior walls, program these by the space function where there are associated Category Codes. Refer to UFC 2-000-05N for programmed areas of these spaces. Examples include:

- Car wash facility
- Gear/equipment washing and drying canopies
- Outdoor pavilion or other covered functional area

2-9.6 GROSS “UNIT” OR “ROOM” AREA.

Gross Unit or Room Area is defined as the area within the walls comprising the perimeter of a (Navy) Unit or (Marine Corps) Room. Review paragraph 2-3.1 entitled “Terminology for "Unit", "Room", "Plan" and "Open Bay"”.

- Wall thickness and chase areas within the perimeter walls are included in the Gross Area.
- Gross Area is measured from the centerline of perimeter walls shared with interior corridors, common chases, or other rooms.
- Gross Area is measured to the outside face of exterior walls.
- Plan corner rooms with two exterior walls are to have the same interior dimensions as other rooms, even though technically the Gross Area for these corner spaces is slightly more than for other spaces.

2-10 FUNCTIONAL SPACES BY ROOM/UNIT TYPE

2-10.1 Navy Required and Optional Spaces

Chapters 3, 4 and 6 provide detailed information on the functional spaces required by the Navy based on Unit types. Table 2-2 presents a summary of space types and those that are required, indicated by an “X”, and those that are optional, indicated by an “O”. “N/A” indicates that a space is not applicable to that Unit type.

Table 2-2 Required and Optional Common Spaces: Navy Unit Types

NAVY UNITS				
AREA/SPACE	**MARKET UNIT**	**NAVY 2+0**	**NETC DORM**	**NAVY OPEN BAY**
Corridors	X	X	X	X
Stairways	X	X	X	X
Offices/Administration Area	X	X	O	O
Elevators	X	X	X	X
Lobby/Reception/Front Desk	X	X	O	O
Mechanical, Electrical and Telecom Rooms	X	X	X	X
*Weather Vestibule	X	X	X	X
Multipurpose Room(s)	X	X	X	X
Game Room(s)	N/A	N/A	O	N/A
Public Toilets	X	X	X	O
Vending (depending on nearby amenities)	O	O	X	O
Bulk Storage	X	X	O	X
General Maintenance Room	O	O	O	O
Janitorial	X	X	X	X
Trash Rooms (in bldgs. over 3 stories)	X	X	X	O
Housekeeping/Linen	X	X	O	N/A
Common Laundry	N/A	X	X	X
Duty Office	N/A	N/A	X	N/A
Duty Bunk	N/A	N/A	X	N/A
Unisex Restrooms	N/A	N/A	X	N/A
Armories	N/A	N/A	N/A	O

* Where required per ASHRAE 90.1, 5.4.3.4

2-10.2 Marine Corps Required and Optional Spaces

Chapters 3, 5 and 6 provide detailed information on the functional spaces required by the Marine Corps based on Room or Plan types. Table 2-3 presents a summary of space types and those that are required, indicated by an "X", and those that are optional, indicated by an "O". "N/A" indicates that a space is not applicable to that Room or Plan type.

Table 2-3 Required and Optional Common Spaces: Marine Corps Room or Plan Types

MARINE CORPS UNITS				
AREA/SPACE	**MC 2+0 ROOM**	**MC 1+1E ROOM**	**MC OFFICER PLAN**	**MC OPEN BAY**
Corridors	X	X	X	X
Stairways	X	X	X	X
Offices/Admin Area	O	O	O	N/A
Elevators	X	X	X	X
Lobby/Reception/Front Desk	** X	O	O	O
Mechanical, Electrical and Telecom Rooms	X	X	X	X
*Entry Vestibule	X	X	X	X
Multipurpose Room(s)	X	X	O	X
Game Room(s)	O	O	O	N/A
Theater Room	O	N/A	O	N/A
A/V Equipment Rooms	N/A	N/A	O	N/A
Internet Cafe	O	O	O	N/A
Public Toilets	O	O	O	O
Vending	X	X	O	O
Bulk Storage	O	O	O	O
General Maintenance Room	O	O	O	O
Janitorial	X	X	X	X
Trash Rooms (in bldgs. over 3 stories)	X	X	X	O
Housekeeping/Linen	X	X	X	X
Centralized Kitchen	O	O	N/A	N/A
Common Laundry	X	X	N/A	X
Duty Office	X	X	N/A	O
Duty Bunk	X	X	N/A	O
Unisex Restrooms	X	X	X	O
Armories	N/A	N/A	N/A	O

* Where required per ASHRAE 90.1, 5.4.3.4.
** Optional at satellite facilities.

CHAPTER 3 GENERAL DESIGN CRITERIA - NAVY AND MARINE CORPS

3-1 SCOPE.

This Chapter is applicable to new construction, and renovation and modernization UH projects. Redesign and renovation project teams must apply sections relevant to the scope of work for their project.

3-2 SITE DESIGN.

Comply with the requirements of UFC 3-201-01. Analysis of existing site conditions (e.g., utilities and plant material, traffic patterns, land use, community facilities, and off-site workplaces), and antiterrorism is important for effective site design.

- Site Navy and Marine Corps UH to take advantage of the positive features of the site. Provide protection from undesirable winds and glare, shading from excessive sun in warm climates, and orientation of operable windows to take advantage of summer breezes.
- Pay special attention to building orientation, mass, and scale in developing the site plan. Develop a sense of order, arrival, orientation, and community in planning the site. Arrange the placement of structures in relationship to one another to create outdoor spaces for use as passive or active recreation areas. Achieve spatial balance and scale through thoughtful placement and arrangement of structures, landscaping, and landforms. Organize the site using functional zones and the appropriate relationship of functions. Intermittent functions such as trash collection, vending machine service, furniture moving, and mechanical repair should not interrupt residents' activities.
- Establishing the finished floor elevation of the project is one of the most important aspects of site planning. The Finished Floor Elevation affects grading, cut and fill, and visual impact of the facility, as well as interior and exterior transitions. In addition, the Finished Floor Elevation has a significant impact on the landscape architect's ability to effectively introduce site improvements into the new environment. When the approach is to "level the site" without sensitivity to other demands, the results lack visual interest. Closely combine efforts of the landscape architect, architect, and civil engineer to achieve the most optimum design results. For Civil Engineering, provide the facility's minimum finished floor elevation and the mechanical/electrical equipment pad elevations in accordance with the latest civil design guidance.

3-2.1 Walkways and Sidewalks.

Locate and size walkways to efficiently connect residents with site amenities, parking, station transportation, community facilities, jogging trails, and workplaces. Place walkways with emphasis on functional rather than formal needs. Grade walkways to

drain away from the building and ensure non-slip surfaces are provided. Consider security in all circulation designs.

- Construct walkways to building entrances to be 8 feet (2.5 meters) wide.
- Construct sidewalks used for troop formations to be as much as 28 feet (8.5 meters) wide.
- Construct typical pedestrian sidewalks 6 feet (2 meters) wide.

3-2.2 Vehicular Access.

Provide access to the housing site from secondary (collector) streets to reduce congestion associated with main arterial streets. Where possible, divide main entrances with landscaped traffic medians between entry and exit lanes. Because of high volume of traffic using the entrances, construct the width of non-divided entrances to be a minimum of 24.6 feet (7.5 meters). Carefully review security requirements when designing for vehicular access.

3-2.3 Parking.

Review the security study and incorporate its requirements into the design. Ensure existing and proposed parking is in compliance with Chapter 3, paragraph 3-5, entitled, Antiterrorism. Provide parking for residents, visitors, staff, and service personnel that is convenient, safe, and pleasant to use. Locate and shape parking areas to improve the residential environment. Use landforms such as earth berms, retention ponds, and tree islands to separate parking from other functional zones and to buffer the residential area from possible surrounding adverse environment.

Provide standard parking spaces for 70% of the resident capacity. Provide motorcycle parking for 5% of the resident capacity; provide dedicated space with concrete paving. Provide bicycle parking for 5% of the resident capacity; provide secure, weather protected, conveniently located facilities. Provide visitor parking for 2% of the resident capacity. Locate two standard parking spaces for guest check-in near the entrance. Provide parking for each staff member and locate staff parking at the outer areas of the parking area. Maintenance parking for service functions does not necessarily require dedicated space. Use the expected frequency of maintenance vehicles to determine whether dedicated parking is needed. Locate service access and parking to avoid disturbing residents.

3-2.4 Vehicular Service to Building.

Antiterrorism requirements take precedence over other requirements.

- Entrances. Where possible, separate service entrances associated with mechanical rooms or mechanical enclosures from parking areas.
- Design access streets and parking areas to accommodate service vehicles and fire protection equipment. Where interior court areas are being proposed between adjoining buildings, consider designing the main

pedestrian walks to accommodate service and fire protection vehicles. For example, construct the minimum width of such walkways a minimum of 8 feet (2.5 meters) wide and constructed using reinforced concrete to accommodate Government vehicle weight class 4 and 5.

- Consider treating the walkways with a patterned concrete system to minimize the negative impact of the wider access route. Use materials such as concrete grass road type pavers to provide access for infrequent service vehicles.

3-2.5 Bus Route Access.

Consider developing shelters and walks to serve personnel needs if the base provides bus service. Design bus shelters to be compatible with the architectural aesthetic of existing buildings, Installation Appearance Plan (IAP), and existing bus shelters on base. Program at least one bus stop shelter for each major housing complex. Coordinate with the base in selecting a new shelter that is programmed with new projects, where existing shelter design needs upgrading.

3-2.6 Utility Corridors.

Develop utility corridors in coordination with the planner, electrical, mechanical, and civil engineers. Size the corridors to accommodate future expansion. Locate utility corridors no closer to tree trunks than one and one-half times the crown width of mature trees or 33 feet (10 meters), whichever is the greater amount. Locate utility corridors to allow for future street tree plantings.

3-2.7 Fire Protection Access.

Site new structures a minimum of 39 feet (12 meters) laterally from the closest adjoining building. Provide fire department access, fire lanes, and fire apparatus turn-a-rounds in accordance with UFC 3-600-01.

3-2.8 Site Furniture.

Select site furniture that is in harmony with the architecture of the new and surrounding existing facilities, compliments the building, and makes the outdoor spaces more usable and organized. The landscape architect must coordinate the selections with the architect and interior designer to ensure smooth transitions are made in the procession from within the building to the outdoors and vice versa. Effective transitions are affected when building materials, colors used in the building exterior and interior areas, and design details from the building are incorporated into the paving materials and site furnishings. Durable site furnishings are to be used to support various site functions. Wherever possible, use recycled materials for site furnishings. Coordinate the use and locations of site furnishings, trash receptacles, seating, picnic shelters and grills, and lighting. Provide public areas suitable for various group sizes (4-20) with grills and at least partially covered seating. Site public areas to accommodate larger coordinated and smaller separated activities.

3-2.9 Mechanical Enclosures.

Screen mechanical equipment such as chillers, evaporating condensers, switchgear, and electrical transformers. Use architectural screening materials that complement the materials used to construct the new facility. Use landforms to screen objects in the landscape that do not require enclosures. Design screening low and in cognizance of the requirements of the Risk Analysis and Vulnerability Assessment and security requirements.

3-2.10 Trash Dumpsters.

Locate dumpsters in areas away from main entrances, while still as convenient as possible to residents and large trash handling trucks. Screen trash dumpster locations with any combination of hard wall materials, earth forms, and landscaping to reduce their impact. Where hard wall materials are used, use materials that complement the materials used in the project and adjacent facilities. Locate dumpsters and design screening in accordance with the requirements of the Risk Analysis and Vulnerability Assessment and security requirements.

Where large refuse containers or compactors are located within building footprints, locate trash chutes conveniently for use by all occupants. Provide trash rooms with a hose bib and floor drain for cleanup.

3-2.11 Planting and Vegetation.

Comply with the requirements of UFC 3-201-02. Proper planning and design, plant selection, and use of turf alternatives and mulch materials, zoning of plants in accordance with water requirements, soil improvements, efficient irrigation, and appropriate maintenance are the fundamentals of good landscape planting.

- Develop plantings to create an aesthetically pleasing landscape that conserves water and resources while minimizing maintenance requirements.
- Provide low shrubs and ground covers at the building foundation, bio-retention cells (if utilized), and for screening unsightly utility features.
- Provide trees throughout the site including at parking areas, along roadways, around the building as appropriate, and in turf areas.
- Provide new plantings which enhance the visual quality of the site during all seasons and incompliance with local installation standards.
- Provide a one-year maintenance contract on all plants, including sod or grass seeded areas.
- Provide plant materials that are drought tolerant, disease and pest resistant, and are native or naturalized.
- Plantings must meet Anti-terrorism (AT) Standards.

3-2.12 Landscape Maintenance Provisions.

The initial contract must provide landscape establishment and maintenance for installation of plant materials. Use a one-year duration of the establishment period in all cases. This must not be made optional. Include the following establishment requirements:

- Irrigation including adjusting sprinkler head radius, direction, and resetting to finish grade, replacing broken heads and other equipment, adjusting automatic irrigation controller timing;
- Mowing and edging, replacing mulch;
- Inspection, control of pests and weed control;
- Tightening, staking and guying materials, pruning, fertilization;
- Replacing damaged, dying, or dead plant materials;
- Maintaining watering saucers.

3-2.13 Irrigation.

Comply with the requirements of UFC 3-201-02. For Navy projects, permanent reclaimed water irrigation systems are required only for building perimeter planted areas, such as the 20-foot (6.096 meter) perimeter immediately around the building.

For Marine Corps projects, permanent irrigation systems are not required. Permanent reclaimed water irrigation systems may be approved where climactic conditions dictate.

3-2.14 Outdoor Recreation.

When providing sand volleyball courts and full basketball facilities or other appropriate amenities, light these facilities for evening use. Locate these recreational functions to reduce interference with other functions on and near the site. Shelter or screen both active and passive recreational facilities to temper wind and other climate elements. Provide horseshoe pits or other recreational activities, as well as tables, benches, appropriate lighting for safety and evening recreational activities, and appropriate plant materials.

3-3 RESTORATION AND MODERNIZATION REQUIREMENTS.

Projects for any existing facility housing unaccompanied personnel must incorporate a ‘whole building approach’ with the goal of eliminating all identified building deficiencies.

3-3.1 Navy RM.

Restoration and Modernization (RM) UH projects for the Navy will be executed to the maximum extent possible to include new construction requirements noting that a market style standard (assignment) for permanent party unaccompanied personnel may not be achieved within existing older facilities. RM projects must address all identified

deficiencies (Condition and Building Code), and functional Quality of Life (QOL) deficiencies.

3-3.2 Marine Corps RM.

Restoration and Modernization UH projects for the Marine Corps will be executed to the maximum extent possible to include new construction requirements noting that a 2+0 standard (assignment) may not be achieved within existing older facilities.

3-4 STRUCTURAL DESIGN.

Use UFC 1-200-01 for structural engineering and seismic design.

3-4.1 Structural Selection.

Coordinate column spacing and layout with the building's floor plan so that they occur within or in alignment with walls. Hold columns occurring within spaces to a minimum and limit them to larger public spaces. Analyze and select the proposed structural system that is the most economical method of realizing the architectural design intent.

Select an economical structural system based on: facility size; load requirements; geotechnical conditions and foundation design based on local experience; antiterrorism considerations, including progressive collapse for buildings of three stories or greater; local availability of materials and labor; local construction practices; experience of inspection personnel; resistance to fire; permafrost conditions; construction schedule.

3-5 ANTITERRORISM (AT).

The DOD objective is to eliminate personnel exposure to security threats in occupied UH and workspaces, limit property damage, and minimize the likelihood of mass casualties from terrorist attacks through cost effective security improvements. DOD policy and guidance for antiterrorism and the physical security of facilities is contained in core criteria as referenced in UFC 1-200-01. Use UFC 4-010-01 and Geographic Combatant Commander Antiterrorism construction standards for these antiterrorism requirements. These requirements are applicable for new construction, restoration, and modernization or redesign of existing facilities.

3-5.1 Vulnerability and Risk Assessment.

During the initial UH planning process, the Planning Team must conduct a vulnerability assessment to determine the appropriate Design Basis Threat (DBT) and associated level of protection. Use UFC 4-020-01.

3-5.1.1 UH Design in High Threat Environments.

When the vulnerability and risk assessment of a new project identifies a higher DBT, the following minimum design features are required:

- Kitchen/Bath. Kitchen and bath areas located to the threat side of the occupied space as a buffer to the more frequently occupied sleeping areas.
- Windows and Glass. Limit the use of doors and windows. Windows must be operable, and with lockable hardware.
- Protected Courtyard. A protected courtyard may or may not be a structurally enclosed space. A protected courtyard is a space where access by unauthorized persons or vehicles is limited by landscaping, structures or fencing.

3-6 ARCHITECTURE.

Refer to UFC 1-200-01 for direction to the appropriate core criteria for architectural details and finish concerning:

- Exterior Finishes, vapor retarders, thermal insulation, and air infiltration.
- Roof systems. Design and detail roof systems to resist maximum wind for the area.

3-6.1 Building Design.

Design buildings to make arrival and movement through them orderly and clearly understandable by users (visitors, residents, staff, and service personnel). Use circulation to organize and zone activities and to promote physical security.

- Provide a single public entrance to the building and to different functional areas within the building.
- Provide a weather protected entrance vestibule with two sets of doors. The first exterior door must not be secured. The second door set to provide secure access to the building.

3-6.2 Architectural Character and Scale.

Most military installations have published exterior architectural guidelines that contain criteria relative to achieving, maintaining, and emphasizing a positive exterior visual environment. Follow the design guidance contained in these documents. In the absence of such guidelines, design facilities to harmonize with the character of existing facilities considered historically or architecturally significant to the area.

Design the architectural character of the facility in context with its surroundings and relate not only to the immediate site and adjacent buildings, but also to the Installation itself.

3-6.3 Residential Character for Unaccompanied Housing.

Design housing to provide a residential environment through both exterior and interior elements. Design exterior building forms to reflect the residential character of the project. These residential images can be reinforced through the following:

- Provide gable or similar steep sloped roof shapes. Sloped metal roofs are mandatory on UH, with limited exceptions for Navy projects. The Navy will accept other roofing materials if necessary, to match existing buildings, with exception of asphalt shingles.
- Asphalt shingle roofs are prohibited.
- Bay windows may be used to change the exterior appearance from institutional to more residential. Additionally, architecturally integrated sunshades or other features are acceptable.

3-6.4 Model Unit “Mockups”.

Construction of a UH Model Unit or "Mockup" of a typical Unit/Plan or selected spaces within a typical Unit/Plan, created and finished for illustration purposes, have proven to be very effective in cost management and quality control. They are most successful when completed prior to the start of project construction. For new construction, mockups may be elemental or whole, built off-site and later dismantled or built on-site and converted for actual use. For RM projects, construct mockups in place on-site and convert to actual use to be most cost effective. For mockup reviews, include acoustical field testing in accordance ASTM E336.

- Mockups are required for Navy projects that contain more than 24 units. Provide a virtual typical unit model to test in-unit door swings and unit design functionality for projects containing less than 24 units.
- Mockups are encouraged for Marine Corps projects where space is available and time permitting, and if so, incorporated in the project RFP.

3-6.5 Acoustics.

Careful attention to acoustic design is required for UH to ensure a high degree of privacy for residents. Design to meet acoustic requirements structurally rather than through the use of applied finishes. Do not compromise the acoustical integrity of wall, floor, or ceiling assemblies with electrical outlets, or mechanical ducts. If required, field test assemblies in accordance with ASTM E336 and ASTM E492. Provide the following acoustic ratings:

- Walls between living units and between living units and corridors, and exterior walls of living units require a sound transmission class (STC) of minimum STC 55.
- Walls within the living units (room to room) require a minimum STC 50.
- Unit entry doors require a minimum STC 41.

Floor and ceiling assemblies require a minimum STC 55 and have an impact isolation class of at least (IIC) 60 for Navy. An impact Isolation rating (IIC) of STC 50 is the minimum design target for the Marine Corps, but an IIC 45 rating is acceptable if field tested.

3-6.6 Doors.

Specify doors, frames, and hardware to meet sound separation, fire separation, and security requirements unique to Navy and Marine Corps UH. Design all doors and frames in accordance with the findings of the Risk Analysis and Vulnerability Assessment provided for the project. Fully weather strip exterior doors and provide heavy duty metal thresholds that prevent drafts, dirt, water, and insect entry. Provide lobby and entry vestibules with glass commercial storefront doors with automatic openers at both sets of doors at major entrances. Provide other exterior doors as metal, thermally insulated, and secure.

- At Unit Entry for Navy facilities and at Room Entry for Marine Corps facilities, doors must be solid core wood (interior access) or thermally insulated metal doors (for exterior access) to provide sound isolation. Note that the acoustic rating of the door is not required to meet the adjacent wall acoustic rating. Provide a fire-rated, wide-angle security view port at 60-inch (1524 mm) height and an additional wide-angle security view port at 43-inch (1092 mm) height for accessible units.
- Doors within the units are required to be solid core wood doors. Connecting doors between bedrooms are not allowed.

3-6.7 Hardware and Locks.

Provide hardware that conforms to Builders Hardware Manufacturers Association (BHMA) standards, ANSI/BHMA A156, (1000 series). Use Grade 1 for entry doors. Occupant entry doors BHMA 4000 series Grade 1 locksets and privacy latches. All locks must be industry standard and comply with UFC 1-200-01 and UFC 3-600-01. All electronic locks must have a mechanical key override. Installations must ensure procurement of new and replacement lock systems are based upon a single system to reduce operating costs. Provide doors with programmable electronic key systems except for bathrooms and closets. Provide stand-alone programmable new and replacement electronic lock systems, not connected to any information network. Procurement of networked electronic lock systems is prohibited. Use stand-alone key-encoding systems. Use of CAC cards as keys for new internal lock systems is prohibited. Use RFID key card locks with a battery compartment accessible from the exterior of the secured space.

3-6.7.1 Navy Locks.

New and replacement electronic lock systems must comply with the CNIC authorized system, an all-in-one system without a computer interface.

- Each occupant's key card must be able to open the entrance to their unit, bedroom, closet and secured common rooms (such as lounges and laundry) as appropriate. Provide dead bolts on unit entrance doors and privacy latches on bathroom doors.
- Provide Front Desk Unit (FDU).
- Exterior doors. Electronic locks are required at exterior doors. Building access must comply with CNIC and Installation standards.
- Use of mechanical key/tumbler locks is limited to service closets and administrative spaces.

3-6.7.2 Marine Corps Locks.

When determining lock configuration requirements, consider the different locking levels a manager, lock system programmer, facility employees such as housekeeping, and an occupant would need to open. Each occupant's key card must be able to open the entrance to their room and secured common rooms (such as lounges and laundry) as appropriate.

- Bathroom doors must have privacy latches and ensure that they cannot be locked from the outside.

3-6.8 Windows.

Fenestration must conform to the recommendations of DOD standards for buildings, and fire and life safety, including exiting. See UFC 3-101-01 for additional window design information. Place windows to prevent illicit entry accomplished by reaching adjacent entry door hardware. For exterior corridor configurations, where windows are likely to be kept covered for privacy, higher fenestration with a separate covering mechanism is recommended to allow light to enter the room while maintaining privacy at eye level. In general, size glazed openings to approximately 30% window to wall ratio to provide day light. Operable windows are encouraged within sleeping and living areas, subject to code compliance. Window sizing, placement, and shading should respond to the building's orientation and climate zone. Provide an energy efficient envelope which considers many aspects of opening design: allowing winter sun, shading summer sun, allowing day light into the majority of a given sleeping or living space, and quality of the glazing system. Specify commercial grade windows; low "E" glass is required. Install heavy duty insect screens on operable windows. For more information about optimum daylighting, see *Tips for Daylighting with Windows*.

3-6.9 Walls and Partitions.

Design walls and partitions to meet appearance and acoustic and durability requirements of Navy and Marine Corps UH. Seal edges of wall assemblies to adjacent construction to avoid flanking sound paths.

- For Navy projects, use light-frame construction for interior wall construction. When using gypsum board interior walls in high-use areas

(such as lobby, corridors and multi-purpose rooms), provide double layer gypsum board, high-impact gypsum board, plywood backing board as a base to gypsum board, or similar. When using CMU interior walls, provide a grout or resin based (not plaster) finish to CMU walls to fill the joints to be a uniformly smooth surface to be painted.

- Marine Corps exterior walls must be masonry construction and finish. Basic wall construction types consist of concrete masonry units (CMU), precast concrete, or cast-in-place concrete construction, where appropriate. The Marine Corps requires interior walls with hard finishes similar in durability to CMU. When using CMU interior walls, provide a grout or resin based (not plaster) finish to CMU walls to fill the joints to be a uniformly smooth surface to be painted.

3-6.10 Balcony.

For projects with exterior breezeway or balcony access to each room, consider the use of an upper window, and transom over the entry door. This allows for the entry of natural light into the occupants' rooms while retaining privacy from travelers along the breezeway or balcony.

3-6.11 Signage.

Prepare a signage design package that instructs the activity in maintenance of the signage system and provides equipment and materials necessary for this. Place emphasis on directional signage to allow visitors and occupants to immediately familiarize with room names and numbers.

3-6.11.1 Exterior Signs.

Design directional signs as an integral part of an overall building and site system, to be furnished and installed under the construction contract. Economy, aesthetics, durability, flexibility, ease of installation and maintenance are important considerations of signage design. Design the system to inhibit vandalism but with flexibility to enable the addition or deletion of information. Select a mechanical mounting mechanism for the signs to permit the reuse of signs as the facility changes.

- Specify an easily read typeface such as Helvetica Medium.
- Provide a signage plan, legend, and details. Indicate the design, location, and installation method in the plan, elevations, and specifications.
- Require the Contractor, in the project specifications, to make a comprehensive submittal of the proposed signage system and to provide information necessary for acquiring new or replacement signs.
- Provide building signs and other items on the building exterior that meet the IAP (Installation Appearance Plan).
- The exterior signage system must be respected both on and off the specific facility site. Signage must also be harmonious in the landscape.

Care must be taken to use signs only when necessary and to restrict the use of random sizing, placement, and colors.

- The interior designer will coordinate interior signage and identification with the exterior designs.

3-6.11.2 Project Signage.

Provide the following signs for each project or building:

- Entrance signs at roadway, walkway and building entry point as appropriate.
- Building Identification Sign.
- Building Directory.
- Directional Signs.
- Room Identification Signs. Coordinate room identification signs with the facility functions regarding occupant information.
- Regulatory Signs.
- Informational Signs. Include command board signage/display.
- Notices Board for residents' use (Permanent Party only).
- Bulletin Boards (for official use).

3-7 INTERIOR DESIGN.

Refer to the tables in this manual for specific interior finish schedules for Navy and the Marine Corps. Employ finishes that are easily cleaned and endure hard use and food spills. Select neutral colors for the more permanent surfaces within the facility (such as floor/wall tiles, solid surfacing material, masonry) to facilitate future finish/material changes with respect to Installation guidelines where available. See Table 3-1 for Navy and Table 3-2 for Marine Corps interior finish requirements.

Table 3-1 Interior Finishes Schedule: Navy

NAVY INTERIOR FINISH SCHEDULE			
AREA/SPACE	**FLOORS**	**WALLS**	**CEILING**
Administration/ Conference Rooms	Resilient (LVT or RT) or Poured Epoxy Terrazzo	Gypsum Board, impact resistant or smooth finished CMU, painted.	Gypsum board, painted or SAT
Elevators	Resilient (LVT or RT) or Porcelain Tile	Plastic laminate, stainless steel, or solid surface material wall panels	Factory finish with lighting
Lobby/Front Desk	Porcelain Tile, Resilient (LVT or RT) Poured Epoxy Terrazzo or integrally colored or honed concrete	Gypsum Board impact resistant or Accent material	Gypsum board, painted or SAT
Mechanical and Electrical Rooms	Sealed Concrete with Rubber cove base	Gypsum Board, impact resistant, Concrete or CMU	Exposed Structure, painted
Weather Vestibule	Entrance Mat, Porcelain Tile, integrally colored or honed concrete, or Epoxy Terrazzo	Exterior Building Finish, Porcelain Tile or Gypsum Board, impact resistant	Exterior Finish or Painted Gypsum Board
Lounge/Meeting/ Game Room	Resilient (LVT or RT) or Poured Epoxy Terrazzo	Gypsum Board, impact resistant or smooth finished CMU, painted.	Gypsum board, painted or SAT
Public Toilets	Porcelain Tile, Epoxy Flooring or Poured Epoxy Terrazzo	Gypsum board, and Porcelain Tile, floor to ceiling	Gypsum board, painted or SAT
Vending/Coffee Mess	Porcelain Tile, integrally colored or honed concrete, Epoxy Flooring or Poured Epoxy Terrazzo	Gypsum board, impact resistant, painted, extended solid surface backsplash at counter	Gypsum board, painted or SAT
Bulk Storage	Sealed Concrete	Gypsum Board, impact resistant, Concrete or CMU, painted	Exposed Structure, painted or SAT

NAVY INTERIOR FINISH SCHEDULE			
AREA/SPACE	**FLOORS**	**WALLS**	**CEILING**
Bike Rooms	Sealed Concrete	Gypsum Board, impact resistant, Concrete or CMU, painted	Exposed Structure, painted or SAT
Trash Rooms	Sealed Concrete	Gypsum Board, impact resistant, Concrete or CMU, painted	Exposed Structure, painted
Housekeeping/Linen	Sealed Concrete	Gypsum board, impact resistant, painted	Gypsum board, painted or SAT
Common Laundry	Porcelain Tile, Epoxy Flooring or Sealed Concrete	Gypsum Board, impact resistant, Concrete or CMU, painted	Gypsum board, painted or SAT
Public Corridors	Resilient (LVT or RT) or Epoxy Terrazzo or Porcelain Tile	CMU with grouted smooth finish, painted or Accent Finishes	Gypsum board, painted or SAT
UNITS			
Entry/Service Areas	Resilient (LVT or RT) or Porcelain Tile	Gypsum board, impact resistant, painted	Gypsum board, painted
Living/Dining Area	Resilient (LVT or RT), Porcelain Tile	Gypsum board, impact resistant, painted	Gypsum board, painted
Kitchen	Resilient (LVT) or Porcelain Tile	Gypsum board, impact resistant, painted	Gypsum board, painted
Bedrooms	Resilient (LVT or RT) plank or tile	Gypsum board, impact resistant, painted	Gypsum board, painted
Closets	Resilient (LVT or RT) plank or tile	Gypsum board, impact resistant, painted	Gypsum board, painted
Laundry	Resilient (LVT or RT), Epoxy Flooring or Porcelain Tile	CMU or Impact Resistant Gypsum board, painted	Gypsum board, painted
Bathrooms/Vanity	Porcelain Tile	Gypsum board with PT Tile full height, solid surface in showers, full height	Gypsum board, painted

NAVY INTERIOR FINISH SCHEDULE			
AREA/SPACE	**FLOORS**	**WALLS**	**CEILING**
Kitchen	Resilient (LVT) or Porcelain Tile	Gypsum board, impact resistant, painted	Gypsum board, painted

Table 3-2 Interior Finishes Schedule: Marine Corps

MARINE CORPS INTERIOR FINISH SCHEDULE			
AREA/SPACE	**FLOORS**	**WALLS**	**CEILING**
Entry Vestibule	Entrance Mat, Porcelain Tile, integrally colored or honed concrete, or Epoxy Terrazzo	Exterior Building finish; Painted CMU or concrete. Optional grouted smooth finish. Painted CMU used with split faced block wainscot or equal.	Exterior Finish or Painted Gypsum Board
Duty Office	Resilient (LVT or RT) plank or tile	Painted CMU or concrete.	Gypsum board, painted
Duty Bunk Room	Resilient (LVT or RT) plank or tile	Painted CMU or concrete.	Gypsum board, painted
Public Toilet	Porcelain Tile, Epoxy Flooring or Poured Epoxy Terrazzo	Gypsum board, and Porcelain Tile, floor to ceiling	Gypsum board, painted
Vending	Porcelain Tile, integrally colored or honed concrete, Epoxy Flooring or Poured Epoxy Terrazzo	Painted CMU or concrete, optional grouted smooth finish. Painted CMU or concrete used with split faced block wainscot or equal.	Gypsum board, painted or SAT
Multi-Purpose Room	Porcelain Tile, integrally colored or honed concrete, Epoxy Flooring or Poured Epoxy Terrazzo	Painted CMU or concrete, optional grouted smooth finish. Painted CMU or concrete used with split faced block wainscot or equal.	Gypsum board, painted or SAT
Janitor Closet	Sealed Concrete	Painted CMU or concrete.	Exposed Structure, Paint

MARINE CORPS INTERIOR FINISH SCHEDULE			
AREA/SPACE	**FLOORS**	**WALLS**	**CEILING**
Laundry Room	Porcelain Tile, Epoxy Flooring or Sealed Concrete	Painted CMU or concrete.	Exposed Structure or Gypsum Board, Paint
Public Corridors	Resilient (LVT or RT) or Epoxy Terrazzo or Porcelain Tile	Painted CMU or concrete, optional grouted smooth finish. Painted CMU or concrete used with split faced block wainscot or equal.	Gypsum board, painted or SAT
Bedrooms	Epoxy Terrazzo; Resilient (LVT or RT) plank or tile.	Painted CMU or concrete.	Concrete, painted
Room Service Areas	Epoxy Terrazzo; Resilient (LVT or RT) plank or tile.	Painted CMU or concrete.	Gypsum board, painted
Room Toilets	Porcelain Tile	Gypsum board with PRT Tile full height, solid surface in showers, full height	Gypsum board, painted
Bedroom Closets	Epoxy Terrazzo; Resilient (LVT or RT) plank or tile.	Painted CMU or concrete.	Concrete, painted

3-7.1 Paint.

Paint interior surfaces, except factory pre-finished material, a minimum of one prime coat and two finish coats. Provide painted finishes with a minimum of high-performance architectural paint as defined by Master Paint Institute (MPI) on gypsum board and CMU. On steel and non-ferrous surfaces, provide a minimum of high-performance system as defined by MPI in a minimum of a semi-gloss finish. Back prime wood trim frames, and other wood.

3-7.2 Wall Finishes.

Provide wall finishes that are easy to clean, repair and refinish. Proprietary finishes are prohibited. Vinyl Wall Covering is prohibited in all UH facilities.

3-7.2.1 Gypsum Board.

Gypsum board must be a minimum of level 4 finish and a minimum of an eggshell finish; semi-gloss where required. Use epoxy paint for high use areas such as laundry rooms and stairwells.

3-7.2.2 Concrete Masonry Units.

Concrete Masonry Units (CMU) must have a minimum of an eggshell finish, semi-gloss is recommended in certain utilitarian spaces such as mechanical and electrical rooms. Coordinate where smooth finish CMU is to be used. Use epoxy paint for high use areas such as laundry rooms and stairwells.

3-7.2.3 Porcelain Tile.

Provide color body porcelain tile in UH facilities. In Toilets and vanity areas, provide full height color body porcelain tile with matching cove base or coved metal profile for floor to wall tile transitions. Include metal corner trims to protect outside corners from chipping. In public and recreational areas, porcelain tile may be used for a highly durable, cleanable wall finish and double as wall protection.

3-7.2.4 Showers.

Provide seamless solid surface materials (except at corners) from top of shower receptor to ceiling in showers. Tile with grout lines is not recommended for maintenance challenges.

3-7.2.5 Wall Protection.

Provide resilient corner guards consisting of integrally colored high impact resistant extruded vinyl, polyvinyl chloride, stainless steel, or injection molded thermal plastic. Install at outside corners of interior walls, partitions, and columns in all public spaces, high traffic, and high use spaces. Provide full height, minimum 8 ft. (2.44 m), corner guards at all locations where required. Additional wall protection, such as wainscots, bumper guards, and wall guards, may be required depending on the use of the space.

3-7.3 Ceilings.

Suspended acoustical tile may be used in corridors, entryways, and multi-purpose rooms. Suspended acoustical tile (SAT) is prohibited in bedrooms/bathrooms in UH projects. Provide painted gypsum board or concrete ceilings in these spaces with an off-white color. Blown-on or spray applied acoustic ceiling finish is not allowed in any space.

3-7.4 Flooring.

3-7.4.1 Resilient Flooring.

Use Luxury Vinyl Tile (LVT) flooring in units, rooms, corridors, and lounge/recreational spaces. Provide LVT in planks or large format sizes, with a minimum 20 mil wear layer and a minimum 20-year manufacturer’s commercial, non-pro-rated, written warranty. LVT flooring must be provided in medium tone colorations to minimize appearance of scratching and scuffing. Integral acoustical backing is required where noise transmission in existing facilities where the structure does not conform to acoustical

requirements. LVT must be used with a minimum 4 inch (102 mm) high rubber cove base.

Use Rubber Tile (RT) flooring in units, rooms, corridors, elevators, stair landings and lounge/recreational space. Provide a minimum of 0.125 inch (3.2 mm) thick tile with textured, easy to clean surface and through color patterned or multi-color visual. RT must be used with a minimum 4-inch (102 mm) high rubber cove base. For interior stairs, provide coordinating rubber tile for stair landings and rubber stair treads which allows compatible maintenance and cleaning methods. Grit and contrasting strips on stair treads are required to be integral to the tread construction. Applied grit and contrasting strips are not acceptable.

3-7.4.2 Carpet.

Carpet is prohibited throughout Navy and Marine Corps UH facilities.

3-7.4.3 Porcelain Tile.

For porcelain tile, use through-body color tile with a heavy commercial rating for floors. Provide appropriate slip resistance in all areas. Specify a mottled or shaded tile to hide discoloration from detergents and other substances. Provide epoxy grout in a medium to dark color. Provide matching coved wall base or metal cove trim for floor to wall tile transitions.

3-7.4.4 Resinous Epoxy Flooring.

Provide a 3/16-inch (4.8 mm) thick, decorative flake or quartz broadcast system. Epoxy flooring must be a troweled mortar system, utilizing epoxy and silica aggregate mortar, high build grout, seal coat and decorative vinyl chip or quartz aggregates. Install with minimum with minimum 4-inch (102 mm) high integral resinous epoxy cove base.

3-7.4.5 Poured Epoxy Terrazzo.

Poured epoxy terrazzo system must include (but not be limited to) moisture vapor primer system, isolation crack membrane, and divider strips; and include minimum 4-inch (102 mm) high by ½-inch (12.7 mm) thick precast epoxy terrazzo base. Thinner epoxy bases are not acceptable. Porcelain tile base is acceptable for terrazzo floor as it has a harder breaking strength and is more durable.

3-7.4.6 Integrally Colored or Honed/Polished Concrete.

Use honed, colored, polished, or sealed concrete as appropriate for the use of the space. Coordinate concrete finish products and specifications with the aesthetic, durability, and maintenance requirements of the space. Wall base must be rubber cove base or porcelain tile base.

3-7.4.7 Wall Base Molding.

Provide wall base molding for the flooring systems indicated above. Accent wall base molding may be provided in building and elevator lobbies.

3-7.5 Cabinets, Millwork, and Hardware.

Construct cabinets to American Woodworking Institute Custom grade with heavy-duty hardware.

- Provide acrylic solid surface or solid surface veneer kitchen countertops. Use of natural stone is prohibited. Coordinate type of sink and mounting with Plumbing.
- Provide acrylic solid surface, solid surface veneer or cultured marble bathroom vanity tops, with integral sink bowl. Coordinate type of sink and mounting with Plumbing.
- Provide cabinet boxes, bases and toe kick a minimum 3/4-inch (19 mm) hardwood plywood. Provide interior of cabinet boxes and drawer boxes with melamine for easy cleaning. Provide high pressure plastic laminate for exterior surfaces for impact resistance and easy cleaning. Cabinet backs and drawer bottoms should be minimum 1/4-inch (6.4 mm) hardwood plywood with melamine interior finish.
- Provide drawer boxes of 5/8-inch (15.8 mm) hardwood, with dovetail or box joints, mounted on full extension guides, rated for minimum 75 lbs (34 kg).
- Provide cabinet interior shelving of 3/4 inch (19 mm) hardwood plywood with melamine surface for ease of cleaning and with matching front edge banding. Hanging or mounting rails for wall cabinets must be a 3/4-inch (19 mm) hardwood.
- Cabinet doors and drawer fronts must be 3/4-inch (19 mm) hardwood plywood or medium density fiberboard, with high pressure plastic laminate on all surfaces and 1/8-inch (3 mm) PVC edging on all edges.
- Provide adjustable, cup type, hinges having a minimum 105-degree swing. Cabinets and countertop support must comply with CPA/ANSI A208.2 or ANSI/HPVA HP-1 standards for low formaldehyde emissions.
- Sustainable alternative materials should be considered where they provide comparable strength, quality, and durability, including formaldehyde free, or no added formaldehyde plywood and alternative backer boards.

3-7.6 Entrance Mats.

Provide entrance mats at main entries and at heavily used entrances which can be removed and cleaned as well as cleaned underneath them. Roll-up mats with the aluminum frame, vinyl hinges and foot cleaning treads are preferred. Provide a

minimum uniform floor load of 300 lb/sq ft (14.36 KPa) and a wheel load of 350 lb (160 kg) per wheel.

3-7.7 Toilet Partitions.

Provide toilet partitions of high-density solid plastic, stainless steel, or solid phenolic core with decorative laminate materials. Painted metal and plastic laminate clad MDF core toilet partitions are not allowed.

3-7.8 Toilet Accessories.

Provide toilet accessories as surface mounted or recessed, of non-corrodible metal or solid surface (showers). Provide heavy duty materials with concealed mounting methods. Provide toilet paper holder, soap dish, bathrobe hooks, and towel bars. Provide a shower curtain rod. Specify rod at proper height for conventional shower curtains (72 inches by 72 inches [1.8 m by 1.8 m], approximately).

3-7.9 Window Treatments.

Include window treatments (such as black out shades and sun shading systems) as an integral part of the construction contract. Dual solar roller shade systems with manual roll chain operation are recommended. Consider solar conditions when selecting window treatment light filtering opacity. Dual solar shade system provides visual privacy and natural light, with black out shades for sleeping. With black out shades, provide track on side of system for added durability and stability. Window treatments should overlap window openings to reduce light leakage, where possible. Note that soft window treatments, such as draperies, are considered collateral equipment and will be included in the FF&E package. Any window treatment must have flame resistance, blackout shade/lining, and be of commercial quality.

3-7.10 Furnishings, Fixtures and Equipment (FF&E).

3-7.10.1 Navy FF&E.

UH FF&E procurement packages must be designed by the same design agent as the facility and coordinated with UH Managers. Final approval of UH FF&E specifications will be determined by the design team to include guidance/input received from the respective Naval Facilities Command Interior Designers and the UH Manager. Use of turn-key approach to UH FF&E procurement within military construction UH projects is directed to the greatest extent possible and practical. This will ensure a coherent UH FF&E package which promotes an increased QOL for occupants and makes the best use of funding. This applies to UH furniture, furnishings, and equipment for new construction (collateral equipment) and existing UH (whole room concept and replacement items).

3-7.10.2 Marine Corps FF&E.

Marine Corps will prepare UH FF&E procurement packages through collaborative effort with Base Property, Purchasing and Contracting office, and installation Bachelor Housing Directors. Final approval of UH FF&E specifications will rest with the Installation BH Director. Procurement must conform to acceptable funding restraints. Incorporate to the extent possible guidance/input received from the respective Naval Facilities Command Interior Designers. Use of turn-key approach to FF&E procurement within military construction UH projects is directed to the greatest extent possible and practical. This will ensure a coherent UH FF&E package which promotes an increased QOL for occupants and makes the best use of funding. This applies to UH furniture, furnishings, and equipment for new construction (collateral equipment) and existing UH (whole room concept and replacement items).

3-7.11 Interior Signage, Artwork and Accessories.

Provide artwork for public areas, except storage rooms and maintenance areas. Coordinate graphics and interior signage to complement the architectural and finish materials. Provide attached or integral wall protection for recreational games such as dartboards and billiards. Provide bulletin boards in service areas and at the main entry. Provide interior signage, bulletin boards and wall protection devices as an integral part of the construction contract. Artwork is considered collateral equipment and will be included in the furnishings option. Provide interior signage at each room. Provide directional signage as required for way finding. Provide interior signage educating occupants on energy efficient and sustainable elements of the facility, particularly those elements with occupant control or influence. Educational signage should be permanent in nature but flexible for future additions/deletions of information. Utilize mechanical fasteners for interior signage.

3-8 LIFE SAFETY AND FIRE PROTECTION.

3-8.1 Sprinkler Systems.

All UH buildings are required to be sprinkled.

3-8.2 Fire Alarm Systems.

Install addressable building fire alarms systems and connect to the base reporting system.

3-8.3 Smoke Detectors.

Install smoke detectors for personnel housing facilities and power them from the building fire alarm system.

3-8.4 Carbon Monoxide (CO) Detectors.

Install approved carbon monoxide detectors in Navy and Marine Corps UH that contain carbon-based fuel burning systems. Use carbon monoxide detectors that are 24 Vdc

powered by the building fire alarm system. An alarm from the Carbon monoxide detector will cause the fire alarm system to activate a voice announcement stating the following," Carbon monoxide has been detected in the building. Please exit the building." The fire alarm system must send a separate signal via the base reporting system.

3-9 HEATING, VENTILATION, AND AIR CONDITIONING (HVAC).

Design and construct facilities to comply with UFC 3-401-01 and UFC 3-410-01. Apply smart building concepts using local loop technology. Avoid central controllers and monitors. Provide an HVAC system to give residents individual choice of heating and cooling year-round within each living area. Provide one thermostat per unit. All new buildings shall meet ASHRAE 62.1 or ASHRAE 62.2 ventilation requirements.

3-10 VENTILATION AND MOISTURE MITIGATION.

Design and construct new Navy facilities in accordance with ASHRAE 62.1 or ASHRAE 62.2, as applicable to facility size. Design and construct facilities to comply with UFC 3-401-01 and 3-410-01. Consideration should be given to all components of natural and mechanical ventilation to provide a system which is adequately sized and easily maintained to avoid excessive indoor moisture, mold growth, and poor indoor air quality.

Navy Renovation and Redesign projects must address building and unit ventilation and moisture management deficiencies, and endeavor to comply with ASHRAE 62.1 or 62.2. For new construction, redesign, and renovation projects, UFC 1-200-01 provides reference to the criteria governing moisture control.

3-11 SUSTAINABILITY.

Comply with the requirements of UFC 1-200-02.

3-12 COMMISSIONING.

Comply with the requirements of UFC 1-200-02.

3-13 PLUMBING.

Comply with the requirements of UFC 3-420-01. Avoid plumbing chases whenever possible by placing plumbing in wall cavities. Mechanical engineers, architects, and structural engineers must coordinate to plan and minimize the size and location of plumbing chases. Set fixture clearances for the intended occupants and use low-flow fixture requirements.

- Provide hot and cold water to public toilets, en-suite bathrooms, compact kitchens, janitor closets, and laundry rooms.
- Provide shutoff valves at all fixtures.
- Water Closets. Provide commercial quality, low consumption type water closets. It is recommended that areas with low water pressure use power-

flush type water closets. Use elongated, one-piece construction with a closed front seat and a lid. Provide matching water closets and bath fixtures in neutral color.

- Navy: Provide residential, tank-type water closets.
- Marine Corps: Provide flush-valve toilets, dual-flush manual type, and overhead rain fall type shower heads that meet low flow requirements set at a minimum of 75 inches (190.5 cm) above the shower base.
- Central Heads: For Navy recruits only, provide central heads in open-bay designs, including the following: Water closets 1 per 10 persons; Lavatories 1 per 10 persons; Individual Showers at 1 per 8 persons, or centralized showers with shower heads separated by partitions and tile floors sloped to drain.
- Provide hose bibs on exterior walls of each building at 100-foot (30 meter) intervals; in trash rooms and near rooftop mechanical units; frost-free as dictated by climatic conditions. Provide floor drains in all janitor closets, laundry rooms, public restrooms, and trash rooms.
- Provide a drinking fountain(s) with cooler for interior public areas. Include water bottle filling features.
- Domestic Hot Water System type is optional but must meet FEMP recommendations. Recommend building wide system.
- Natural Gas is prohibited in unit or room.
- Provide one Service Sink per floor.
- Use the following fixtures as standards: Washerless faucets at lavatories. Single lever faucets at tub/showers or shower stalls. Provide showerheads with maximum 2.2 gpm (8.3 lpm) flow rate. Locate showerheads a minimum of 75 inches (190.5 cm) above the floor.
- Showers are to have solid floor pans, with full height solid surface surround with separated shower stalls. New construction must provide a 12 ft2 (1.11 m2) shower space with a minimum dimension of 30 inches (76.2 cm). Renovation projects without redesign must provide a minimum 30-inch (76.2 cm) dimension and 9 ft2 (0.84 m2) in order to fit in existing space.
- Provide stainless steel kitchen sinks (double bowl), kitchenette (single bowl). All sinks to be provided with single lever faucets, sprayers are prohibited.

3-14 ELECTRICAL.

Provide site electrical utilities, interior distribution systems, communications and security, and site lighting according to core criteria referenced by UFC 1-200-01 and the latest installation design requirements. Provide site lighting to ensure occupants have a means of safely moving between outdoor spaces. Refer to the Installation Appearance

Plan in the selection of light poles and signs. Provide adequate site lighting where there is a change in grade requiring steps, near handicap and motorcycle parking areas, and near main entrances to buildings. Provide exterior lighting in parking areas, building entrances, and walkways.

Interior distribution systems include service entrance and distribution equipment, Televised Surveillance System (TVSS), dry type transformers, wiring devices, raceways, conductors, interior lighting systems, emergency power systems, lightning protection systems, hazardous locations, housing distribution, and systems furniture. Communications and security systems include telecommunications systems, television systems, electronic security systems (ESS), and intercommunication systems.

3-14.1 Ceiling Fans.

Ceiling fans are optional, except as noted below. Provide fans that are Energy Star compliant. Where included, provide ceiling fans in bedrooms and living areas within units. Also consider ceiling fans for multipurpose rooms and laundry facilities.

3-14.2 Power.

Provide electrical outlets appropriately adjacent to telecommunication outlets combined with television and telephone and computer data outlets. Provide duplex outlets in the compact kitchen or service areas. Provide a service panel located within the Unit or Room. Provide meter bases for all new and renovated buildings. Provide two USB charging outlets per occupant in each sleeping area.

3-14.3 Lighting.

Provide Energy Star certified lighting fixtures and lamps. LED lamps are preferred. Select fixtures to reflect a residential style, rather than institutional. Provide recessed hallway lighting (walls and ceilings). Suspended exit signs are prohibited. Surface mounted "pillow" or "cloud" light fixtures are prohibited for Navy. Recessed fixtures are preferred by Navy and allowed by Marine Corps.

3-14.3.1 Navy.

- Provide three-way switches at Unit/Room entrance and bedroom(s) doors. Also, provide motion sensor switches at closets, bathrooms and living rooms to control the light fixtures.
- Provide minimum 15 foot-candles lighting at the exterior of each unit or room entrance.
- Bedrooms: Provide overhead ambient lighting in bedrooms, separately switched and dimmed for each occupant side of the room. Ambient light level at desk height must provide a minimum of 30 foot-candles in each bedroom. The use of recessed and indirect fluorescent fixtures (T-8 730 lamps and electronic ballasts) is required by Navy.

- Bathrooms: Provide overhead ambient lighting and separate lighting at the lavatory mirror.
- Kitchens: Provide overhead ambient lighting, under cabinet lighting and lighting at sink.

3-14.3.2 Marine Corps.

- For direct entrance rooms, provide three-way switches at the entrance door and in the vanity area so that the living room and bedroom area lighting is controlled at either location. Also, provide motion sensor switches at bathroom doors to control the bathroom light fixture.
- Provide one exterior light fixture outside each room entrance door for exterior entry designs.
- Bedrooms: Provide overhead adjustable level ambient lighting in bedrooms; separately switched/dimmed for each occupant side of the room. Coordinate this with the furnishings plan. Marine Corps uses both indirect fluorescent fixtures (T-8 730 lamps and electronic ballasts) and dimmable LED lighting is allowed. Do not rely solely on table lamps for room lighting. Ambient light level at desk height must provide a minimum of 30 foot-candles in each bedroom. Indirect “cove” lighting is preferred.
- Bathrooms use fluorescent or LED lighting fixtures. Provide overhead lighting and valance lighting at the lavatory mirror. Use recessed valance or under counter (task) lighting in service area.
- Carefully consider the coordination of lighting with ceiling fans.
- Provide appropriate lighting and consider providing a recessed light at each entrance in addition to standard overhead corridor lighting.

3-14.4 Appliances.

Provide residential grade appliances, "Energy Star", CEE Tier 2 compliant.

3-14.4.1 Navy and Marine Corps.

- Washing machines: Minimum 3 c.f. (0.08 c.m.), top-loading where space accommodates. Size in-unit Laundry Area to accommodate a variety of available washing machines, including front loading, to ease future replacement. Where stackable washers and dryers are planned, specify that they can be separated and used and replaced separately.
- Dryers must be electric.
- Garbage disposal: 1/2 HP minimum, with SS impellers and sound insulation.
- Range: Free standing glass top electric 30-inch (76.2 cm) width.
- Cooktop: Minimum two burner electric cooktop.

- Exhaust Hood: Provide three speed vented exhaust fan, maximum 5.0 sones with dual light settings. Vent to exterior.

3-14.4.2 Navy.

- Appliances must be color white.
- Refrigerator: Kitchen 18-22 c.f. (0.5-0.62 c.m.); Kitchenette 16-19 c.f. (0.45-0.54 c.m.); Service Area 10-16 c.f. (0.28-0.45 c.m.)
- Microwave: Kitchen/Kitchenette 1500 watts; Service Area 1200 watts.
- Dishwashers are prohibited in new construction and renovation projects. Existing dishwashers may be replaced in renovation projects as applicable.
- Bathroom Exhaust Fan: Maximum 1.0 sones, minimum 50 cfm. Humidistat control preferred, with delay-off at switch.

3-14.4.3 Marine Corps.

- Dishwasher: Minimum 24-inch (60.96 cm) width.
- Refrigerator: Service Area 10.3 c.f. (0.29 c.m.); Kitchens (SNCO/BOQ), 18-22 c.f. (0.51-0.62 c.m.)
- Microwave: 1200 watts.
- Bathroom Exhaust Fan: Maximum 1.5 sones, minimum 50 cfm. Humidistat control preferred, with delay-off at switch.

3-14.5 Emergency Power.

Emergency power is not required in UH.

3-14.6 Telecommunication Service.

Provide in each Unit/Room a permanently installed conduit raceway system, supporting future needs of telecommunication systems. Provide a minimum of one outlet for each bedroom and one for each living room, located for flexibility and easy furniture access. Do not provide outlets in open bay berthing spaces. Navy UH and Marine Corps UH currently receive wireless internet service from service-wide contracted provider; coordinate to provide ample equipment space to meet the needs of this service.

3-14.7 Cable Television.

Navy requires no cable television service to each unit, but does permit vendor installation to each unit, through the Installation’s contract. Navy does require cable television service in each building, to be provided in common areas, such as lounges and lobbies.

Marine Corps requires cable television service in each building. Provide a permanently installed conduit raceway system for cable television system media. Refer to specific Plan for additional details.

3-14.8 Intrusion Detection/Monitoring systems (IDS).

Navy requires provision of conduit with pull strings and boxes for future installation of Intrusion Detection/Monitoring (IDS) systems that can cover building entrances/exits, entrance/elevator lobbies and hallways. With respect to "centrally monitored", the requirement is only something that is "central" to the building rather than central "base-wide". Provide IDS systems and Access Control systems with BMS switches (fixed) and card swipes (fixed) along with conduit, wiring and a "basic" monitoring panel, (fixed). Provide an appropriate location for a "stand-alone" card station.

3-14.9 Closed Circuit Television (CCTV) Systems.

Provide conduit systems with pull strings and outlet boxes to accommodate later installation of a monitoring system as part of all new construction. System to include all common areas such as hallways, lobbies, lounges, classrooms/special use rooms, common kitchens, game rooms, laundry rooms, vending areas, stairwells (interior and exterior), elevators, entrances and exits, building exterior and additional areas/facilities adjacent to the UH facility.

Navy: CCTV systems are Not allowed without prior authorization as per CNIC M 11103.2 (CNIC Note pending N00 sig).

3-15 GENERAL SPACE REQUIREMENTS FOR UH FACILITIES.

3-15.1 Laundry Facilities.

Laundry facility requirements vary. Refer to the detailed descriptions in Chapters 4 and 5.

3-15.2 Resident Bulk Storage.

Examples of items typically stored in bulk storage areas include luggage, original stereo system cartons, snow tires, bicycles, surfboards, ski equipment, and other sports gear. Resident bulk storage requirements vary by Unit or Room plan. Refer to the plan’s chapter for details.

3-15.3 Utility Area (Space).

Provide appropriate space for the mechanical and electrical systems and telecommunications. These rooms are calculated at between 6% and 10% of the Gross Building Area. This includes: Main Mechanical room at ground floor, Electrical control closet, Electrical room, Elevator Equipment room, Mechanical room on each floor, and main vertical duct space (floor to floor). A dedicated fire pump room is not included in these allowances.

3-15.4 Elevators.

Elevators are intended for the movement of furniture and people. Provide elevators sized to accommodate movement of both furniture and a medical stretcher for personnel. Provide elevators and rooms which support elevator operations meeting the requirements of UFC 3-490-06. Special consideration is to be given to protecting elevators from harmful weather conditions. Additional gross area may be added for high-rise construction. Refer to paragraph 2-9.3 entitled “High Rise Structures and Additional Gross Area.” for details. The following is guidance for new construction.

Additional elevators may be provided at the discretion of the Installation Commander. Conduct Client Surveys and Traffic Studies to determine the number of elevators. Provide the following for new construction at a minimum:

- Two elevators are required for buildings 2-5 stories;
- Three elevators are required for buildings 6-7 stories;
- Four elevators are required for buildings 8 stories or higher;
- Marine Corps Recruit Facilities require a minimum of one elevator.

3-15.5 Circulation.

Design interior corridors to emphasize each quarter’s entrance, and to de-emphasize length or “tunnel vision.” Size the corridor to provide a minimum clear width to accommodate two persons with suitcases, and a base minimum of 5 feet (1.52 meters). Ensure that exterior walkways have non-slip surfaces and drain away from the building.

3-15.6 Multi-Purpose Areas (Spaces).

Multi-purpose areas (spaces) are for individual recreation, group activities, training, and meetings. Multi-purpose space requirements vary by plan. Refer to the specific plans in Chapters 4 and 5 for details.

3-15.7 Game Rooms.

Requirements for Game Rooms vary by plan. Refer to the specific plans in Chapters 4 and 5 for details.

3-15.8 Vending Area (Space).

Discuss vending area, machine quantity and the desired type with the installation and the local Navy Exchange General Manager/Vending Manager or the Marine Corps Community Services Director as appropriate. Provide space adjacent or co-located to the Multi-Purpose Room.

3-15.9 Public Toilets.

Navy: provide public toilets adjacent to lobby and public areas. Provide commercial grade fixtures. For a 96-person project, provide a minimum of one water closet, one

urinal, and two sinks in the men's toilet and two water closets and two sinks in the women's toilet. Add one of each fixture for each increment of 100 persons; to a maximum of five of any fixture type. Provide floor and wall finishes as described in Tables 3-1 and 3-2. Use solid surfacing material for lavatory counters and solid plastic, continuous anchorage toilet partitions. Provide a floor drain placed out of the usual traffic pattern and close to the water closets. Provide appropriate dispensers for soap, towels, toilet tissue, and recessed waste receptacle. A single unisex toilet may be adequate for smaller capacity UH.

Marine Corps: requirements are described in Chapter 5.

3-15.10 Janitorial.

Requirements for Janitorial vary by Plan. Refer to the specific unit or plan for details.

3-15.11 Administrative Area (Space).

Requirements for Administrative areas (spaces) vary by Plan. Refer to the specific Plans in Chapters 4 and 5 for details.

3-15.12 Lobby, Vestibule, and Reception.

Lobby, Vestibule, and Reception vary by Plan. Refer to the specific plans in Chapters 4 and 5 for details.

3-15.13 General Maintenance Room

Locate on main entry level, size to be coordinated with the overall Base needs or Housing Complex needs. Where room will only serve the individual UH facility, size at 150 NSF (13.9 NSM) for <100 rooms plus 0.5 NSF (0.046 NSM) per each additional room (rooms are double occupancy).

3-15.14 Trash rooms

For facilities exceeding 3 stories, provide a trash chute to dumpster at main level. Provide fully walled room at each level for trash chute access, 64 ft^2 (min) to 100 ft^2 (max).

3-16 FALL PREVENTION AND PROTECTION.

Any location of the UH including accessing the roof structure or equipment that requires future maintenance work and exposing maintenance personnel to falls from heights above 4 feet, must incorporate prevention and control measures into the design. This is to protect personnel working at heights and exposed to fall hazards in accordance with OPNAVINST 5100.23H.

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CHAPTER 4 NAVY UNITS

This Chapter describes the variety of units to be constructed, or Redesigned to, for Navy unaccompanied enlisted personnel. New construction must correspond to the current Construction Standard for the type of personnel to be housed. In accordance with DOD 4165.63-M and CNO direction, the construction standard for the Navy's core requirement (E1-E4) is a Market Unit. Restoration and Modernization (RM) project teams should take into account both the current DoD and Navy construction standards for the type of personnel, as well as the current layout of the facility, to determine best practices. RM project teams must utilize the Business Case Analysis process to determine whether renovation or replacement construction is more cost effective.

4-1 NEW CONSTRUCTION REQUIREMENTS.

- Construction of new Units for Permanent Party (E1-E6) must be the 2-bedroom double occupancy Market Unit, reference Figure A-1.
- Construction of new Units at remote locations where higher pay grades are housed in UH (E7-O10) must be the 1-bedroom Market Unit.
- Construction of new Units for Mission Essential must be the Navy 2+0 Unit, reference Figure B-4.
- Construction of new Units for Students (Training Necessity) must be the NETC 2+0 Dormitory Unit, reference Figure B-5.
- Construction of new Units for Recruits must be Open Bay Berthing (refer to Chapter 6).

4-1.1 Adaptable Units.

In new construction projects, provide a minimum of two easily "adaptable" rooms on the ground floor to allow assigned service members with minor injuries to remain with their Units or within proximity to their shipmates. To determine the quantity of units or rooms required in a project, take into account the number of rooms provided in other UH facilities and include the quantity of rooms in the current project to meet the total required. Adaptable rooms allow flexibility to accommodate the temporary requirement to house Members who are temporarily unable to climb stairs or have only limited mobility. These type facilities are not intended to house wounded warriors who require long term medical care. See Chapter 2 for additional information on "Adaptable Units".

4-2 MARKET UNIT PROJECTS.

Market Units have floor plans similar to comparable private sector housing, including entry areas, living room, kitchen, laundry, bedrooms, baths, and storage; see Figures A-1 and B-1, B-2. In new construction projects, Market Units must be 2-Bed/2-Bath. 1-Bed/1-Bath Market Units are authorized only at remote locations with a requirement to house personnel ranking E7-O10. Refer to Table 4-1 for space and area requirements. Dimensional requirements are not fixed but must remain functional and include all required features.

Table 4-1 Market Unit Square Footages

Market Unit Type	Minimum Areas (Net Square Feet (Net Square Meters))					Laundry (In-Unit / Common)	Minimum / Maximum Allowable Areas		Navy GSF per unit programmed amount (note 4)
	Bedroom (note 1)	Bedroom Closet (provide 2 per bedroom)	Shower /Toilet area (per bathroom)	Living / Dining Area (Note 2)	Kitchen		Construction Minimum GSF per Unit (note 3)	Construction Maximum GSF per Unit (note 3)	
2-Bed/2-Bath	144 (13.4)	12 (1.1)	40 (3.7)	N/A	55 (5.1)	IU	850 (79.1)	1290 (120.1)	1,212 (112.6)
1-Bed/1-Bath	144 (13.4)	12 (1.1)	40 (3.7)	N/A	55 (5.1)	IU	750 (69.8)	1050 (97.7)	1,028 (95.5)

Note 1: Bedroom area is Net Square Feet, specifically as defined by DOD 4165.63-M.

Note 2: No minimum living/dining area requirements.

Note 3: Construction Minimum and Maximum Gross Square Feet includes building circulation and common areas, as defined by DOD 4165.63-M.

Note 4: Navy requirements represent the Navy Programming standard inclusive of building circulation and common areas.

4-2.1 Market Unit Detail Requirements.

Refer to Chapter 3 for mechanical, plumbing, electrical, and telecommunication requirements.

4-2.1.1 Living/Dining Room.

Living/Dining Rooms can be a single shared space or two discrete spaces and must be sized to accommodate all occupants at one time. At a minimum, living rooms must accommodate a two-seat sofa, two lounge chairs, occasional tables, table lamps, in an arrangement for viewing a flat screen television. Provide a minimum of one hall/entry closet with shelf and coat rod. Dining areas must accommodate all occupants at one time.

4-2.1.2 Bedrooms.

Size bedrooms to accommodate two extra-long twin beds, two desks and two desk chairs. Provide wall mounted full height mirror, located to be able to be used by either occupant. Provide two closets per bedroom, equally sized. Closets must have a minimum of 4 lineal feet of hanging space and 4 lineal feet of 15” deep shelving space above. Lowest shelf must be no less than 30 inches AFF allowing for bulk storage below.

4-2.1.3 Laundry.

Units require in-unit laundry. Provide a full-size Energy Star CEE Tier 2 top-load washer and a full-size dryer in each Unit. Size laundry closet to accommodate a variety of top and front-loading washing machines, such that options will be available for replacement equipment in the future. Provide drip pan and drain in floor slab, tie this plumbing to restroom, kitchen, or other regularly used drain with trap. Include space in laundry closet for storage of one full size ironing board and iron, one shelf for product storage, and one hanging rod for clothes.

4-2.1.4 Kitchens.

Provide upper and lower cabinets, at least 3 lineal feet of uninterrupted countertop as food preparation area, two compartment sink, and full-sized residential grade appliances. For any galley or u-shaped layout, provide a minimum of 4 feet (1.22 m) between countertop edges. Overall, cabinet layout must provide a minimum of 75 c.f. (2.12 c.m.) of storage space behind a variety of doors and drawers. Appliances must include refrigerator/freezer, microwave, garbage disposal, range (or electric 4-burner cook top and oven), and range hood. Dishwashers are not authorized. Provide Energy Star Certified and CEE Tier 2 appliances. See additional appliance and ventilation requirements in Chapter 3.

4-2.1.5 Bathrooms.

Each bathroom is to be designed to provide two separate areas: a Shower/Toilet room and a Lavatory/Vanity area. In the case of remote locations authorized to construct 1-Bed/1-Bath units, provide a one room bathroom.

- Each Lavatory/Vanity Area will contain one sink, two medicine cabinets, and associated fixtures. Vanity must be a continuous counter surface at least 2 feet (0.61 m) deep and 4 feet (1.22 m) wide with a centrally located bowl. Base cabinetry must include a two-door storage area and minimum two drawers. Shield bedroom from spillover light from vanity.
- Each Shower/Toilet Room will contain a water closet and shower in a separate enclosed room, located adjacent to the Lavatory/Vanity Area. Locate toilet within a clear space at least 4 ft (1.22 m) in width; shower must be a minimum size of 12 ft^2 (1.1 m^2). See ventilation requirements in Chapter 3.

4-2.1.6 Doors and Locks.

Electric locks are required on Market Unit entrance doors, bedroom doors, and closet doors. Refer to Chapter 3.

4-2.2 Market Unit Building Common Areas.

Provide the following common areas. Mid/High-rise construction (over 3 stories) will have added common areas as identified.

4-2.2.1 Circulation.

Provide Corridors, Interior Stairways, and Elevators (optional/per local code requirements).

4-2.2.2 Building Utilities.

Provide Mechanical Rooms, Electrical Rooms, and Telecommunications Rooms sized to accommodate the building requirements. See UFC 3-580-01 for minimum telecom room size and system requirements.

4-2.2.3 Trash Chute (over 3 stories).

Provide a trash chute to dumpster at main level. Provide fully walled room at each level for trash chute access – see Chapter 3 for trash room sizing. At base of chute, provide dumpster room with lighting, ventilation, hose bib and floor drain. Trash compactors are optional. Provide only waterproof washable surfaces in trash and dumpster rooms.

4-2.2.4 Janitorial.

Janitorial includes vacuum cleaner storage and janitor’s sink and faucet, as well as storage for maintenance supplies per floor.

4-2.2.5 Vestibule and Lobby.

Provide vestibule with entrance mat of type and size to be effective for sustainability requirements. Provide lobby space in proportion with capacity of building and locate to facilitate way finding for residents and guests. At a minimum, provide a waiting/lounge area with one seat per eight Units in building. Design lobby and vestibule space to allow pedestrian traffic into building without passing through waiting/lounge area.

4-2.2.6 Reception/Front Desk.

Coordinate size with overall Base needs for check-in space; do not duplicate functions which are already accommodated in other UH buildings. If functional space is inadequate in an existing facility, consider including this space of an adequate size in new construction projects.

4-2.2.7 Offices/Administration Area.

Identify specific requirements to avoid future conversion/loss of assignable spaces. Do not duplicate functions which are already accommodated in other UH buildings. If functional space is inadequate in an existing facility, consider including this space of an adequate size in new construction projects.

4-2.2.8 Bulk Storage Room.

Storage room(s) may be provided for both UH Management and occupant storage. Storage room(s) must be climate controlled. Occupant storage lockers/areas, if provided, must be a minimum 50 c.f. (1.42 c.m.), securable by occupants.

4-2.2.9 Public Toilet.

Located at main entry level, provide a minimum of one male and one female restroom. Coordinate placement with multi-purpose rooms; and provide additional restrooms to accommodate occupancy of large multi-purpose rooms, including those located on other floors.

4-2.2.10 General Maintenance Room.

Locate on main entry level, size to be coordinated with the overall Base needs or Housing Complex needs. See Chapter 3 for sizing information.

4-2.2.11 Multi-purpose Room/Rooms.

Provide a combination of room types (including game room, lounge, and meeting room), at a minimum of 5 ft^2 (.47 m^2) per planned occupant to a maximum of 10 ft^2 (.93 m^2). Plan for space usage to change in the future and provide maximum flexibility. Isolate these areas acoustically and locate them close to public toilets when possible. Provide finishes that are easily cleaned and durable. Provide cabinets and counter space for minor food service and to accommodate a microwave oven. Provide locked storage for related supplies and equipment. Provide rooms with light and power for general use. Room lights must be controllable to accommodate multiple uses. Provide window coverings and hardware to allow for darkening of the room with blinds or shades.

4-2.2.12 Vending Area.

Coordinate vending area size with the Base needs or the Housing Complex needs. Do not duplicate functions which are already accommodated in other UH buildings. For large buildings, allow space for a minimum of four full-sized commercial vending machines with front facing circulation; three soft drink machines and one snack vending machine is typical. Allow a minimum recess of 40 inches (1 m) from the rear wall to the soffit. The minimum clearance from the finish floor to the soffit is 80 inches (2 m) for soft drink machines and 74 inches (1.9 m) for vending machines. Minimum space requirements for the vending areas are 180 inches (4.5 m) long x 84 inches (2.13 m) wide x 80 inches (2 m) high from finished space to finished space.

Locate vending areas on the ground floor with access from the parking areas. Locate vending space for security of users and for ease of service. Secure vending machines to prevent tipping. Provide appropriate sound isolation between vending and other spaces. Recess the machines into the wall or use materials to create a recessed appearance. Drop the soffits above the machines to the top of the machines but allow for proper cooling and heat dissipation. Coordinate paint or wall coverings with the interior designer's concept of the facility. Mirrored panels, cove lighting, and neon lights are optional, but desirable. Provide vending areas with appropriate outlets for appliances. Provide space for at least one waste receptacle and one recycling container. Provide an accented slip resistant floor surface and a dropped ceiling with open grid type panels or acoustic tiles to accent the vending area. Provide a retail commercial lighting level in this area.

4-2.2.13 Linen/Housekeeping Room.

Locate linen and housekeeping rooms, where provided, to maximize building functionality.

4-2.3 Market Unit Site Amenities.

Provide picnic and barbecue areas for 5% of the resident capacity; locate picnic tables and covers immediately adjacent to barbecue. Provide spaces appropriate for large and small groups. Provide other amenities as identified in the Recreational Services Assessment.

4-3 NAVY 2+0 UNIT.

This Unit type includes double occupancy living/sleeping area, two personal closets, and a separated toilet and shower compartment with a single bowl lavatory/vanity in the service area. Refer to Figure B-4. Access is from an interior corridor. <u>The construction of 2+0 Units is only authorized for Military Essential housing requirements.</u>

- Gross Building Area: Refer to paragraph 2-9.3 entitled "High Rise Structures and Additional Gross Area".
- Minimum Net Square Footage as defined by DOD 4165.63-M: 180 ft^2 (16.7 m^2).

4-3.1 2+0 Unit Detail Requirements.

4-3.1.1 Living/Sleeping Area.

Design room for double occupancy. Room dimensions are not fixed but must remain functional to accommodate two twin extra-long beds, two desk units, two desk chairs, and appropriate dresser drawer storage. For newly constructed facilities, the Sleeping Area must meet the Minimum Net Square Footage per DOD 4165.63-M as indicated above. For renovated and redesigned facilities, it may be appropriate to meet the Minimum Net Square Footage by combining both Sleeping Area and Service Area square footage.

4-3.1.2 Personal Closets.

Minimum 22 ft^2 (2 m^2) Net Area required. Provide one closet for each resident. Provide each closet with closet organizers with storage capability extending to the ceiling. Provide continuous ventilation in closets to resist mold and mildew growth. A light inside the closet with motion-activated control is preferable, but carefully placed lighting outside 2 ft (0.6 m) deep closets is acceptable.

4-3.1.3 Bathroom.

Provide a single lavatory and valance lighting in the service area with two medicine cabinets.

Provide a separate compartment with full-sized shower (12 ft^2 (1.1 m^2)) and water closet. Provide towel/toiletry hardware for two residents. Provide a full-length framed mirror mounted on Service area side of one door.

4-3.1.4 Service Area.

For Shared Units in a newly constructed facility, the Service Area is the corridor/service space within the unit that is not incorporated into the Net Square Footage. The service area provides access to the storage closets, bathroom, and a kitchenette. Kitchenette must include refrigerator, microwave, single bowl sink, and some counter and cabinet space. Kitchenette sink is separate from lavatory/vanity bowl.

In renovated and redesigned facilities, it is appropriate that Net Square Footage per DOD 4165.63-M may be achieved by combining both Sleeping Area and Service Area square footage.

4-3.1.5 Locks.

Electric locks are required on building entrance doors, Unit doors, and closet doors. See Chapter 3.

4-3.2 2+0 Unit Building Common Areas.

Provide common spaces as detailed for Market Unit Buildings, reference paragraph 4-2.2 entitled “Market Unit Building Common Areas”. Additionally, provide a common Laundry room(s), with a minimum one washer and two dryers for every 15 occupants.

4-4 THE NAVY (NETC) 2+0 DORMITORY UNIT.

This room plan includes double occupancy living/sleeping area, two personal closets, shared toilet with a separated shower compartment, and single bowl lavatory in the service area. Access is from an interior corridor.

- Gross Building Area: Refer to paragraph 2-9.3 entitled “High Rise Structures and Additional Gross Area”.
- Gross Room Area: 380 ft^2 (35.3 m^2) in the example plan.

- Net Living/Sleeping Area: 180 ft^2 (16.7 m^2) is the required MINIMUM size per bedroom.

4-4.1 Unit Details.

- Living/Sleeping Area. Bedrooms are intended for double occupancy. Bedroom dimensions are not fixed but must remain functional to accommodate two twin extra-long pop-top captains' beds with double storage compartments below, storage headboard; two computer/TV wall desk units with built-in under-cabinet lighting, two chairs, and at least one credenza with double sided drawers.
- Heads. Heads and fixtures are to be of residential design, quality, and finish. Provide a single lavatory and valance lighting in the service area, a separate compartment with full sized shower, and separate compartment with water closet with shelving. Provide towel/toiletry hardware for two residents. Provide a full-length framed mirror mounted on Service area side of one door.
- Personal Closets. 22 ft^2 (2 m^2) Net Area required. Provide at least one closet for each resident. Provide each closet with closet organizers with storage capability extending to the ceiling. Provide additional storage in service areas as appropriate. Provide closets full height, using the space above the normal door height for bulk storage. Provide continuous ventilation in closets to resist mold and mildew growth. Provide integral full-length hanging rods for coats and shelves. A light with motion-activated control is preferable, but carefully placed lighting outside 2 ft (0.6 m) deep closets is acceptable. Secure closets with standard hinged doors with non-removable pin hinges and locking hardware. Provide padlocking slide bolt hardware for personal closets. Bi-fold and sliding doors are not acceptable.
- Service Area. This term refers to the corridor/service space within the plan that is not incorporated into the Net Living/Sleeping Area. The service area in the plan provides access to the personal closets, head, a FAR Rated, Energy Star, 2-door refrigerator (10.3 cu. ft maximum) and microwave, and small counter space with the single bowl sink.
- Locks. Electric locks are required on building entrance doors, Unit doors, and closet doors. Use a magnetic key card system with hard key override.

4-4.2 Building Common Areas (Required).

The following spaces are REQUIRED common spaces. The net areas shown are approximations to assist the designer.

- Entry Vestibule. 50 ft^2 (4.5 m^2) Net Area. Provide automatic entry doors and weather vestibule. This area serves as the controlled single point of entry/exit quarterdeck as part of the Navy Military Training (NMT)

environment. Install an alarm system at other points of emergency egress, which would activate when door is opened.

- Duty Office. 125 ft^2 (12 m^2) Net Area. Include a duty office designed to provide the staff with a secure, efficient, and comfortable environment from which to manage the building. Provide area for one desk with computer.
- Duty Bunk. 80 ft^2 (7.5 m^2) Net Area. Provide lockable room for one bed and one wall locker. Locate adjacent to the Duty office.
- Unisex Restrooms. 45 ft^2 (4.5 m^2) Net Area. Provide one water closet, and one lavatory with associated hardware.
- Elevator. 85 ft^2 (8 m^2) Net Area each. (Elevator machine room area is excluded.) See Chapter 3 for added details.
- Vending. 85 ft^2 (8 m^2) Net Area. Provide space adjacent or co-located to the Multi-Purpose Room. Allow space for a minimum of four full-sized commercial vending machines with front facing circulation - three soft drink machines and one snack vending machine is typical. Discuss vending area, machine quantity and desired type with the activity and local UH Manager.
- Multi-Purpose Room. Calculate room size based on 6.25 ft^2 (0.58 m^2) minimum to 12.5 ft^2 (1.16 m^2) maximum area for each occupant. Includes spaces such as: Lounge, Meeting, Conference, Classroom(s), or other appropriate spaces. Isolate the area acoustically and locate them close to public toilets. Provide cabinets and counter space for minor food service and to accommodate a temporary microwave oven, waste receptacles, and other similar food warming equipment. Provide locked storage for related supplies and for equipment. Provide rooms with light and power for resident's general use and provide light dimmers. Provide window coverings and hardware to allow for darkening of the room with blinds or shades. With the military requirement of service members to access the internet to review military records and conduct personnel administration, multi-purpose rooms are required to be wired with infrastructure to support high speed internet access. Provide a minimum of two (2) eight-pin data ports wired with Category 5e wiring and clean power in each multi-purpose room.
- Laundry Room. Calculate room size based on 50 GSF (4.65 GSM) per 1 washer/2-dryer module. Provide 1 washer/2-dryer module for every 15 residents, as a minimum. Stacked units are acceptable. Locate laundry rooms (at the ground floor for NETC 2+0 Dormitory Unit only) for easy access and provide acoustic separation from other areas. Provide adjacency to a Multi-Purpose room as appropriate. Provide 12 linear feet (3.66 m) of folding table(s), clothes hanging area with hanging rods and 4 ft (1.25 m) of full height hanging for drip-dry clothing. Set aside a space of 36 inches x 72 inches (915 mm x 1829 mm) for soap, bleach, fabric softener and other laundry aid vending in each laundry facility.

- Janitor Closet(s). 90 ft^2 (8.5 m^2) Net Area. Provide a minimum 5 ft x 3 ft (1.5 m x 0.9 m) closet for permanent party facilities at each floor. At each floor level, provide a 5 ft x 5 ft (1.5 m x 1.5 m) closet for Transient facilities. In addition, for transient facilities, provide one secure space of about 250 ft^2 (23 m^2) net area for housekeeping equipment and supplies. Finish floor, base, and wall at the mop receptor to resist water. Slip resistant quarry tile or ceramic tiles are examples of acceptable finishes. Provide a motion-activated light. Provide a janitor's sink with drain, and basic storage for mops and one commercial grade floor polisher.
- Mechanical and Electrical Room(s). See Utility Area (Space) requirements in Chapter 3.
- Corridors. Travel distance from corridor door of any guest room to the nearest exit is limited by Code.
- Stair Towers. Estimate each exiting stair tower at 170 ft^2 (16 m^2) net area per floor. Enclose exterior stair towers or provide open-air per locale and building configuration.

4-4.3 Building Common Areas (Optional).

The following common spaces are OPTIONAL.

- Admin/Office Space. Provide other administrative office spaces as required within approved gross area constraints.
- Game Rooms. Acoustically isolate game rooms as appropriate. Include appropriate electrical outlets, and place close to public toilet(s). Design the rooms for installation of electronic video games. Locate within building design for appropriate monitoring by Marine Corps UH personnel. Provide rooms with substantial natural lighting.
- Resident Bulk Storage. Resident Bulk Storage as required.

4-4.4 In-Room Services.

See Chapter 3 for requirements for in-Room telephone, cable television and Local Area Network Systems (LAN).

4-5 OPEN BAY PLAN.

This construction standard is current for Recruits. See Chapter 6.

4-6 RESTORATION AND REDESIGN REQUIREMENTS FOR NAVY.

Refer to paragraph 3-3.1 entitled “Navy RM” for specifics concerning RM requirements for Navy projects.

4-6.1 Renovation.

Several previous Construction Standards are still considered adequate Unit design for housing Permanent Party unaccompanied enlisted personnel. As such, when facilities with adequate Unit Types are programmed for an RM project, the project team must endeavor to include features and benefits of current Construction Standards without Redesign, while providing best return on investment.

4-6.1.1 Adequate Previous Construction Standards/Unit Types.

Existing 1+1, 1+1E, and 2+0 Types, when minimum bedroom sizes are met see paragraph 4-6.3 entitled “Renovation and Redesign Criteria" below, are acceptable Unit plans. Project teams must apply the recommendations in the paragraph entitled “Renovation and Redesign Criteria" to the specific facility in question to determine best practices, ideal return on investment for the Navy, and how to best return adequate quarters for unaccompanied personnel. For example, considerations should include re-working single user bathrooms to the separate lavatory/vanity area and toilet-shower room when the project scope already includes bathroom work.

4-6.2 Redesign.

Several previous Construction Standards are inadequate for Permanent Party unaccompanied enlisted personnel. As such, when facilities with those Unit Types are programmed for an RM project, the project team must select the optimum solution for reconfiguring and most efficiently utilizing the existing footprint, providing best return on investment.

4-6.2.1 Previous Construction Standards/Unit Types.

Redesign existing Open Bay and Gang Head Unit Types, such as Motel or Tower, when planned to house Permanent Party Sailors. Existing Open Bay/Gang Head Unit Types must be redesigned when planned to house Students, subject to individual school requirements. Refer to the recommendations below for the specific facility to determine best practices, ideal return on investment for the Navy, and how to best return adequate quarters for unaccompanied personnel.

Permanent Party Barracks:

- Redesign Open Bay or Gang Head buildings to Navy Shared 2+0 Units
- 2+2 Units may be Redesigned to Market or 2+0 Units based upon the BCA.

Student Dormitories:

- Open Bay or Centralized Head buildings should be redesigned to NETC 2+0 Dormitory Units, requirements vary by school

4-6.3 Renovation and Redesign Criteria.

SRM Project Teams are responsible for evaluating optimum return on Navy investment for the specific facility in question, and providing a BCA as required above. For renovation or redesign projects, incorporate design features of current Unit Types whenever practicable. The following list is relevant for all Unit Types except as noted otherwise.

- In RM projects, provide, replace, or upgrade Fire Protection (Sprinkler & Fire Alarm) Systems to meet current requirements.
- Redesign projects must return the following minimum Bedroom area (NSF): Shared Unit = 180 ft^2 (16.7 m^2); Market Unit = 144 ft^2 (13.4 m^2) with no more than two Sailors per bath.
- In renovation projects, retain existing Bedroom size, except where built-in closets are being added. Renovated bedrooms must provide a minimum 90 NSF (8.36 NSM) per occupant.
- Bathroom Configuration. Where economically feasible and load bearing structure allows, provide separate lavatory/vanity and shower-toilet areas. Provide one medicine cabinet per potential occupant. Meet bathroom ventilation requirements in Chapter 3.
- Closet Sizing and Organization: Renovation projects should, and Redesign projects must, comply with current closet standards, Reference Chapter 3.
- HVAC: Projects must meet applicable energy conservation criteria as identified in UFC 1-200-02, including occupant HVAC controls in unit.
- Ventilation: Renovation projects should, and Redesign projects must, meet applicable criteria of ASHRAE 62.1 or 62.2.
- Laundry: Central laundry is not mandatory but is acceptable in existing buildings being renovated. Redesign projects should evaluate feasibility of relocating Laundry in the Unit. In-Unit, stacked full size washer/dryers are acceptable in Redesign projects. If central laundry will remain, provide one washer and two dryers per 15 Sailors.
- Kitchenette: For renovation and redesign projects returning 2+0 Units, provide a kitchenette meeting the following minimum requirements: Single bowl stainless steel sink; Base and wall cabinets; Microwave; Minimum 16 c.f. (0.45 c.m.) refrigerator. Where feasible, two-burner electric cook top if the building has no common kitchen.
- Building Common Areas: At Installations with surplus housing capacity, Renovation and Redesign project teams should evaluate the conversion of assignable building area to Common Areas, defined for new construction earlier in Chapter 4, to improve Sailors Quality of Life and ‘right size’ building capacity.

CHAPTER 5 MARINE CORPS ROOM PLANS

This chapter describes the variety of room plans to which Marine Corps unaccompanied enlisted personnel and single non-commissioned officers are assigned.

5-1 DESIGN PARAMETERS.

These plans are the basic building blocks from which Marine Corps UH designs are developed. The building layouts are provided to promote uniformity. All plan features must be included as a mandatory minimum.

- Building Gross Area must not be exceeded.
- Room Plan dimensions are NOT fixed but must remain functional. Size bedrooms to accommodate two extra-long twin beds. Room Plans are accessed from an interior corridor, or an exterior open breezeway.
- Adaptable Rooms**.** The Marine Corps will provide two easily adaptable rooms at the ground floor of new construction projects to allow Marines with minor injuries to remain with their group. Fully accessible rooms are NOT intended; rather to serve those who are temporarily unable to climb stairs. This billeting is not intended for wounded warriors who require long term medical care. This is not part of the accessibility requirements of the DoD Memorandum, Accessibility for People with Disabilities. Refer to paragraph 2-4 entitled “Accessible Units”.

5-2 MARINE CORPS 1+1E ROOM MODULE (OCONUS USE ONLY).

The 1+1E Room Plan Module has been approved as the standard for future UH built at Marine Corps Installations in Japan, instead of the 2+0 Module. Access is from an interior corridor, or conditioned or open breezeway.

- Gross Room Area: 600 ft^2 (56 m^2) (Example plans are notional).
- Net Living/Sleeping Area: 155 ft^2 (14.4 m^2) is the required MINIMUM size per bedroom.

5-3 MARINE CORPS 2+0 ROOM.

This room plan includes double occupancy living/sleeping area, two personal closets, shared toilet with a shower compartment, and sink service area. Access is from an interior corridor, conditioned or open breezeway.

- Gross Room Area: 387.5 ft^2 (36 m^2) (Example plans are notional).
- Net Living/Sleeping Area: 180 ft^2 (16.7 m^2) is the required MINIMUM size per bedroom.

5-3.1 Room Plan (Spaces) Detailed.

- Living/Sleeping Area. 180 ft^2 (16.7 m^2) Net Area required. Bedrooms are intended for double occupancy. Bedroom dimensions are not fixed but must remain functional to accommodate two twin extra-long pop-top captains beds with double storage compartments below, storage headboard; two computer/TV wall desk units with built-in under-cabinet lighting, two chairs, and at least one credenza with double sided drawers.
- Heads. Heads and fixtures are to be of residential design, quality, and finish. Provide a double vanity with double lavatory and valance lighting with double medicine cabinets, a full-sized shower, and water closet with shelving and towel/toiletry hardware for two residents. Provide a full-length framed mirror mounted on Service area side of the bathroom door.
- Personal Closets. 22 ft^2 (2 m^2) Net Area required. Provide at least one closet for each resident. Closets must be accessible to each living/sleeping area. Provide each closet with closet organizers with storage capability extending to the ceiling. Provide additional storage in service areas as appropriate. Provide closets full height, using the space above the normal door height for bulk storage. Provide continuous ventilation in closets to resist mold and mildew growth. Provide integral full-length hanging rods for coats and shelves. A light with motion-activated control is required. Carefully placed lighting outside 2 ft (0.6 m) deep closets is acceptable. Secure closets with standard hinged doors with non-removable pin hinges and locking hardware. Provide padlocking slide bolt hardware for personal closets. Bi-fold and sliding doors are not acceptable.
- Service Area. This term refers to the corridor/service space within the 2+0 Room Plan that is not incorporated into the Net Living/Sleeping Area. The service area in each Plan Room provides access to the personal closets, head, a FAR Rated, Energy Star, 2-door refrigerator (10.3 cu. ft) maximum, a microwave, and counter space with single bowl sink.
- Locks. Electric locks are required on building entrance doors and room doors. Use a magnetic key card system with hard key override. Provide each occupant one key that opens the room entry door, and one bedroom door. Installation Commanders may require electronic locks for closet doors as an option that provide each occupant with a second key for entry to his closet, without access to the other occupant's closet.

5-3.2 Required Common Building Spaces Detailed.

The following spaces are REQUIRED common spaces for the Marine Corps 2+0 Room configurations. The net areas shown are approximations to assist the designer.

- Entry Vestibule. 50 ft^2 (4.5 m^2) Net Area. Provide automatic entry doors per ABA and weather vestibule.

- Duty Office. 125 ft^2 (12 m^2) Net Area. Include a duty office designed to provide the staff with a secure, efficient, and comfortable environment from which to manage the building. Provide area for one desk with computer.
- Duty Bunk. 80 ft^2 (7.5 m^2) Net Area. Provide lockable room for one bed and one wall locker. Locate adjacent to the Duty office.
- Unisex Restrooms. 45 ft^2 (4.5 m^2) Net Area. Provide one water closet, and one lavatory with associated hardware.
- Elevator. 85 ft^2 (8 m^2) Net Area each. (Elevator machine room area is excluded.) See Chapter 3 for added details.
- Vending. 85 ft^2 (8 m^2) Net Area. Provide space adjacent or co-located to the Multi-Purpose Room. Discuss vending area, machine quantity and desired type with the activity and local Marine Corps Community Services Director. See Chapter 3 for details.
- Multi-Purpose Room. Calculate room size based on 6.25 ft^2 (0.58 m^2) minimum to 12.5 ft^2 (1.16 m^2) maximum Net Area for each occupant. Includes spaces such as: Lounge, Meeting, Conference, Classroom(s), or other appropriate spaces. Isolate the area acoustically and locate them close to public toilets. Provide cabinets and counter space for minor food service and to accommodate a temporary microwave oven, waste receptacles, and other similar food warming equipment. Provide locked storage for related supplies and for equipment. Provide rooms with light and power for resident's general use and provide light dimmers. Provide window coverings and hardware to allow for darkening of the room with blinds or shades. With the advent of Marine Online and the military requirement of Marines to access the internet to review military records and conduct personnel administration, multi-purpose rooms are required to be wired with infrastructure to support high speed internet access. Provide a minimum of two (2) eight-pin data ports and clean power in each multi-purpose room. Refer to UFC 3-580-01 for telecom room size and system requirements.
- Laundry Room. Calculate room size based on 50 GSF (4.65 GSM) per 1 washer/2-dryer module. Provide 1 washer/2-dryer module for every 12 residents, as a minimum. Stacked units are acceptable. Locate a single laundry rooms for easy access and provide acoustic separation from other areas. Provide adjacency to the Multi-Purpose room. Provide 12 linear feet (3.65 linear m) of folding table(s), clothes hanging area with hanging rods and 4 ft (1.25 m) of full height hanging for drip-dry clothing. Set aside a space of 36 inches x 72 inches (915 mm x 1829 mm) for soap, bleach, fabric softener and other laundry aid vending in each laundry facility.
- Janitor Closet(s). 90 ft^2 (8.5 m^2) Net Area. Provide a minimum 5 ft x 3 ft (1.5 m x 0.9 m) closet for permanent party facilities at each floor. Finish floor, base, and wall at the mop receptor to resist water. Slip resistant quarry tile or ceramic tiles are examples of acceptable finishes. Provide a

motion-activated light. Provide a janitor's sink with drain, and basic storage for mops and one commercial grade floor polisher.

- Mechanical and Electrical Room(s). See Utility Area (Space) requirements in Chapter 3.
- Corridors and Breezeways. Code limits travel distance from corridor door of any guest room to the nearest exit. Size building corridors to meet the minimum (or better) requirements of the International Building Code. Provide appropriate lighting and consider providing a recessed light at each entrance in addition to standard overhead corridor lighting. Size the corridor to meet NFPA 101 requirements with a minimum clear width to accommodate two persons with suitcases (60 inches (152.4 mm) clear).
- Stair Towers. Estimate each exiting stair tower at 170 ft^2 (16 m^2) net area per floor. Enclose exterior stair towers or provide open-air per locale and building configuration.
- Adaptable Rooms. Provide easily adaptable rooms per 5-1 Design Parameters.

5-3.3 Optional Common Building Spaces Detailed.

The following common spaces are OPTIONAL for the Marine Corps 2+0 configuration:

- Admin/Office Space. Provide other administrative office spaces as required within approved gross area constraints.
- Game Rooms. Acoustically isolate game rooms as appropriate. Include appropriate electrical outlets, and place close to public toilet(s). Design the rooms for installation of electronic video games. Locate within building design for appropriate monitoring by Marine Corps UH personnel. Provide rooms with substantial natural lighting.
- Resident Bulk Storage. Resident Bulk Storage as required.
- Centralized Kitchen.

5-3.4 In-Room Services.

See Chapter 3 for requirements for in-Room telephone, cable television and Local Area Network Systems (LAN).

5-3.5 Exterior Washdown Areas.

Size these areas based upon the number of occupants.

- Equipment Washdown Area. Locate equipment washdown areas at a covered cleaning shelter adjacent to a building entry point. The area must be concrete based, approximately 15 ft (4.6 m) width by 50 ft (15 m) length with supported standpipes consisting of six hose bibs with sturdy supports and anchored at the tabletop level 40 inch (1016 mm) maximum

height with separate cut-off valves suitable for simultaneous operation of all six (6). Provide a properly sized supply standpipe with a freeze-proof design and easily accessible shut-off valve(s). Slope the concrete tabletop area to a central drain with easy cleanout for mud and debris. Provide equipment suitable for outside service.

- Equipment Drying Areas**.** Provide a semi-enclosed roofed equipment drying area on concrete hardstand adjacent to the equipment washdown area. Each drying area may be totally enclosed on four sides and across the top for security per Command decision. The drying area must be divided into separate sections. If gates are used, each must have a lockable hasp. Slope the concrete hardstand adequately to prevent ponding water.
- Note that these structures will be counted as part of the allowable area limits for the project.

5-3.6 Windows.

Continuous overhead fenestration which provides cross ventilation is encouraged. See Chapter 3 for additional window requirements.

5-3.7 Interior Walls and Finishes.

Refer to paragraph 3-6.9 entitled “Walls and Partitions”, and Table 3-2 in this FC for specific interior finishes and schedules.

5-4 MARINE CORPS SNCO/OFFICERS ROOM.

This room plan is intended for unaccompanied Staff Noncommissioned Officers (E6-E9) (SNCO) and Officers on a dependent restricted unaccompanied orders, and support personnel on the Unit Deployment Program (UDP). Access is from an interior corridor, conditioned or open breezeway.

- Gross Room Area: 603 ft^2 (56 m^2).
- Bedroom Area: 151 ft^2 (14 m^2) is the required MINIMUM size per bedroom.

5-4.1 Room Plan (Spaces) Detailed.

- Bedroom. 151 ft^2 (14 m^2) Net Area required. Bedrooms are intended for single occupancy. Bedroom dimensions are not fixed, but must remain functional to accommodate one queen bed, one computer/TV wall desk unit with hutch, one chair, one nightstand, one lamp and at least one bureau or chest.
- Living Room. 130 ft^2 (12 m^2) Net Area required. Living rooms are intended for one occupant and two visitors use, sized for a sofa, chair, coffee table, end lamp, floor lamp and TV/credenza. Provide adjustable level lighting,

recess mounted in the ceiling. Provide a ceiling fan with no light attachment appropriately mounted to avoid the recessed fixtures.

- Laundry Area. Provide one washer and one dryer for every resident, as a minimum, vented to the exterior. Stacked units are acceptable. Provide a containment curb. A floor drain is optional. Provide room for storage of ironing board and shelving for laundry soap.
- Heads. Heads and fixtures are to be of residential design, quality, and finish. Provide a vanity with lavatory and valance lighting with a single medicine cabinet, a full-sized tub-shower, and water closet with shelving and towel/toiletry hardware for one resident.
- Walk-in Closet. 32 ft^2 (3 m^2) Minimum Net Area required. Provide at least one walk-in closet for each resident. Closet must be accessible to the sleeping area. Provide organizers with storage capability extending to the ceiling. Closet must be full height, using the space above the normal door height for bulk storage. Provide continuous ventilation in closets to resist mold and mildew growth. Provide integral full-length hanging rods for coats and shelves at the long side, with shelf above the hanging rod, and five fixed shelves located at the far end wall. Provide one wall void of shelving for storage of tall items. Lighting outside of closets is not acceptable. An interior light with motion-activated switch is required. Carefully placed lighting outside closets is not acceptable. Secure each closet with standard hinged doors with non-removable pin hinges and keyed locking hardware. Bi-fold and sliding doors are not acceptable. Closet doors must have full-length dressing mirrors.
- Kitchen. The kitchen area is adjacent and provides open access to the living area, and doorway access to the bath and bedroom. The kitchen area will contain a full-sized refrigerator (14 c.f. (0.40 c.m.) maximum), a four-burner range with oven below and microwave and ventilation fan collocated above, appropriate counter space with under cabinet lighting with single bowl sink. Provide a small pantry and closet with broom storage capabilities adjacent to the main Room entry door.
- Locks. Use a magnetic key card system with hard key override. Provide occupant one key that opens the room entry door and bedroom door.

5-4.2 Required Common Building Spaces Detailed.

The following spaces are REQUIRED common spaces for the Marine Corps SNCO and Officers configurations:

- Entry Vestibule. 50 ft^2 (1.5 m^2) Net Area. Provide automatic entry doors and weather vestibule.
- Unisex Restrooms. 15 ft^2 (1.5 m^2) Net Area. Provide one (1) water closet, and one (1) lavatory with associated hardware.

- Elevators. 85 ft^2 (8 m^2) Net Area. (Elevator machine room area is excluded.) Note that the number of elevators allowed is now calculated by the building height. See Chapter 3 for additional details.
- Janitor Closet(s). 90 ft^2 (8.5 m^2) Net Area. Provide a minimum 5 ft x 3 ft (1.5 m x 0.9 m) closet for permanent party facilities at each floor. Finish floor, base, and wall at the mop receptor to resist water. Slip resistant quarry tile or ceramic tiles are examples of acceptable finishes. Provide a motion-activated light. Provide a janitor's sink with drain, and basic storage for mops and one (1) commercial grade floor polisher.
- Mechanical and Electrical Room(s). These rooms are calculated at 6% of the Gross Building Area, (10% maximum). This includes: Main Mechanical room at ground floor, Electrical control closet, Fire Pump Room, Elevator Equipment room, Mechanical room on each floor, and main vertical duct space (floor to floor). Refer to UFC 3-580-01 for telecom room size and system requirements.
- Corridors and Breezeways. NFPA 101 limits travel distance from corridor door of any guest room to the nearest exit. Size building corridors to meet the minimum (or better) requirements of the International Building Code. Provide appropriate lighting and consider providing a recessed light at each entrance in addition to standard overhead corridor lighting. Size the corridor to meet NFPA 101 requirements with a minimum clear width to accommodate two persons with suitcases (minimum 66 inches (167.64 cm) clear).
- Stair Towers. Estimate each exiting stair tower at 170 ft^2 (16 m^2) net area per floor. Enclose exterior stair towers or provide open-air per locale and building configuration.

5-4.3 Optional Common Building Spaces Detailed.

The following common spaces are OPTIONAL for unaccompanied SNCO and Officers configurations.

- Admin/Office Space. Provide other administrative office spaces as required within approved gross area constraints.
- Vending. 85 ft^2 (8 m^2) Net Area. Provide space adjacent or co-located to the Multi-Purpose Room. Discuss vending area needs, machine quantity and desired type with the activity and local Marine Corps Community Services Director. Refer to Chapter 3 for details.
- Multi-Purpose Room. Calculate room size based on 6.25 ft^2 (0.58 m^2) minimum to 12.5 ft^2 (1.16 m^2) maximum area for each occupant. Includes areas such as: Billiards, Ping Pong, Foosball and Air Hockey and spaces such as a Game Room, Internet Café, Theater, or other appropriate areas or spaces. Isolate the area acoustically and locate them close to public toilets. Provide cabinets and counter space for minor food service and to accommodate a temporary microwave oven, waste receptacles, and other

similar food warming equipment. Provide locked storage for related supplies and for equipment. Provide rooms with light and power for resident's general use and provide light dimmers. Provide window coverings and hardware to allow for darkening of the room with blinds or shades. With the advent of Marine Online and the military requirement of Marines to access the internet to review military records and conduct personnel administration, multi-purpose rooms are required to be wired with infrastructure to support high speed internet access. Provide a minimum of two (2) eight-pin data ports wired with Category 5e wiring and clean power in each multi-purpose room.

- Game Rooms. Acoustically isolate game rooms as appropriate. Include appropriate electrical outlets, and place close to public toilet(s). Design the rooms for installation of electronic video games. Locate within building design for appropriate monitoring by Marine Corps UH personnel. Provide rooms with substantial natural lighting.
- Resident Bulk Storage. Resident Bulk Storage as required.
- Theater room is acceptable as an option.
- Audio/Visual Equipment Rooms are acceptable as an option.
- Balconies are an option.

5-5 ADDITIONAL REQUIRED BUILDING FEATURES.

The following common features must be provided.

5-5.1 Heating, Ventilation and Air Conditioning.

Design an HVAC system to provide residents with individual choice of heating and cooling year-round within each living area.

5-5.2 In-Room Services.

See Chapter 3 for requirements for in-Room telephone, cable television and Local Area Network (LAN) Systems.

5-5.3 Doors and View Ports.

Provide solid core doors or thermally insulated metal doors (in exterior applications) for sound isolation for the entry units. Provide a fire rated, wide angle security viewport at the 60-inch (1524 mm) height and an additional wide-angle security view port at 43-inch (1092 mm) height for accessible units.

5-5.4 Hardware and Locks.

Refer to Chapter 3 for hardware and lock information.

5-5.5 Windows.

Provide continuous overhead fenestration which allows cross ventilation in projects where open breezeway corridors are present. Single hung windows with window screens are required for interior corridor designs. Locate secure openings above the entry door and over windows in living room and bedroom. See Chapter 3 for additional window requirements.

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CHAPTER 6 OPEN BAY

This Chapter describes Open Bay configurations used by the Navy and the Marine Corps. Marines Corps variations are specifically identified.

6-1 OPEN BAY PLAN.

An Open Bay barracks consists of an open-bay, central head facilities, common areas, circulation, and laundry facilities.

6-1.1 Gross Open Bay Sleeping Area.

Determine the total gross area of the open bay by the number of persons that will occupy the space. (# of persons x minimum net sleeping area per person). Typical sizes are 60 persons per bay.

6-1.2 Net Living/Sleeping Area.

Recruit net living area is 72 ft^2 (6.7 m^2) per person minimum.

6-1.3 Required Common Areas (Spaces).

The following spaces are required common spaces in Open-Bay designs.

- Navy Laundry facilities: Provide one washer and two dryers for every 12 residents as a minimum. Adjust this number as appropriate where some or all of the laundering is performed by contract. Locate laundry rooms preferably at each floor for easy access and provide acoustic separation from other areas; provide 10 linear feet (3 linear meters) of folding table with hanging rods above and 4 feet (1.25 meters) of full height hanging for drip-dry clothing.
- Marine Corps Laundry facilities: Provide one washer and two dryers for every 12 residents, at a minimum. Locate laundry rooms on the ground floor or in an adjacent separate building. Clothing and gear requirements vary by location. Provide folding tables with hanging rods appropriately designed for the mission of the occupants.
- Building Utility Room;
- Bulk storage. Provide bulk storage areas for gear and supplies for Navy. This is optional for the Marines Corps.
- Mechanical and Electrical Rooms. The spaces including main mechanical rooms, main electrical rooms, telecommunication room, and fire pump room must be provided within the limits of the maximum gross building area. This is limited to a maximum of 7% of the Gross building area. The elevator equipment room (not generally required for open bay UH), and the floor-to-floor duct spaces are not included in this limit.

- Design circulation, corridors, and hallways for appropriate passage with luggage and exiting. Provide additional recessed lighting at all entrances.
- Multi-Purpose Areas (Space) such as lounge or classroom. Isolate the areas acoustically and locate them close to public toilets. Provide rooms with light and power and provide light dimmers. Multi-purpose rooms are required to be wired with infrastructure to support high-speed internet access. Provide a minimum of two (2) eight-pin data ports wired with Category 5e wiring and clean power in each multi-purpose room. Provide window coverings and hardware to allow for darkening of the room with blinds or shades.
- Janitorial. Provide a 5-foot x 3-foot (1.5 meter x 0.9 meter) closet for each Bay to house vacuum cleaner storage and janitor's sink and faucet. Finish floor, base, and wall at the mop receptor to resist water. Slip resistant quarry tile or ceramic tiles are examples of acceptable finishes. Provide a motion-activated light.

6-1.4 Optional Common Areas (Spaces).

The following spaces are optional common spaces in Open-Bay designs.

- Automatic entry doors and weather vestibule. Weather vestibule may be required based on requirements in UFC 1-200-02.
- Administration Area (for Navy). Design administrative areas to provide the staff with a secure, efficient, and comfortable environment from which to manage the building.
- Navy Office Space. Provide other administrative office spaces to meet mission requirements within the gross building area limits.
- Lobby, Vestibule, Reception Desk. Locate the lobby and its vestibule for easy identification by arriving guests. Include a seating area for visitors and guests waiting for transportation. Locate the seating area for clear view of arriving automobiles and of the front desk. Choose and arrange lighting fixtures to organize and identify the space. Finish the lobby and entrance with attractive, durable, and easily cleaned materials. Provide the Reception Desk with enclosed space or counter/workspace. Locate the counter for visual control of the lobby and other central common spaces. Arrange the counter for check-in by several persons at once with computer, key control, and forms storage. Light counter surfaces for writing, mount duplex outlets above work surface, and provide computer and telephone cables and connections.
- Vending Area. Note that this is optional for recruit barracks.
- Public Toilets. Note that this is optional for recruit barracks.
- Marine Corps Drill Instructor Area. These spaces include a duty office designed for the Drill Instructor with head and bunkroom. Provide area to accommodate one desk with computer, with adjacency to a non-public

lavatory (included in the net area); a lockable room to accommodate one bed and one wall locker. Provide windows in the office area to observe conditions within the open-bay area, if located on each floor.

- Armories. Individual armories (if required) are part of the open bay area, or an adjacent space. This consists of a lockable (metal cage) cabinet permanently attached per force protection standards as referenced in UFC 1-200-01, and MCO 5530.14A.
- Marine Corps Multi-Purpose Areas. Isolate these areas acoustically and adjacent to a single public toilet. Provide these rooms with easily adjustable light (dimmers), power and internet capabilities according to mission use. Provide window coverings and hardware to allow for darkening of the room with blinds or shades. With the advent of Marine Online and the military requirement of Marines to access the internet to review military records and conduct personnel administration, multi-purpose rooms are required to be wired to support high speed internet access. Provide a minimum of two (2) eight-pin data ports wired with Category 5e wiring and clean power in each multi-purpose room.
- Exterior Wash down areas will be provided as follows: Navy will provide exterior water at a paved and well drained area with six grouped hose bibs securely posted at 40-inch (101.6 cm) height for individual wash down of field gear and shelters are optional. Marine Corps will provide exterior equipment wash down areas and shelters for them as described in paragraph 5-3.5 entitled, Exterior Washdown Areas.

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APPENDIX A BEST PRACTICES

A-1 NAVY RESIDENT AND BUILDING MANAGER INPUT.

Best practices for new construction and renovation projects for Navy Permanent Party UH should consider recent resident feedback, documented in the form of Post Occupancy and Tenant Satisfaction Surveys. The most common desires among residents included:

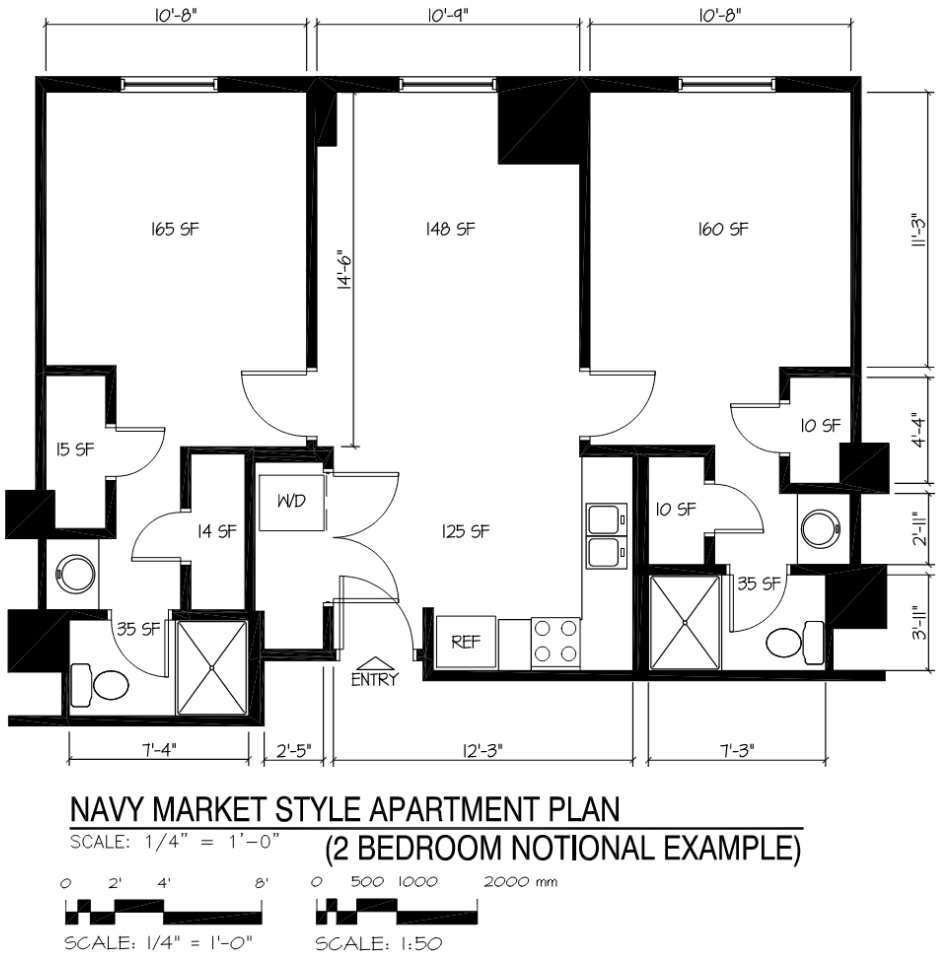
- Outdoor BBQ areas, ideally with shade covers, and a variety of sizes to accommodate varying size groups. Provide site furnishings such as but not limited to picnic tables, benches, and trash receptacles.
- For bathrooms which will be shared by two people, consider how two Sailors will use the area at the same time. In addition to providing separate vanity area, provide space for closet access while roommate is using vanity.
- When possible, maintain 2-bedroom Market Units, and do not add additional bedrooms, as it complicates roommate interactions.
- Look at entry/exit travel paths for residents when setting building entries; with use of electronic locks and cameras, resident entries can be remote from main lobby on convenient travel paths from commonly used facilities on the Installation (such as the fitness center).
- Consider noise issues with locating equipment such as ice machines in Lounge or computer spaces.
- Consider noise issues when locating exterior mechanical or other equipment outside of entries, bedroom units, or recreational activities.
- Cleanliness and maintenance of buildings are a consistent top resident concern; strongly consider ease of maintenance in selection of finishes and equipment.
- Consider how to maintain operations when critical systems are being maintained; for example, providing a hookup for a generator-based A/C system during chiller maintenance.
- Door hardware: consider use of push plates and kick plates for appearance retention and minimize maintenance. Also consider use of a threshold shape that discourages the use of a tool or device under the entry door to gain access to the lever handle on the secured side.
- Consider using non-painted aluminum railings on exterior applications.
- Site: consider stamped concrete in lieu of pavers where pervious surface is not required.

Building Managers offered the following input during the Post Occupancy Survey process:

- Appliances:
  - Residential Grade, simple appliances are the best for obtaining replacement parts as well as ease of cleanability. For example, all-glass stovetops which require special cleaners are not usually properly maintained by UH residents.
  - Strongly consider maintainability in initial appliance selection, including ability to maneuver the unit in and out for replacement or maintenance, serial numbers and product codes on the front of units, and providing ample attic stock/replacement parts as part of initial construction contract.
- Finishes: strongly consider not only durability but colors which hide stains and dirt well for carpet, other flooring, grout, countertops, and other materials.

A-2 NAVY FLOOR PLAN EXAMPLE.

Figure A-1 Navy Market Style Example



The Market Style Apartments shown above offer a variety of solutions for accommodating all requirements.

A-3 MARINE CORPS BEST PRACTICES.

Marine Corps Best practices for new construction and renovation projects for Permanent Party barracks include:

- Design a cohesive and integrated campus style complex for convenience of residents, with better traffic flow, hierarchical outdoor spaces, varying from large active outdoor areas to smaller areas for passive use.
- Co-locate UHs and support facilities in order to provide more usable outdoor areas. Site buildings and structure to protect residents from strong winds and inclement weather, wherever possible; and use solar orientation to reduce summer heat gain and site to take advantage of seasonal cooling breezes.
- Provide identifiable entry and focal points, variation of building massing and colors, landscape with native plants (low maintenance and water conserving) and use of locally available site materials and elements.
- Outdoor BBQ areas, ideally with shade covers, and a variety of sizes to accommodate varying size groups. Include quality built-in BBQs and maximize outdoor seating/eating capacity with open green space areas.
- Provide home-like environment by maximizing living/sleeping area (within the maximum limits), provide beds with lockable storage compartments, maximize the use of natural daylight and ventilation.
- Utilize daylighting in multipurpose spaces and provide a visual connection to associated outdoor spaces (such as BBQ area and outdoor activity areas).
- For bathrooms, consider how two Marines will use the area at the same time. In addition to providing separate vanity area, provide space for closet access while roommate is using vanity, where possible.
- Finishes: strongly consider not only durability but colors which hide stains and dirt well for carpet, other flooring, grout, countertops, and other materials.
- Provide coordinated furnishings, fixtures, and equipment (FF&E) packages reflective of the buildings architectural style, local culture and theme. Involve interior designers in complete process (Concept Design Workshops (CDW), FF&E selection/design and turnkey process).
- Specify sustainable FF&E with an extended warranty for material and labor beyond the normal contract or manufacturer’s warranty period.
- Cleanliness and maintenance of buildings are a consistent top resident concern; strongly consider ease of maintenance in selection of finishes and equipment.

Create a team of professionals during the process from start to finish; these should include: NAVFAC, Contract Specialist, Project Manager, design manager, Interior

Designer, ROICC/Construction Manager, ROICC Contract Specialist, Client/End user, Bachelor Housing Director, Public works project manager, Installation Property Manager/CMSC Officer, and HQMC LF (where necessary).

Figure A-2 Best Practice, UH Campus Arrangement



In this illustration, the UH Facilities (3 each) are sited in the same complex with the new Dining Facility to form a very comfortable, easy to walk to various facilities in a coherent, sustainable complex with plenty of usable outdoor facilities for both very active sports to very low key passive recreational spaces.

UH CAMPUS ARRANGEMENT: Example of Preferred Building Arrangement, Adjacency, Massing, Site Improvements, Landscaping, and Vehicle and Pedestrian Circulation Paths.

Figure A-3 Best Practice, UH Campus Sun Shading and Walkways



Building design and site design: Example of using shading structures for outdoor gathering spaces, deep overhang to provide shade and shadow and minimize heat gain in Summer time, walkway connecting all elements of projects to each other, enhanced paving materials at important nodes in the circulation paths. Note site planning and building design to offer optimum views to all rooms in the UH.

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APPENDIX B FIGURES

Figure B-1 Navy Market Style Unit (Two Bedroom) Bubble Diagram

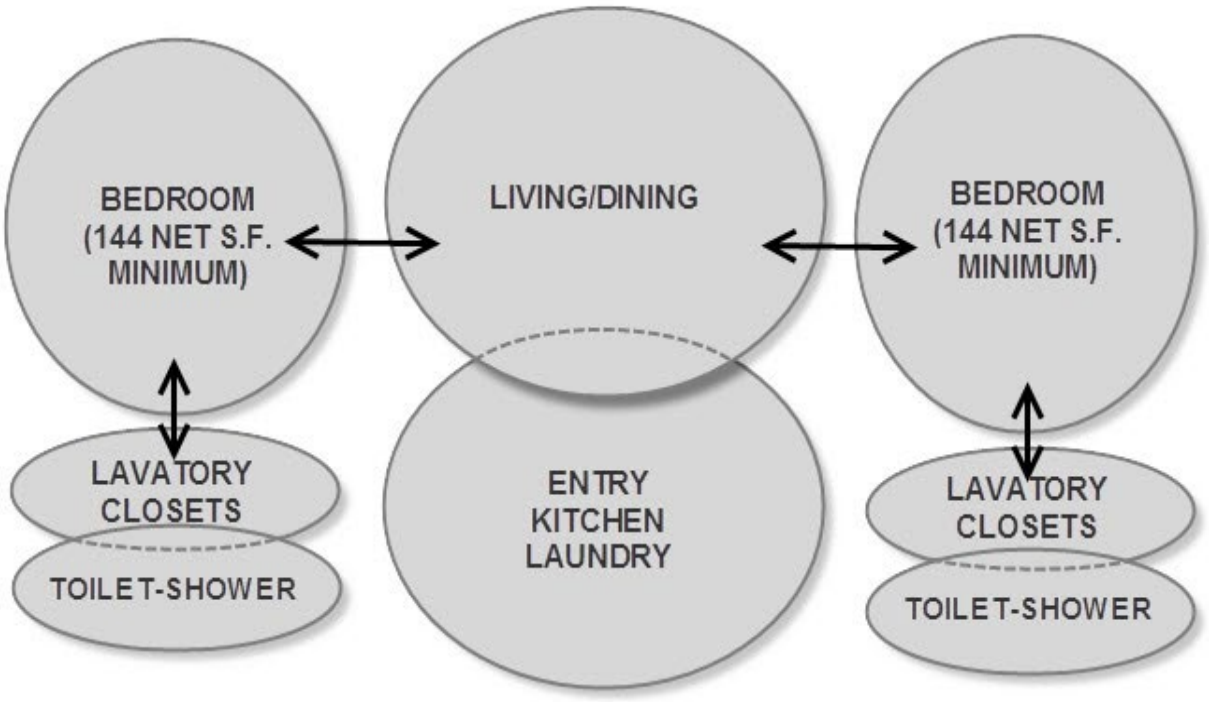


Figure B-2 Navy Market Style Unit (One Bedroom, Remote Locations) Bubble Diagram

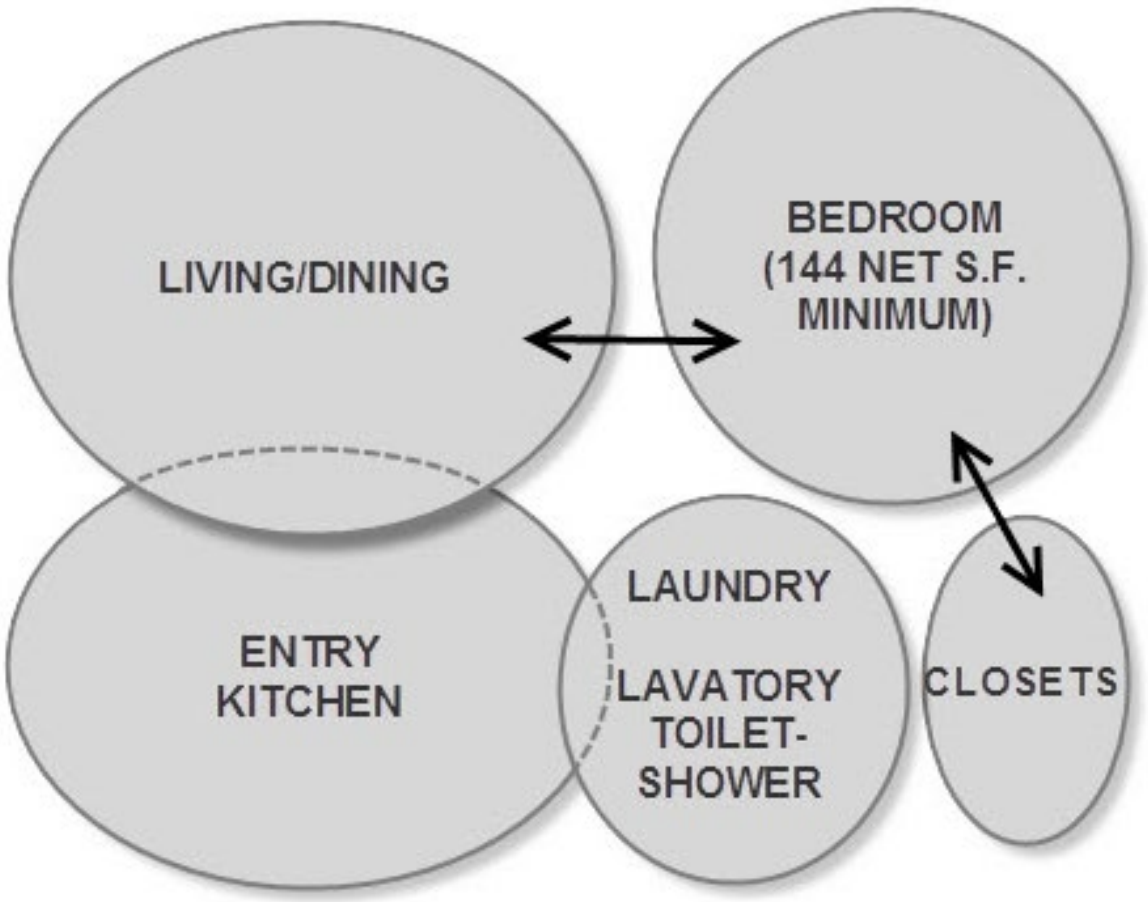


Figure B-3 Navy 2+0 Unit Bubble Diagram

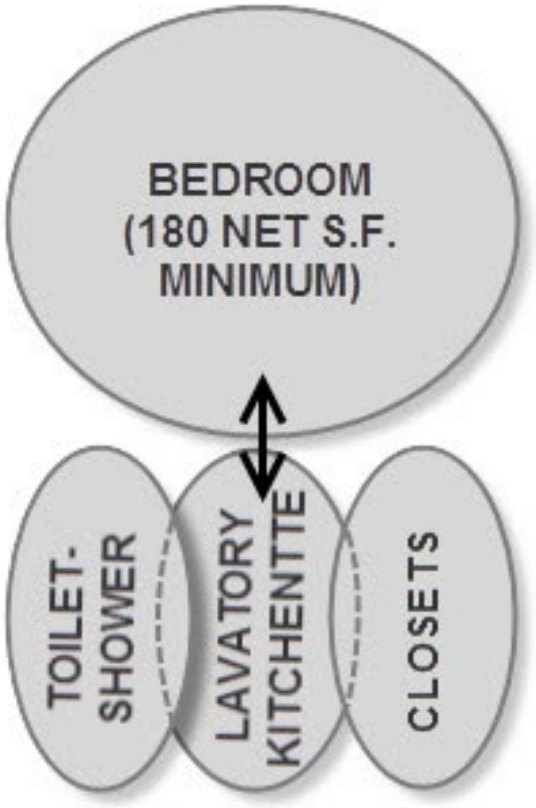
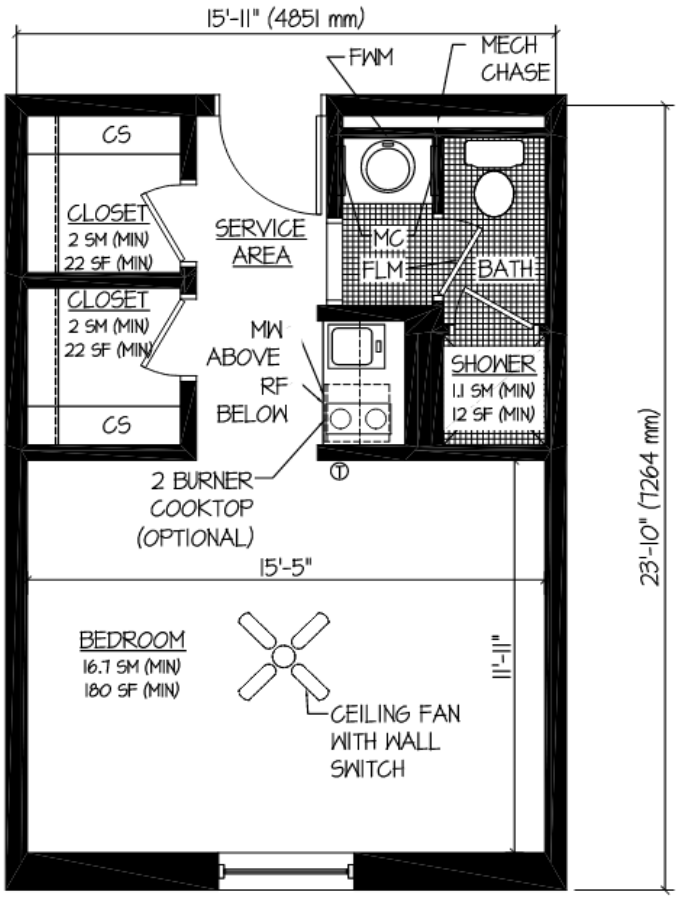


Figure B-4 Navy 2+0 Unit Floor Plan



LEGEND:

ⓣ	HVAC CONTROL
FLM	FULL LENGTH MIRROR
FWM	FULL WIDTH MIRROR
MC	MEDICINE CABINET
MW	MICROWAVE
RF	REFRIGERATOR
CS	CLOSET SYSTEM

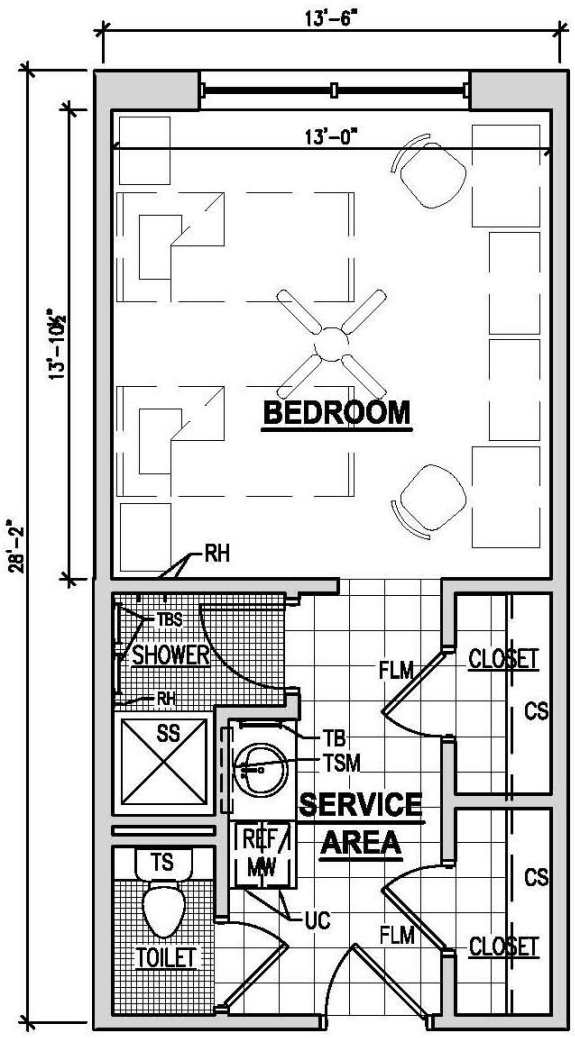
REQUIREMENT	CRITERIA
GROSS MODULE AREA	380 SF (35.5 SM MAX)
NET SLEEPING AREA	180 SF (16.7 SM)

0 2' 4' 8'

0 500 1000 2000 mm

THE NAVY 2+0 ROOM PLAN
SCALE: 1/4" = 1'-0"
(INTERIOR CORRIDOR ACCESS)

Figure B-5 NETC Dorm Room Floor Plan



LEGEND:

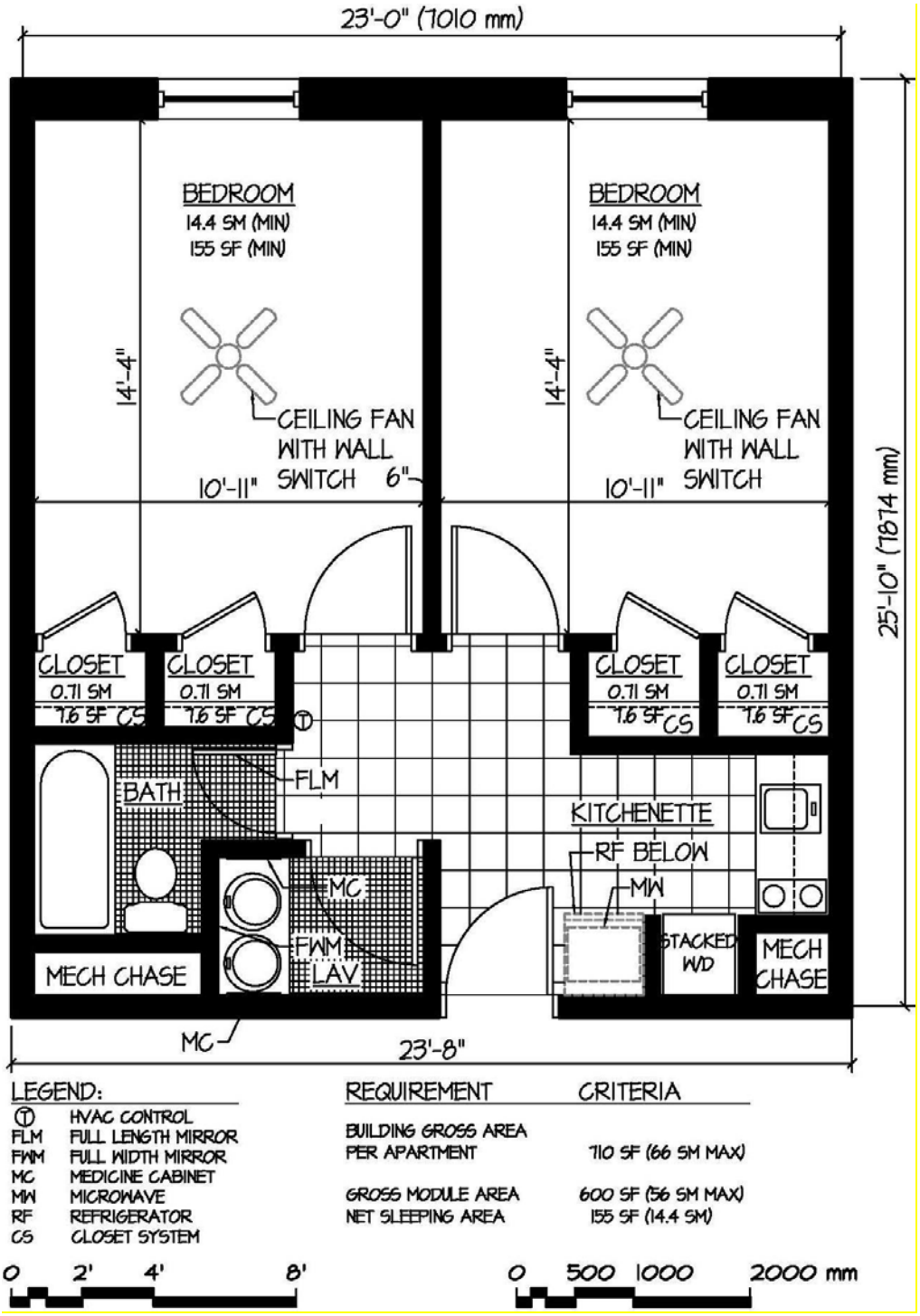
TBS	TOWEL BAR WITH SHELF ABOVE (2)
RH	ROBE HOOK
SS	SHOWER STALL
TS	12"D X 36"W UPPER CABINET
FLM	FULL LENGTH MIRROR
UC	12"D X 24"W UPPER CABINET
TSM	THREE SECTION MIRROR W/ TWO BUILT-IN MEDICINE CABINETS.
CL	CLOSET SYSTEM
IB	IRONING BOARD WITH IRON STORAGE RACK
TB	TOWEL BAR

NOTE: REFER TO UFC FOR GROSS AND NET AREAS

0 2' 4' 8'

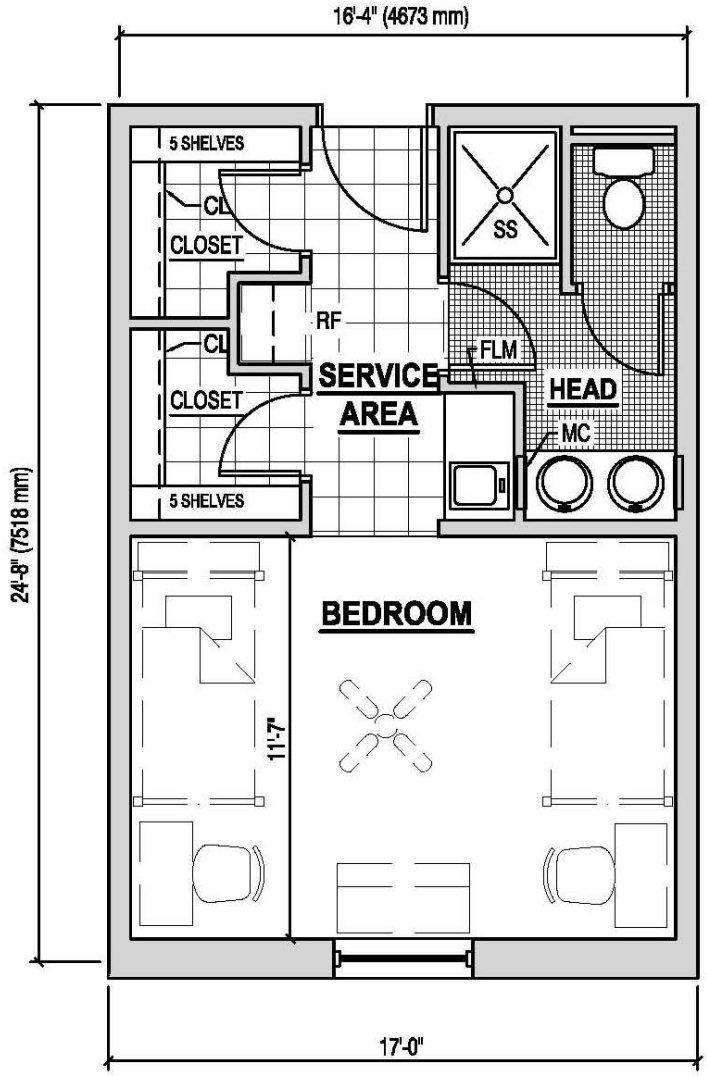
0 500 1000 2000 mm

Figure B-6 Marine Corps 1 + 1E Plan – OCONUS Use Only



2-1

Figure B-7 Marine Corps 2+0 Room



LEGEND:

FLM	FULL LENGTH MIRROR	MW	MICROWAVE
FWM	FULL WIDTH MIRROR	RF	REFRIGERATOR
MC	MEDICINE CABINET (2 STACKED)	SS	SOLID SURFACE SHOWER ENCLOSURE
CL	CLOSET SHELVES & RODS		

NOTE: REFER TO UFC FOR GROSS AND NET AREAS

0 2' 4' 8'

0 500 1000 2000 mm

Figure B-8 Marine Corps 2+0 Room (Breezeway Access)

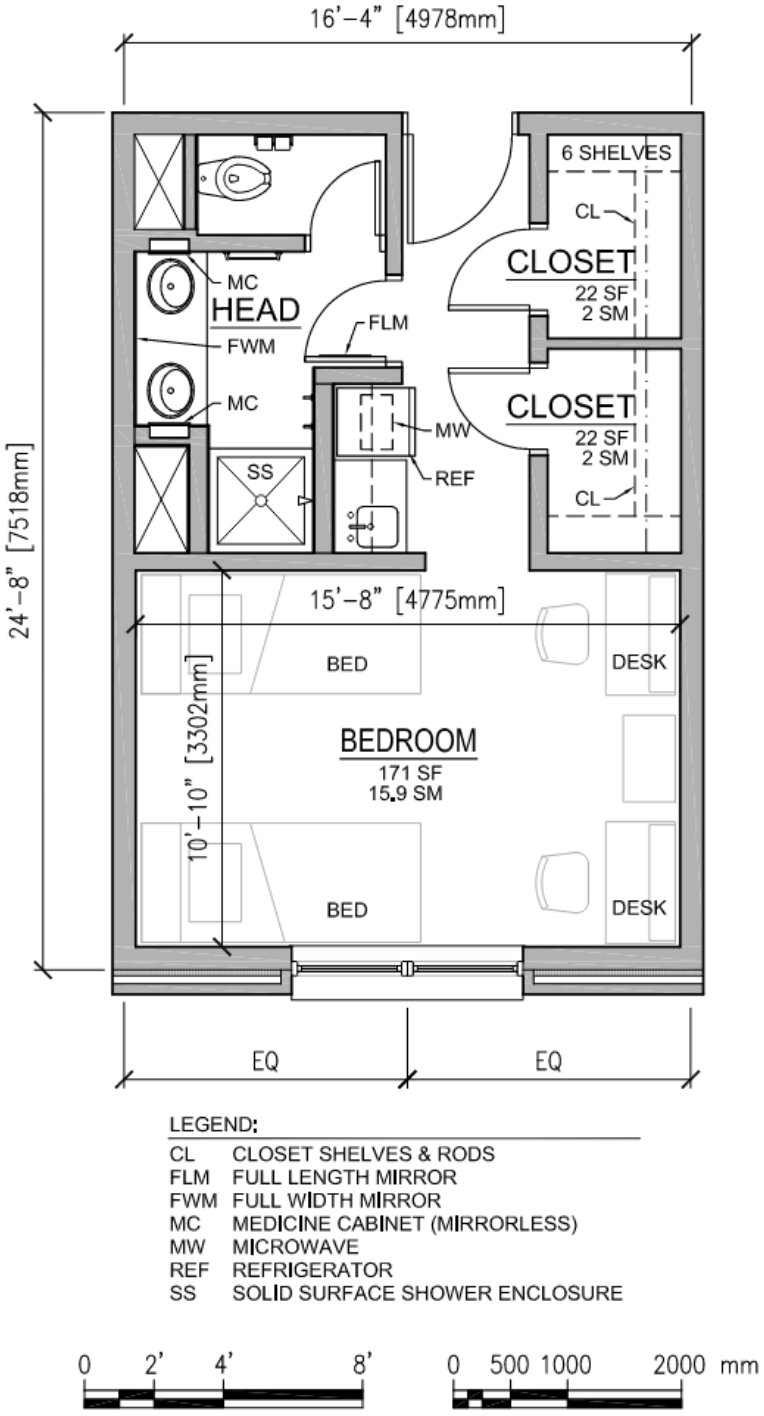
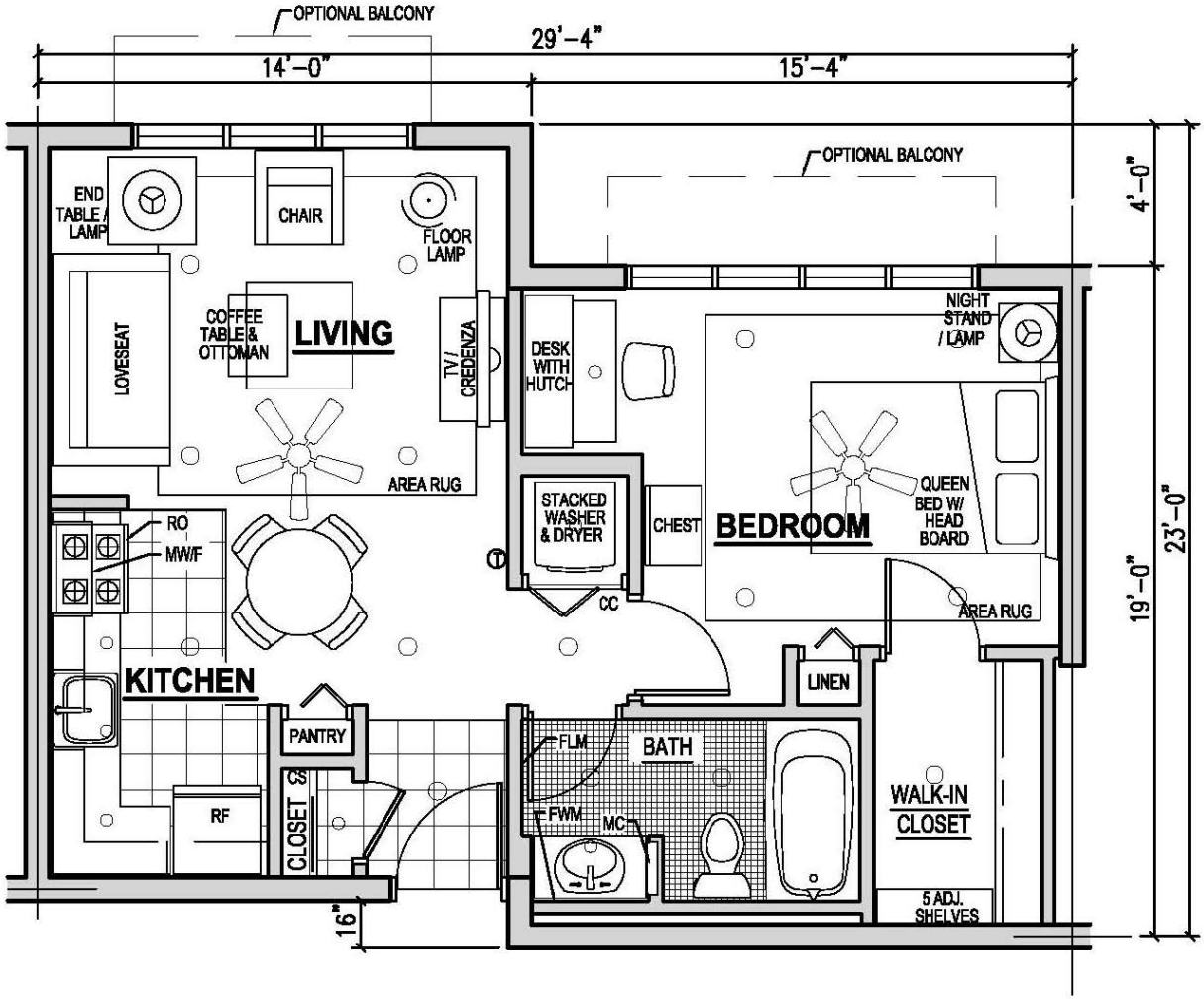


Figure B-9 Marine Corps SNCO/Officer's Room Plan



LEGEND:

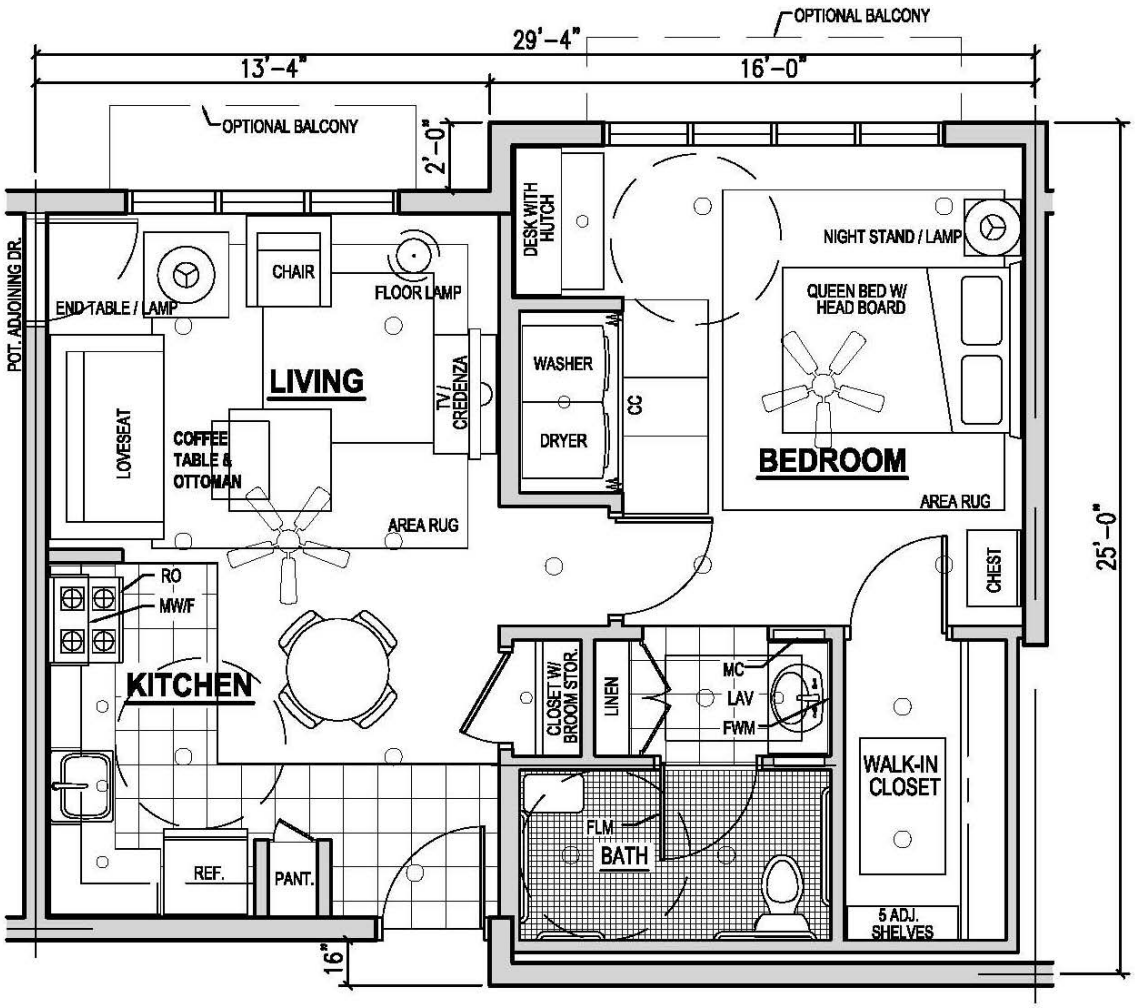
ⓣ	HVAC CONTROL	CC	CONTAINMENT CURB
FLM	FULL LENGTH MIRROR	RF	REFRIGERATOR
FWM	FULL WIDTH MIRROR	CS	CLOSET SYSTEM
MC	MEDICINE CABINET	RO	RANGE OVEN
MW/F	MICROWAVE W/ RANGE FAN		

NOTE: REFER TO UFC FOR GROSS AND NET AREAS

0 2' 4' 8'

0 500 1000 2000 mm

Figure B-10 Marine Corps SNCO/Officer's Room Plan (Accessible Example)



LEGEND:

ⓣ	HVAC CONTROL	CC	CONTAINMENT CURB
FLM	FULL LENGTH MIRROR	MW	MICROWAVE
FWM	FULL WIDTH MIRROR	RF	REFRIGERATOR
MC	MEDICINE CABINET	CS	CLOSET SYSTEM

NOTE: REFER TO UFC FOR GROSS AND NET AREAS

0 2' 4' 8'

0 500 1000 2000 mm

APPENDIX C AUSTERE UNACCOMPANIED HOUSING

C-1 PURPOSE.

The purpose of this appendix is to provide implementation guidance for austere construction established by Commander, Navy Installations Command (CNIC). These requirements were developed to address construction of support facilities only in designated operating environments.

C-2 DEFINITION AND SCOPE.

An austere facility is defined as a structure designed and constructed with minimal infrastructure, footprint/area, and finishes while still incorporating applicable building codes and facility criteria to assure adherence to all health, accessibility, and life safety standards and regulations required to fulfill the mission, including anti-terrorism force protection regulations as appropriate to each site. Construct austere facilities with the lowest total ownership costs (TOC) possible, including purchase, maintenance, and use of consistently available local goods.

C-3 APPLICABILITY.

Austere construction is intended for facilities in locations determined by CNIC and approved by OPNAV to be eligible for austere facilities construction. The austere standards are intended to be applied flexibly and in varying degrees to all facilities at locations designated as austere. The flexibility should be allowed to ensure the criteria are appropriate for individual austere locations.

C-4 MODIFICATIONS FOR AUSTERE CONSTRUCTION.

For austere design and construction, use the facility criteria in the prior Chapters of this FC with the (generally deductive) modifications included in this Appendix, as follows.

(FC) CHAPTER 3 GENERAL DESIGN CRITERIA - NAVY AND MARINE CORPS.

3-2 SITE DESIGN.

Add the following to the FC paragraphs. Apply austere decision making to assess, modify and incorporate requirements such as pedestrian circulation, vehicle parking, and lighting plans appropriately to local conditions.

3-2.3 Parking.

Delete the FC paragraphs and use the following. Apply austere decision making to assess, modify and incorporate requirements such as pedestrian circulation, bus access, service vehicle parking, and lighting plans appropriately to local conditions and to limit parking as much as possible while still meeting the facility mission. Review the security study and incorporate its requirements into the design. Ensure existing and proposed parking is in compliance with antiterrorism requirements. In austere facilities parking for residents, visitors, staff, and service personnel should be extremely minimal

and only to the mission. Maintenance parking for service functions does not necessarily require dedicated space. Use the expected frequency of maintenance vehicles to determine whether dedicated parking is needed. Locate service access and parking to avoid disturbing residents.

3-6 ARCHITECTURE.

Add the following to the paragraphs. Austere construction requires cost effective and durable materials and finishes throughout. Refer to the Table 3-3 Austere Interior Finishes.

3-6.2 Architectural Character and Scale.

Delete this FC paragraph in its entirety. Scale should be a reflection of security and local military construction requirements.

3-6.3 Residential Character for Unaccompanied Housing.

Delete this FC paragraph in its entirety.

3-6.4 Model Unit "Mockups".

Delete the FC paragraph in its entirety. Mockups are not required in austere facilities construction.

3-6.7 Hardware and Locks.

Use the FC paragraphs with the following exceptions: Electric locks are optional in austere UH. Provide locks to ANSI/BHMA standards.

3-6.7.1 Bathroom locks.

Provide the following for bathroom locks: Provide hardware and latches for Common Centralized Shower, Toweling, Dressing, and adjacent Toilet only as privacy and personal security requires.

3-6.9 Walls and Partitions.

Delete the FC paragraphs and use the following for austere construction. The ability to repair, refinish and reconfigure are important in austere construction. Design walls and partitions to meet appearance, acoustics, and durability requirements of Navy UH. Seal edges of wall assemblies to adjacent construction to avoid flanking sound paths. Consider ease of repair and refinishing when choosing wall finishes. Proprietary finishes are prohibited. Provide corner guards on walls in public areas. Austere projects use of light-frame construction with gypsum board for interior wall construction is preferred. Concrete / masonry is optional; minimize load bearing walls where appropriate.

3-7 INTERIOR DESIGN.

Delete FC Table 3-1 and Table 3-2 and use the following Table 3-3 for Austere Facilities Finishes.

Table 3-3 for Austere Interior Finishes

AREA/SPACES	FLOORS	WALLS	CEILING
Entrance weather Vestibule	Concrete, hardened and sealed	Match exterior building finish at sides, 2 sets of double doors at entry	Moisture weather resistant gypsum board, painted
Resident Corridors/Distribution	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Resident multi-occupant rooms	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Centralized Toilets and Showers	Porcelain tile, slip-resistant	Ceramic Tile over Gypsum Board to full height; Painted Gypsum Board at plumbing/wet walls	Refer to 3-7.3 of this appendix
Janitorial Areas	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Housekeeping Areas	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Utility Rooms	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Laundry, linens (optional)	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix

Table 3-3 for Austere Interior Finishes			
AREA/SPACES	FLOORS	WALLS	CEILING
Laundry, resident use (optional)	Concrete, hardened and sealed	Ceramic Tile over Gypsum Board to full height; Painted Gypsum Board at plumbing/wet walls	Refer to 3-7.3 of this appendix
Laundry Storage, clean (optional)	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Laundry Storage, soiled (optional)	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Receiving (optional)	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Reception, (optional)	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Storage, cleaning fluid (optional)	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Storage, General supply (optional)	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix
Mechanical and Electrical Utility rooms	Concrete, hardened and sealed	Gypsum Board, painted	Refer to 3-7.3 of this appendix

3-7.1 Paint.

Delete the FC paragraphs and use the following. Interior (and Exterior) surfaces requiring paint must use a minimum of one prime coat and two finish coats.

3-7.3 Ceilings.

Delete the FC paragraph and use the following. Suspended acoustical ceilings and blown-on acoustical ceiling finishes are prohibited. Ceilings are to be exposed and painted, including all exposed plumbing mechanical and electrical conduit, unless it is more cost effective to provide a hard finished (gypsum board) painted ceiling.

3-7.4.7 Wall Base Molding.

Revise the paragraph as follows. For porcelain or ceramic tiled areas, use matching or cove base trim. For all other flooring, use coved rubber molding.

3-7.5 Cabinets, Millwork, and Hardware.

Delete the FC paragraph and substitute the following: Construct cabinets to American Woodworking Institute Custom grade with heavy-duty hardware. Centralized / Group bathrooms provide solid surface vanity tops with integral bowl lavatories. Toilet / Shower partitions (if applicable) shall be solid plastic (HDPE) or Color-through Phenolic.

3-7.8 Toilet Accessories.

Delete the FC paragraph and substitute the following: Provide toilet accessories as surface mounted or recessed, of non-corrodible metal or tile. Provide toilet paper holders, soap dishes, and bathrobe hooks. Provide shower curtain rods set at proper height for conventional shower curtains.

3-7.9 Window Treatments.

Delete the FC paragraph and substitute the following: Include window treatments (shading systems) as an integral part of the construction contract. Dual fabric solar roller shade systems with manual roll chain operation are recommended. Consider solar conditions when selecting a window treatment. Dual solar shade system provides visual privacy and natural light, with black out properties available as required. Sidetracks can add durability, stability and reduce light leakage.

3-7.10 Furnishings, Fixtures and Equipment, (FF&E).

Delete the FC paragraphs and substitute the following:

FF&E procurement packages must be designed by the same design agent as the facility to ensure complete coordination. Final approval of FF&E specifications will be determined by the design team to include guidance/input received from the respective NAVFAC Interior Designers. Use of turn-key approach to FF&E procurement within

MILCON projects is directed to the greatest extent possible and practical. This will ensure a coherent FF&E package and the most practical use of funding.

Specify furnishings as minimal as possible to meet the required mission of the facility. The major prerequisites for all products are durability, flexibility and sustainability. The standard finishes must be easily maintained and non-corrosive. Special attention must be given to the geographical location and extreme weather conditions of the facility to provide the most practical solutions to endure the situation. Consider surge capabilities as required by the specific location and facility requirements.

3-11 SUSTAINABILITY.

Delete the FC paragraph and substitute the following: Do not register or certify projects designated austere. The Chief Engineer of NAVFAC has waived Third Party Certification requirements for projects designated austere (OCONUS). However, requirements for the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (HPSB) remain. Refer to UFC 1-200-02 for criteria associated with HPSB.

3-12 COMMISSIONING.

Delete the FC paragraph and substitute the following: Austere projects require fundamental commissioning or an equivalent process. At a minimum, commission the following systems: HVAC systems and controls, lighting controls, and if provided, day lighting controls, refrigeration systems and controls, renewable energy systems and domestic hot water systems. Refer to UFC 1-200-02.

3-13 PLUMBING.

Delete the FC paragraph and substitute the following: Avoid plumbing chases whenever possible by placing plumbing in wall cavities. Fixture clearances should be appropriately sized for the intended occupants and use low-flow Water Sense requirements where feasible.

- Centralized or common toilet areas are to be standard for austere housing. The International Plumbing Code (IPC) uses the term "Bathroom Group" for fixtures located together on the same floor. These bathroom groups should be centrally located at each floor within each building and designed with consideration to the local male/female resident privacy requirements. No tub-showers or bathtubs are allowed in austere construction. Provide all fixtures in accordance with the UFC 1-200-01 and IPC, for water closets and urinals, lavatories and service sinks, and individual curtained dressing/showers.
- Provide hot and cold water to laundry facilities if applicable.
- Provide easily accessible shutoff valves at all fixtures.
- Water Closets. Provide commercial quality water closets. It is recommended that areas with low water pressure use power-flush type

water closets. Use elongated, one-piece construction with a closed front seat and a lid. Provide matching water closets and bath fixtures in neutral color.

- Provide hose bibs on one exterior wall of each building and near rooftop mechanical units; frost-free as dictated by climatic conditions. Provide floor drains in all janitor closets, and laundry rooms, if applicable.
- Provide a single drinking fountain with cooler in accordance with the IPC.
- Provide a building- wide hot water system.
- Provide the following fixtures as standards: Provide single-lever and washer-less faucets at lavatories. Provide overhead rainfall type showerheads with maximum 2.2 gpm (8.3 lpm) flow rate, low-flow if applicable. Locate showerheads a minimum of 75 inches (190.5 cm) above the shower base.
- Showers are to have porcelain tile bases sloped to drains, with full height surrounds. For new construction, provide a 12 ft2 (1.11 m2) shower space with a minimum dimension of 30 inches (76.2 cm).

3-15 GENERAL SPACE REQUIREMENTS FOR UH FACILITIES.

3-15.1 Service Area.

Austere bedrooms do not have service areas. All bedrooms will use a common bath toileting area that is ideally centralized within the building and may be divided for male and female use with the inclusion of appropriate security measures.

3-15.12 Lobby, Vestibule, and Reception.

Delete the FC paragraph and substitute the following: Provide a weather vestibule with two sets of doors. Lobby and Reception areas are prohibited in austere.

Chapter 4 NAVY UNITS.

Delete the FC Chapter 4 NAVY UNITS except as follows:

4-4 The Unit.

Delete the FC paragraph and substitute the following: Each austere bedroom will be a simple open room sized 288 ft^2 (26.8 m^2) net for habitation by four persons; that is 72 ft^2 (6.7 m^2) net area per person in each room. They do not contain any service area or toilets within the rooms. UH occupants will use centralized toilet facilities.

4-4.1 Unit Details.

Delete the FC paragraph 4-4.1 The Market Unit, and substitute the following:

- Living/Sleeping Area. Bedrooms are intended for occupancy by four persons. Bedroom dimensions are not fixed but must remain functional to accommodate four twin extra-long beds; two desk units, two chairs, and four wall lockers.

- Personal closets are not included in Austere UH construction.

- Bathroom Groups (Common Centralized Shower /Toileting) - refer to Plumbing paragraph 3-13 to describe requirements for "Bathroom Groups". Common bathroom groups will consist of shower/dry toweling/dressing and adjacent toileting areas which are to be centrally located for division for male / female personnel occupancies at each floor.

- Centralized Laundry. The Austere requirement for laundry is optional. If provided, locate a single centralized laundry at the ground floor only if no other laundry facilities are within a reasonable co-location. Provide one washer and two dryers for every 20 residents, as a minimum. Stacked units are acceptable. Provide a single laundry room for easy access and provide acoustic separation from other areas. Provide 12 linear feet (3.6 m) of folding table(s), a clothes hanging area with hanging rods and 4 ft (1.25 m) of full height hanging for drip-dry clothing. Set aside a space of 24 inches x 48 inches (0.6 m x 1.2 m) for soap, bleach, fabric softener and other laundry aid vending.

Delete the FC Chapter 5 MARINE CORPS ROOM PLANS.

Delete the FC Chapter 6 OPEN BAY.

Delete the FC APPENDIX A. BEST PRACTICES.

Delete the FC APPENDIX B FIGURES.

END OF APPENDIX C.

APPENDIX D GLOSSARY

D-1 ACRONYMS

A/E	Architect/Engineer
ABA	Architectural Barriers Act
AFCEC	Air Force Civil Engineer Center
AFF	Above Finished Floor
ANSI	American National Standards Institute
ASTM	American Society of Testing and Materials
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
AT	Anti-Terrorism
BBQ	Barbecue
BCA	Business Case Analysis
BH	Base Housing
BHMA	Builders Hardware Manufacturers Association
BIA	Bilateral Infrastructure Agreement
BOQ	Bachelors Officer Quarters
CAC	Common Access Card
CCTV	Closed Circuit Television
CEE	Consortium for Energy Efficiency
c.f.	cubic feet
cfm	cubic feet per minute
cm	centimeter(s)
c.m.	cubic meter(s)
CMC	Commandant of the Marine Corps
CMU	Concrete Masonry Unit

CNIC	Commander, Navy Installations Command
CNO	Chief of Naval Operations
CO	Carbon Monoxide
DBT	Design Basis Threat
DD, DoD	Department of Defense
eMH	Enterprise Military Housing System
ESS	Electronic Security System
FAR	Federal Acquisition Regulation
FC	Facilities Criteria. Facilities Criteria FCs are part of the Unified Facilities Criteria System but meaning that it is Service specific with a designation in the number title (N) , meaning Navy or (A) Army only as examples.
FDU	Front Desk Unit
FEMP	Federal Energy Management Program
FF&E	Furnishings, Fixtures & Equipment
ft	foot/feet
ft2	square feet
gpm	gallons per minute
GSF	Gross square feet
GSM	Gross square meters
HDPE	High-density Polyethylene
HNFA	Host Nation Funded Construction Agreements
HP	Horsepower
HPSB	High Performance and Sustainable Buildings
HQMC	Headquarters, Marine Corps
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HVAC	Heating, Ventilating and Air Conditioning
IAP	Installation Appearance Plan

IDS	Intrusion Detection System
IIC	Impact Isolation Rating
in	inch(es)
IPC	International Plumbing Code
kg	kilogram
LAN	Local Area Network
lb	pound(s)
lf	linear foot
LED	Light-emitting Diode
lpm	liters per minute
LVT	Luxury Vinyl Tile
m	meter(s)
m2	square meters
mm	millimeter(s)
MCICOM GF	Marine Corps Installations Command Facility Operations and Energy Office
MCO	Marine Corps Order
MCRD	Marine Corps Recruit Depots
MDF	Medium-density fiberboard
MILSTD	Military Standards/Handbook
MOS	Military Occupational Specialty
MPI	Master Painters Institute
NAVFAC	Naval Facilities Engineering Systems Command
NETC	Naval Education and Training Command
NFPA	National Fire Protection Association
NGIS	Navy Gateway Inns and Suites

NMT	Navy Military Training
NSF	Net square feet
NSM	Net square meters
OCONUS	Outside Continental United States
OPNAV	Office of the Chief of Naval Operations
OPNAVINST	Office of the Chief of Naval Operations Instruction
OSD	Office of the Secretary of Defense
PCE	Parametric Cost Estimating
PPV	Privatized Assets
PVC	Polyvinyl Chloride
QOL	Quality of Life
R-19	Navy’s UH Requirements Determination Report
RFID	Radio Frequency Identification
RM	Restoration and Modernization
ROICC	Resident Officer in Charge of Construction
RT	Rubber Tile
SAT	Suspended Acoustical Tile
sf	square feet
sm	square meter(s)
SNCO	Staff Noncommissioned Officer
SOFA	Status of Forces Agreements
SOI	School of Infantry
SRM	Sustainment, Restoration and Modernization
STC	Sound Transmission Class
TEMDUFURAS	Temporary Duty for Further Assignment
TOC	Total Ownership Costs

TV	Television
TVSS	Televised Surveillance System
UDP	Unit Deployment Program
UFC	Unified Facilities Criteria
UH	Unaccompanied Housing
U.S.	United States

D-2 DEFINITION OF TERMS

2+0 Type Designs: Unaccompanied Housing suitable for assignment of two E1-E3 Sailors or one E4 Sailor. 2+0/2+0 Type Designs generally consist of a Unit providing a room of at least 180 net square feet and an in-room bath.

Formal Training/Schools: United States Marine Corps Training and Education Command (TECOM)-Sponsored Professional Military Education (PME) schools (such as the Sergeants course and Advanced Senior Non-Commissioned Officers (SNCO) Academy) or a formal MOS-producing school (similar to Navy A Schools). Formal Training/Schools do not include basic training which includes recruit basic training at Marine Corps Recruit Depots (MCRD), School of Infantry (SOI)/Marine Combat Training (MCT), or local training courses such as the Corporal's course, Vehicle Operator Training Course, and others).

Mission Essential: Housing for rotational/mobilized Sailors outside their homeport and crewmembers of uninhabitable ships/submarines outside their normal homeport.

Military Necessity: Housing supporting Individual's Accounts Personnel, individual augmentees, Sailors assigned to Transient Personnel Units while awaiting ship's movement or separation from the Navy, Sailors executing temporary duty for further assignment (TEMDUFURAS) orders, awaiting Medical boards, executing limited duty orders, or Sailors directed by the Command to temporarily reside in UH because of restricted duty, military protective orders, or cool down. Personnel are considered "must house" on the installation.

Motel/Tower Design: Unaccompanied Housing which generally consists of a ‘module’ including six bedrooms sized to house three Sailors each that share a central head, shower and laundry room and lounge.

Officer Accessions: Any of several programs that provide personnel to assume positions as commissioned officers.

Permanent Party: Active duty and Reserve Component military personnel who are assigned to or are attached to an installation in a PCS Status. Also includes trainees or students who are attending a training course for 20 weeks or longer.

Recruits: Personnel undergoing basic military training who have no continuous prior enlisted service (active or reserve).

Remote Locations: Installations without community housing support (such as NAVSUPPFAC Diego Garcia, NAVSTA Guantanamo Bay, the California Off-Shore Islands of Santa Cruz, San Clemente and San Nicolas, and others) or with only limited community housing support (such as AUTEC Andros Island and others).

Rotational/Mobilized Sailors: Sailors attached to units that are "Sea Duty for rotational purposes" (such as air squadrons, mobile training units and Seabees) on orders as a unit to duty outside their homeport, individuals on orders to a combat zone or crewmembers of uninhabitable ships/submarines outside their normal homeport.

Training Necessity: Training programs including officer accessions (such as OTC) and enlisted initial skills training (such as "A" schools and accessions pipeline schools) where student housing is part of the training mission and separate from other UH, and students are considered 'must house' on the installation.

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APPENDIX E REFERENCES

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

https://www.ansi.org/

ANSI/BHMA A156:

A156.1 Butts and Hinges;

A156.2 Bored and Preassembled Locks and Latches;

A156.3 Exit Devices;

A156.4 Door Controls - Closers;

A156.6 Architectural Door Trim;

A156.13 Mortise Locks and Latches (1000 series);

A156.23 Electromagnetic Locks;

A156.25 Electrified Locking Devices;

A156.29 Exit Locks and Alarms.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

https://www.astm.org/

ASTM E336, *Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings*

ASTM E492, *Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine*

AMERICAN SOCIETY OF HEATING REFRIGERATING AND AIR-CONDITIONING ENGINEERS

https://www.ashrae.org

ASHRAE 62.1, *Ventilation for Acceptable Indoor Air Quality*

ASHRAE 62.2, *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings*

ASHRAE 90.1, *Energy Standards for Buildings*

COMPOSITE PANEL ASSOCIATION

https://www.compositepanel.org/

CPA/ANSI A208.2, *Medium Density Fiberboard (MDF) for Interior Applications*

DEPARTMENT OF DEFENSE

Architectural Barriers Act

https://www.access-board.gov/aba/

DOD 4165.63-M, *DOD Housing Management Manual.*

HARDWOOD PLYWOOD AND VENEER ASSOCIATION

https://www.hpva.org/

ANSI/HPVA HP-1, *American National Standard for Hardwood and Decorative Plywood*

LAWRENCE BERKLEY NATIONAL LABORATORY

https://www.lbl.gov

Tips for Daylighting with Windows, prepared by the Building Technologies Program, Lawrence Berkley National Laboratory, Copyright 1997 The regents of the University of California,

MARINE CORPS AND NAVY

MILSTD 3007, *Unified Facilities Criteria, Facilities Criteria and Unified Facility Guide Specifications*

MARINE CORPS AND NAVY

CNIC M-11103.2, *Unaccompanied Housing Operations Manual*

MCO 5530.14A, *Marine Corps Physical Security Program Manual,*
https://www.marines.mil/News/Publications/MCPEL/

MCO 11000.22, *Marine Corps Bachelor and Family Housing Management,*
https://www.marines.mil/News/Publications/MCPEL/

OPNAVINST 5100.23H, *Navy Safety and Occupational Health Manual*
https://www.secnav.navy.mil/doni/SECNAV%20Manuals1/Forms/AllItems.aspx

OPNAVINST 11010.20, *Navy Facilities Projects.*
https://www.secnav.navy.mil/doni/opnav.aspx

NATIONAL FIRE PROTECTION ASSOCIATION

https://www.nfpa.org

NFPA 101, *Life Safety Code*

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 1-200-01, *DoD Building Code*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

UFC 2-000-05N*, Facility Planning Criteria for Navy/Marine Corps Shore Installations*

UFC 2-100-01*, Installation Master Planning*

UFC 3-201-01*, Civil Engineering*

UFC 3-201-02*, Landscape Architecture*

UFC 3-401-01*, Mechanical Engineering*

UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*

UFC 3-420-01, *Plumbing Systems*

UFC 3-490-06, *Elevators*

UFC 3-580-01, *Telecommunications Interior Infrastructure Planning and Design*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 4-010-01*, DoD Minimum Antiterrorism Standards for Buildings*

UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems*

UFC 4-020-01*, DoD Security Engineering Facilities Planning Manual*

UFC 4-722-01
20 March 2023

UNIFIED FACILITIES CRITERIA (UFC)

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND

AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes FC 4-722-01F, *Air Force Dining Facilities*, 2 July 2007; FC 4-722-01N, *Navy and Marine Corps Dining Facilities*, 1 December 2013; and *Army Standard for Permanent Party Enlisted Personnel Dining Facilities*, 15 February 2012.

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FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States, its territories, and possessions is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Military Department's responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Technical content of UFC is the responsibility of the cognizant DoD working group. Defense Agencies should contact the respective DoD Working Group for document interpretation and improvements. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide website https://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

In July 2007, the most recent version of UFC 4-722-01 was published. Later, each Service developed its own Facilities Criteria (FC) or standards. The following list summarizes the various Services' responses:

- Air Force: FC 4-722-01F, *Air Force Dining Facilities*
- Army: *Army Standard for Permanent Party Enlisted Personnel Dining Facilities*
- Navy/Marine Corps: FC 4-722-01N, *Navy and Marine Corps Dining Facilities*
- Space Force: The Space Force has not developed any criteria or standards related to dining facilities. The Space Force follows Air Force criteria.

1-2 INCORPORATES AND CANCELS.

This UFC incorporates and cancels FC 4-722-01F, *Air Force Dining Facilities*, FC 4-722-01N, *Navy and Marine Corps Dining Facilities*, and *Army Standard for Permanent Party Enlisted Personnel Dining Facilities*.

1-3 PURPOSE AND SCOPE.

This UFC presents the design and construction criteria for all DoD enlisted dining facilities both outside and inside the continental United States. Its purpose is to provide general and specific design guidance. Special attention is focused on planning and budgeting, energy conservation, state-of-the-art food service equipment, and design for durability. Emphasis is placed on the design of functional and pleasant food service facilities that attract and retain Service personnel.

1-4 APPLICABILITY.

This UFC applies to all military Service elements and contractors involved in the planning, design, and construction of DoD dining facilities. Programmatic differences for a specific Service are indicated throughout this UFC. They may be optional or not required by other Services. Comply with the agency requirements that apply to the project.

1-5 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and unique government criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-6 AUSTERE DINING FACILITIES.

Chapter 4 contains requirements for dining facilities designated as “austere.” Austere construction is intended for facilities in locations determined by Commander, Navy Installations Command (CNIC) and approved by the Office of the Chief of Naval Operations (OPNAV) to be eligible for austere construction. The austere standards are intended to be flexibly applied and in varying degrees to all facilities at locations designated as austere. Flexibility is allowed to ensure the criteria are appropriate for individual austere locations. The Air Force and Space Force reserve the right to apply requirements under Chapter 4 as applicable and approved by the Air Force/Space Force Services Center (AFSVC).

1-7 SERVICE RESPONSIBILITIES.

1-7.1 Air Force/Space Force.

There are three participants in the development of Air Force/Space Force facility design. First, the local installation civil engineer identifies the need for a new, modernized, or enlarged dining facility and initiates the project development process. Second, an Air Force/Space Force project manager is designated to manage design and construction. Third, the AFSVC sets the standards for all Air Force food service operations and determines the facilities and equipment required to perform the operations.

Direct questions regarding Air Force projects to AFCEC/CFTP and AFSVC/SVXF.

1-7.2 Army.

Army activities and designers using this UFC are advised that there are three participants in the development of facility design. First, there is the local command that identifies the need for a new, modernized, or enlarged dining facility and initiates the project development process. Second, there is the Army Corps of Engineers, Center of Standardization for Army dining facilities, which is responsible for standards and reviewing all Army facility designs. Third, the Army Center of Excellence, Subsistence sets the standard for all Army food service operations and determines the facilities and equipment required to perform the operations. The Army Center of Excellence, Subsistence is the agent of the Army Chief of Staff for Installation Management (ACSIM) Installation Management Agency (IMA).

Direct questions regarding Army projects to CEW-EV, HQ USACE.

1-7.3 Navy.

There are four participants in the development of Navy facility design. First, the local installation and facility manager identifies the need for a new, modernized, or enlarged dining facility and initiates the project development process. Second, the Naval Facilities Engineering Systems Command sets the standards for developing the criteria and establishing the facility space requirements. Third, the Naval Supply Systems Command sets the standard food service operations, in conjunction with the TYCOM, (i.e., CNIC). Fourth, the management of the design and construction of Navy facilities is

a joint effort of the Naval Facilities Engineering Systems Command and the cognizant Navy Region.

Direct design questions regarding Navy projects to the following contacts:

- Office of the Chief Engineer, Naval Facilities Engineering Systems Command, or to the Commander, Naval Facilities Engineering Systems Command Atlantic, or visit the NAVFAC website at https://www.navfac.navy.mil
- Commander, Navy Installations Command, Fleet and Family Readiness (N92), Galley Program Manager

1-7.4 Marine Corps.

Headquarters Marine Corps, Logistics Food Service (Code LFS-4) manages policies, sets standards, and directs all food service operations within the Marine Corps. The design project manager is responsible for approving design and construction. Each new dining facility will have a technical representative assigned by the activity Food Service Office to coordinate needs and requirements between Code LFS-4, the cognizant Naval Facilities Engineering Systems Command component, and other activities as needed.

Direct questions regarding Marine Corps projects to the Criteria Specialist for Dining Facilities, Naval Facilities Engineering Systems Command, Facilities Criteria Office. Marine Corps requests will be forwarded by NAVFAC to Headquarters, U.S. Marine Corps, Facilities and Services Division (Code LF).

1-8 COORDINATION.

Prior to project development, coordinate the design team composition and facility requirements with the Service contacts provided in paragraph 1-7.

1-8.1 Design Professionals.

Include a food service consultant in the design team of record. The food service consultant is qualified as a member of Foodservice Consultants Society International (FCSI) or equivalent. The consultant’s involvement will include, but not be limited to, developing specifications and schedules for all kitchen equipment, including utility connection sizes and capacities for all applicable items, location of floor sinks and floor drains, and kitchen hoods. Coordinate with the Installation Food Service Team.

1-9 SCOPE OF FACILITY.

Dining facility functional design is driven by the number of personnel to be served, meal schedule and duration, payment style, food delivery and eating methodologies, and any additional functions accommodated in the specific facility. These functions and how they drive the design of the facility are described in paragraph 2-2.

1-10 CYBERSECURITY.

All facility-related control systems (including systems separate from a utility monitoring and control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems*, and as required by individual Service implementation policies.

1-11 GLOSSARY.

Appendix B contains acronyms, abbreviations, and definitions.

1-12 REFERENCES.

Appendix C contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

CHAPTER 2 PLANNING AND LAYOUT

2-1 GENERAL.

Involve the installation's food service manager and food service officer (FSO) in the planning process to ensure new and renovated facilities meet the needs of the installation functional operators. This document includes space calculation tabulations for dining facilities serving up to 2,200 personnel. If facilities are required to feed more than 2,200 personnel, it is recommended to consider extending feeding hours or adding serving lines to accommodate additional personnel in lieu of constructing a substantially larger building.

2-2 FOOD SERVICE PLANNING DETERMINATIONS.

Planning the size and layout of dining facilities depends upon the following determinations.

2-2.1 Number of Personnel to be Served.

The number of personnel to be served drives the overall size of the facility. Refer to paragraph 2-3 for functional spaces, paragraph 2-4 for size of facilities, and paragraph 2-5 for space programs.

2-2.2 Meal Schedule and Duration.

The meal schedule and duration affect both the size and layout of the facility. The meal schedule may vary by Service, region, and installation. Determine meal schedule and duration as part of the planning process.

2-2.3 Payment.

The payment style affects the layout of the facility.

2-2.3.1 Cafeteria Style.

Patrons pay a set meal price upfront at a check-in station and choose from predetermined options.

2-2.3.2 À La Carte.

Patrons pick up individual menu items and pay only for the items selected at a check-out station at the serving area exit. Additionally, new innovations have established on-line ordering, "ghost kitchen," and meal pickup stations/areas within cafeteria-style operations. The Air Force/Space Force use food lockers for advance orders, as well as flight and ground meal pickup.

2-2.4 Food Delivery and Eating Methodologies.

Food delivery and eating methodologies affect the size and layout of the facility. Dining facilities may accommodate more than one of the following methodologies:

2-2.4.1 Serving Line or Station.

Patrons choose from predetermined options from serving lines or stations, such as hot bar line, salad bar, deli bar, pizza bar, taco bar. Food may be packaged for consumption in the facility or for takeout. Payment can be either cafeteria style or à la carte.

2-2.4.2 Short Order.

Patrons order items for custom preparation. Food may be packaged for consumption in the facility or for takeout. Payment can be either cafeteria style or à la carte.

2-2.4.3 Takeout/Meal Replacement.

Patrons choose from assorted prewrapped and prepackaged items that may range from hamburgers and pizza to full meals. Payment is typically à la carte.

2-2.5 Menu.

Determine menu options, nutritional guidelines, and the required variety prior to design and coordinate with the food delivery and eating methodologies. These will be used to determine the needed preparation, serving and storage area sizes, and equipment.

Menus, consumer information, menu boards containing prices and specials, and greeter boards are used within the serving line and dining area space to connect customers to what is offered on the menu. These information systems interact with back office and web-based platforms, typically automatically updated via operational day parts. As a general rule, the larger the space, the larger the menu display systems and independent menus at each station or serving area.

2-2.6 Staffing.

Determine staffing requirements prior to design and use to size the administrative areas, staff lockers, and toilets.

2-2.7 Bussing.

Patron self-bussing is required. Design the facilities to accommodate this mode of bussing, which affects the facility layout. Ideally, automating the patron side of a dining area allows for seamless dishware removal from the dining area into the dish room through automated belts, carousels, or similar systems. Patrons break down their dishware and recyclable items and then place them into automated systems to move dishware into the remote dish room. If used, bussing carts in dining areas should be appropriately sized and screened from the view of the dining area.

2-2.8 Other Facility Functions.

The dining facility may accommodate one or more of the following additional functions.

2-2.8.1 Field Feeding/Vat Chow.

The dining facility prepares group meals for field consumption. This function includes storing field preparation and serving equipment.

2-2.8.2 Flight Kitchens and Box/Bag Meals.

The dining facility prepares individual meals for field consumption. This function requires either storing individual meal packaging or storing commercially prepared individually packaged meals.

2-2.8.3 Satellite Kiosk Locations.

The Air Force/Space Force utilize a series of retail kiosks located adjacent to mission areas, allowing customers to briefly step away from the mission area. These kiosks rarely produce food items onsite, but finish, reheat, and utilize final-finish-in-front-of-the-customer technology. The bulk of all food and beverage items are produced in the primary business and industry cafeteria and then transferred in bulk to the remote kiosk locations. There is limited storage and access in these satellite operations due to their proximity to controlled mission areas.

2-2.8.4 Recreation Chow.

The dining facility prepares special event group meals for consumption outside the facility.

2-2.9 Mass Care Feeding Facility.

Dining facilities may be designated as mass care feeding facilities if mission, region, and installation requirements dictate. A mass care feeding facility is designed to remain operational after an emergency incident when other dining opportunities will not be available. This will significantly affect the project budget and requires classifying the building to meet a higher occupancy category per UFC 3-301-01, *Structural Engineering.* See paragraph 3-4 for more information. Also see paragraph 3-6.4 for emergency back-up power requirements. Coordinate with the installation antiterrorism (AT) plan or emergency management plan.

2-3 FUNCTIONAL SPACES.

The food service planning determinations along with site conditions and other basic building design, operation, and installation determinations establish the size, layout, and design of the facility functional spaces.

2-3.1 Entrance Lobby.

The entrance lobby is the main entrance to the facility and the size is determined by the number of personnel to be served. Provide a canopy or enclosure for patrons who arrive in advance of the opening of the facility or where the line of patrons is anticipated to extend outside the facility. In extreme-weather locations, this function can be accomplished in the form of a vestibule. Provide a bracket to accommodate hand sanitizer placement. Provide a shoe and boot brush cleaner outside the facility entrance.

2-3.2 Queue.

The queue is the space between the entrance lobby and serving area and is determined by the serving capacity, serving methodology, and payment style. Provide storage cubicles and/or coat/hat racks in this area to allow patrons to properly store personal gear. Provide hand sanitation areas/stations for patron use. For Air Force/Space Force, provide greeter information and digital menu display system informing patrons on what is available for à la carte service.

2-3.3 Serving Area.

The serving area accommodates ordering and delivery of food to patrons and is determined by the food delivery methodology and payment style. The design of the serving area impacts the serving capacity. Coordinate serving area design with the queue and dining area. For Air Force/Space Force, add within the dining area designated retail grab & go kiosk areas, ideally incorporated adjacent to dedicated point-of sale (POS) systems and may include retail self-checkout.

2-3.4 Cashier Station.

The cashier station accommodates patron payment. The configuration, location, and number of stations are determined by the number of personnel served, food delivery methodology, and payment style. Accommodate a variety of payment options such as cash, credit, debit cards, and Essential Station Messing (ESM) meal card customers. Provide electrical and data drops to allow for network connectivity, electronic menu board capabilities, and other POS accountability requirements.

Provide CAT6 cable runs between the main comms closet and back-office administrative area. This is required for POS, digital menu boards, and back-office computer systems interfacing with POS and credit card charge-processing systems. Include all in overall comms and data plan requirements.

See Figure A-9 for a schematic plan of the cashier station.

2-3.5 Dining Area.

The dining area accommodates patron eating and relaxation. It is determined by the number of personnel to be served and meal schedule and duration as expressed by

turnover/serving capacity and seating capacity. Coordinate the design with the food delivery methodology and bussing approach.

Air Force/Space Force dining areas contain Wi-Fi access. This is combined into the overall base communication plan for consumer education programs such as Go For Green (G4G), Healthy Food Initiatives, My Fitness Pal, and patron access to hosted online menus and online ordering.

2-3.5.1 Turnover/Serving Capacity.

Turnover is the number of times a dining area seat is occupied during a given period. Turnover drives the serving capacity, which is the number of patrons served within the set meal duration. The serving capacity is used to size the functional elements of the dining facility to ensure the required number of patrons can be served in the meal duration. Determine the serving capacity prior to design.

2-3.5.2 Seating Capacity.

Seating capacity is determined by considering the required serving capacity and the serving methodology. The seating capacity is used to size the dining area of the facility.

2-3.6 Public Toilets.

The public toilets are determined by the number of personnel to be served.

2-3.7 Dish/Pot Washing.

The dish- and pot-washing areas are determined by the number of personnel to be served, bussing considerations, food delivery methodology, and menu. Refer to Figures A-10 through A-13 for schematic dishwashing plans.

2-3.8 Kitchen and Preparation Areas.

The kitchen and all food preparation areas are determined by the number of personnel to be served, food delivery methodology, menu, bussing style, and storage capacity.

2-3.9 Storage.

Storage areas accommodate stocks of subsistence (consumables) and non-subsistence (e.g., tableware, cleaning supplies). The areas are determined by menu analysis, number of personnel to be served, and defined delivery cycles. Separate general storage from food storage areas.

2-3.10 Loading Dock.

The loading dock accommodates material transfer in and out of the facility. Coordinate loading docks with storage requirements. Separate pathways to/from the loading dock for food delivery and trash removal. For Navy and Marine Corps facilities, provide a fall protection system in accordance with OPNAV M-5100.23, *Navy Safety and*

Occupational Health Manual, where the elevation between the floor edge of the dock and adjacent surface is 4 ft (1.2 m) or greater.

2-3.11 Support Areas.

Support areas accommodate staff needs such as offices, training, cashier's office, other administrative tasks, toilets, lockers, and janitor closets. The areas are determined by the mission and staffing requirements. The cashier's office is used for counting money, contains the cashier's safe, and includes a lock on the exterior door.

2-3.12 Other Functions.

These spaces will be determined by the required specific facility functions as described in paragraph 2-2.

2-3.13 Building Services Areas.

These spaces accommodate building services such as mechanical, electrical, and communications.

2-3.14 Garbage Removal.

Determine garbage removal and recycling systems prior to design. Visually shield garbage removal/recycling systems from patron entrances and parking areas.

2-4 SIZE OF FACILITIES.

2-4.1 Air Force/Space Force.

The gross allowable area is defined by DAFMAN 32-1084, *Standard Facility Requirements*. Additionally, AFSVC/SVXF assists in determining requirements for unique Air Force/Space Force mission sets and standard à la carte designs.

2-4.2 Army.

See Table 2-1 for gross area of facilities.

Table 2-1 Permanent Party Enlisted Personnel Dining Facilities Army Standard

ITEM	MANDATORY CRITERIA	
Gross Area of Facilities	**GSF (Gross Square Feet) Deviation:** Facility constructed gross area shall not exceed 105% of space allocation set forth in this document to accommodate site, construction, or environmental factors.	
	Dining Facility: Includes dining, kitchen, storage, attached canopies and loading dock in GSF limits listed below.	
	Small (400–660 PN)	17,500 GSF
	With Field Feeding	17,750 GSF
	With Carry-Out	18,640 GSF
	With Field Feeding & Carry Out	18,890 GSF
	Medium (661–1056 PN)	18,900 GSF
	With Field Feeding	19,150 GSF
	With Carry-Out	20,040 GSF
	With Field Feeding & Carry Out	20,290 GSF
	Large (1057–1716 PN)	26,600 GSF
	With Field Feeding	26,970 GSF
	With Carry-Out	27,740 GSF
	With Field Feeding & Carry Out	28,100 GSF

2-4.3 Navy and Marine Corps.

Determine the number of personnel to be served by multiplying the projected maximum unaccompanied housing occupancy by the utilization factors in Table 2-2. Include the average on-board count of ships entitled to subsistence-in-kind while shipboard facilities are out of service in the projected occupancy. Do not include personnel on separate rations in the projected occupancy.

Table 2-2 Personnel to be Served by Mission

Mission	Utilization Factor
Training	
Basic and/or recruit training	95%
Service schools	85%
Permanent Party	
Remote locations*	90%
Naval stations	70%
Construction battalions	70%
Shipyards	70%
Weapon stations	70%
Personnel transfer and overseas processing centers	50%
Brig	100%

* Defined as a location with minimal available other feeding sources, on or off installation.

Note: Only include officers and civilians in the projected occupancy in overseas or remote locations where support is authorized.

The projected occupancy multiplied by the utilization factor equals the personnel served. The number of personnel served is used to establish the eight facility size classifications for dining facilities. See paragraph 2-2 for facility areas by size classification. Additional space planning criteria can be found in FC 2-000-05N, *Facility Planning Criteria for Navy and Marine Corps Shore Installations*, category code 722.

2-5 SPACE PROGRAMS.

2-5.1 Air Force/Space Force.

The Air Force provides design guidelines for its facilities. Refer to paragraph 2-4.1.

2-5.2 Army.

The Army provides design guidelines for its facilities. Refer to paragraph 2-4.2 and the *Army Standard for Permanent Party Enlisted Personnel Dining Facilities*.

2-5.3 Navy and Marine Corps.

Tables 2-4 and 2-5 identify functional areas in Navy and Marine Corps dining facilities and provide a target space allotment for each functional area. The space requirements are minimums to be provided for the range of personnel to be served. These targets have been provided to serve as a guide to the planner and designer considering the noted assumptions and are not restrictive. Actual gross allowable area for each project will be defined in DD Form 1391, *FY__ Military Construction Project Data*.

2-5.3.1 Space Program Assumptions.

The functional areas and associated space allotments identified in Tables 2-4 and 2-5 reflect the assumptions below. Adjust project areas and space allotments to align with the project-specific parameters.

- Preparation method is conventional cook-serve.
- Mission is basic or recruit training.
- Seating is based on 15 ft^2 (1.4 m^2) per seat.
- Lobby queuing and circulation space is minimized.
- One serving line is needed for every 200 seats, with a minimum of two lines.
- Multiple station/serving areas versus cafeteria lines are recommended for dining facilities serving more than 100 personnel.
- Serving stations will include ventless grills, turbo ovens, and other quick-cook ventless equipment for made-to-order items.
- Baking operations reflect primarily scratch baking methods with capability to bake-off pre-prepared dough or other items.
- Three meals per day are served seven days per week.
- Warm/chill storage stations will be provided for pre-order customer pick-up.
- Dishwashing space reflects a rack dish machine.
- Bussing method is self-bus to remote dish room.
- No provisions for catering are allocated other than field feeding/vat chow.
- Beverages are available at a free-standing self-serve counter.
- Staff toilets do not include showers.
- Staff changing rooms will have personal storage lockers for 100 percent of staff.

2-5.3.2 Storage.

2-5.3.2.1 Storage area requirements typically range from 10 to 25 percent of the facility net area (public, preparation, serving, and support areas) and include dry foods, refrigerated and frozen foods, consumables, and non-food goods. Factors that influence the storage requirements are the method of preparation and the inventory period.

- Scratch preparation has different fresh, dry, and refrigerated storage requirements from frozen convenience and pre-prepared preparation. Determine the mix of preparation methods to correctly size and design the storage areas.
- Inventory period is the time between deliveries. It will be influenced by the facility location (CONUS vs. OCONUS and rural/remote vs. urban areas), facility mission, and the vendor location and delivery contract terms. The longer the inventory period, the larger the storage requirements. On CONUS projects, provide storage space based on an inventory period of 7 to 10 days.
- Under normal CONUS conditions, the distribution of storage space type is 50 percent dry, 30 percent frozen, and 20 percent chill.

2-5.3.2.2 See Table 2-3 for a breakdown of these factors and how they impact the storage requirements.

Table 2-3 Estimated Storage Requirements

Inventory Period Factors	Food Preparation Factors	
	Frozen/Chill	Scratch
Often (urban)	10–15% of net area	15–20% of net area
Infrequent (rural/remote)	15–20% of net area	20–25% of net area

2-5.3.3 Net-to-Gross Multiplier.

The net-to-gross multiplier accounts for mechanical and other utility space, wall thicknesses, and other construction requirements. It typically ranges from 15 to 25 percent of all net areas for dining facilities and is influenced by the mechanical system, the number of floors, and the overall layout and design of the building. Carefully consider the net-to-gross multiplier in the planning and design process as extreme anomalies can occur. Some OCONUS projects have resulted in net-to-gross multipliers as high as 50 percent.

Table 2-4 Navy and Marine Corps Space Program (1–400 Personnel)

		Facility Size Classifications							
		1-80 Personnel Served		81-150 Personnel Served		151-250 Personnel Served		251-400 Personnel Served	
		62 Min. Seats		108 Min. Seats		116 Min. Seats		172 Min. Seats	
		1.3 Min. Turnover		1.4 Min. Turnover		2.2 Min. Turnover		2.3 Min. Turnover	
Functional Components		**ft^2**	**m^2**	**ft^2**	**m^2**	**ft^2**	**m^2**	**ft^2**	**m^2**
Public Areas	Dining Area and Circulation	935	86.9	1630	151.4	1875	174.2	3000	278.7
	Public Toilets	180	16.7	200	18.6	220	20.4	250	23.2
	Queue	130	12.1	250	23.2	325	30.2	500	46.5
	Sign-in Station	40	3.7	40	3.7	40	3.7	60	5.6
	Subtotal	**1285**	**119.4**	**2120**	**196.9**	**2460**	**228.5**	**3810**	**354.0**
Serving Areas	Regular Food Line	250	23.2	320	29.7	0.0	0.0	0.0	0.0
	Fast Food Line	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Combination Food Line	0.0	0.0	0.0	0.0	420	39.0	620	57.6
	Beverage Line/Salad Bar	200	18.6	250	23.2	350	32.5	500	46.5
	Cashier Station	30	2.8	30	2.8	50	4.6	50	4.6
	Dish Washing	180	16.7	250	23.2	320	29.7	380	35.3
	Subtotal	**660**	**61.3**	**850**	**78.9**	**1140**	**105.8**	**1550**	**144.0**
Preparation Areas	Kitchen	650	60.4	800	74.3	600	55.7	845	78.5
	Vegetable Preparation	0.0	0.0	0.0	0.0	220	20.4	255	23.7
	Meat Preparation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Bakery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Utensil Wash	0.0	0.0	0.0	0.0	175	16.3	220	20.4
	Subtotal	**650**	**60.4**	**800**	**74.3**	**995**	**92.4**	**1320**	**122.6**
Support Areas	Offices	230	21.4	310	28.8	400	37.2	580	53.9
	Staff Toilets	260	24.2	260	24.2	260	24.2	260	24.2
	Staff Lockers	0.0	0.0	0.0	0.0	120	11.1	160	14.9
	Janitor's Closet	25	2.3	25	2.3	25	2.3	50	4.6
	Can Wash	40	3.7	40	3.7	40	3.7	40	3.7
	Loading Dock	200	18.6	200	18.6	200	18.6	230	21.4
	Subtotal	**755**	**70.2**	**835**	**77.6**	**1045**	**97.1**	**1320**	**122.7**
FACILITY SUBTOTAL		**3,350**	**311.3**	**4,605**	**427.7**	**5,640**	**523.8**	**8,000**	**743.3**
Storage ranges from 10 to 25% of Facility Subtotal									
Net-to-Gross ranges from 15 to 25% of Facility Subtotal									
Flight Kitchen*		**100**	**9.3**	**100**	**9.3**	**100**	**9.3**	**100**	**9.3**
FACILITY TOTAL		To be determined based on storage and net-to-gross		To be determined based on storage and net-to-gross		To be determined based on storage and net-to-gross		To be determined based on storage and net-to-gross	

* Not all locations will require a flight kitchen. A flight kitchen is a staging area where food products are assembled and packaged for delivery to aircraft. This applies to all stations that require pick-up/delivery options, not just air stations.

Table 2-5 Navy and Marine Corps Space Program (401–2200 Personnel)

Functional Components		Facility Size Classifications							
		401-650 Personnel Served		651-1000 Personnel Served		1001-1500 Personnel Served		1501-2200** Personnel Served	
		288 Min. Seats		345 Min. Seats		460 Min. Seats		575 Min. Seats	
		2.3 Min. Turnover		2.9 Min. Turnover		3.3 Min. Turnover		3.8 Min. Turnover	
		ft^2	m^2	ft^2	m^2	ft^2	m^2	ft^2	m^2
Public Areas	Dining Area and Circulation	4700	436.6	6320	587.1	7565	702.8	11000	1021.9
	Public Toilets	300	27.9	320	29.7	340	31.6	370	34.4
	Queue	750	69.7	1000	92.9	1100	102.2	1650	153.3
	Sign-in Station	80	7.4	100	9.3	120	11.1	120	11.1
	Subtotal	**5830**	**541.6**	**7740**	**719.0**	**9125**	**847.7**	**13140**	**1220.7**
Serving Areas	Regular Food Line	600	55.7	650	60.4	1050	97.5	1300	120.8
	Fast Food Line	600	55.7	650	60.4	650	60.4	650	60.4
	Combination Food Line	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Beverage Line/Salad Bar	650	60.4	700	65.0	810	75.2	1056	98.1
	Cashier Station	100	9.3	150	13.9	200	18.6	250	23.2
	Dish Washing	450	41.8	600	55.7	730	67.8	1032	95.9
	Subtotal	**2400**	**222.9**	**2750**	**255.4**	**3440**	**319.5**	**4288**	**398.4**
Preparation Areas	Kitchen	1000	92.9	1100	102.2	1285	119.4	1600	148.6
	Vegetable Preparation	300	27.9	350	32.5	360	33.4	600	55.7
	Meat Preparation	0.0	0.0	240	22.3	300	27.9	500	46.5
	Bakery	0.0	0.0	690	64.1	825	76.6	1035	96.2
	Utensil Wash	330	30.7	400	37.2	500	46.5	600	55.7
	Subtotal	**1630**	**151.5**	**2780**	**258.3**	**3270**	**303.8**	**4335**	**402.7**
Support Areas	Offices	700	65.0	700	65.0	700	65.0	900	83.6
	Staff Toilets	360	33.4	430	39.9	450	41.8	500	46.5
	Staff Lockers	260	24.2	380	35.3	380	35.3	480	44.6
	Janitor's Closet	50	4.6	75	7.0	75	7.0	100	9.3
	Can Wash	40	3.7	60	5.6	60	5.6	60	5.6
	Loading Dock	300	27.9	300	27.9	400	37.2	400	37.2
	Subtotal	**1710**	**158.8**	**1945**	**180.7**	**2065**	**191.9**	**2440**	**226.8**
FACILITY SUBTOTAL		**11,570**	**1,074.8**	**15,215**	**1,413.4**	**17,900**	**1,662.9**	**24,203**	**2,248.6**
Storage ranges from 10 to 25% of Facility Subtotal									
Net-to-Gross ranges from 15 to 25% of Facility Subtotal									
Flight Kitchen*		**125**	**11.6**	**125**	**11.6**	**150**	**13.9**	**150**	**13.9**
FACILITY TOTAL		To be determined based on storage and net-to-gross		To be determined based on storage and net-to-gross		To be determined based on storage and net-to-gross		To be determined based on storage and net-to-gross	

* Not all locations will require a flight kitchen. A flight kitchen is a staging area where food products are assembled and packaged for delivery to aircraft. This applies to all stations that require pick-up/delivery options, not just air stations.

****** If facility is serving more than 2,200 personnel, consider extended feeding hours or adding serving lines to accommodate additional personnel in lieu of constructing a substantially larger building.

2-6 BUILDING SITE.

This facility will be a focal point of the local community. It should be an open and inviting gathering place for Service personnel. Address the following factors in the site selection and design.

2-6.1 Location.

Locate the facility along the pedestrian paths to existing unaccompanied housing and centralized support services. Accommodate patron access through the relationships to existing vehicular and pedestrian circulation patterns, bike trails, and bus stops. If served by shuttle buses, provide a porte cochere. Provide adequate parking as close to the facility as possible within AT requirements.

2-6.2 Natural Light.

Select a site to maximize the admission of natural light while minimizing heat gain through the glazing.

2-6.3 Separate Service Functions.

Separate service functions such as loading docks, maintenance yards, trash containers, on-grade mechanical equipment, and staff parking from the rest of the site by architectural screening, landscaping, or grading. Illuminate parking areas, pathways, and service areas. Do not impede visual access of pathways with landscaping shrubbery.

2-6.4 Patron Circulation.

Patrons arrive from many directions. Identify the various access points, both pedestrian and vehicular, and channel circulation to the entrance of the building. Encourage smooth circulation by landscaping and paving complementary to the building. Entry circulation begins as the patron enters the site and continues through the interior of the facility.

2-6.5 Outdoor Dining Area.

If climate and site permit, consider providing an outdoor area.

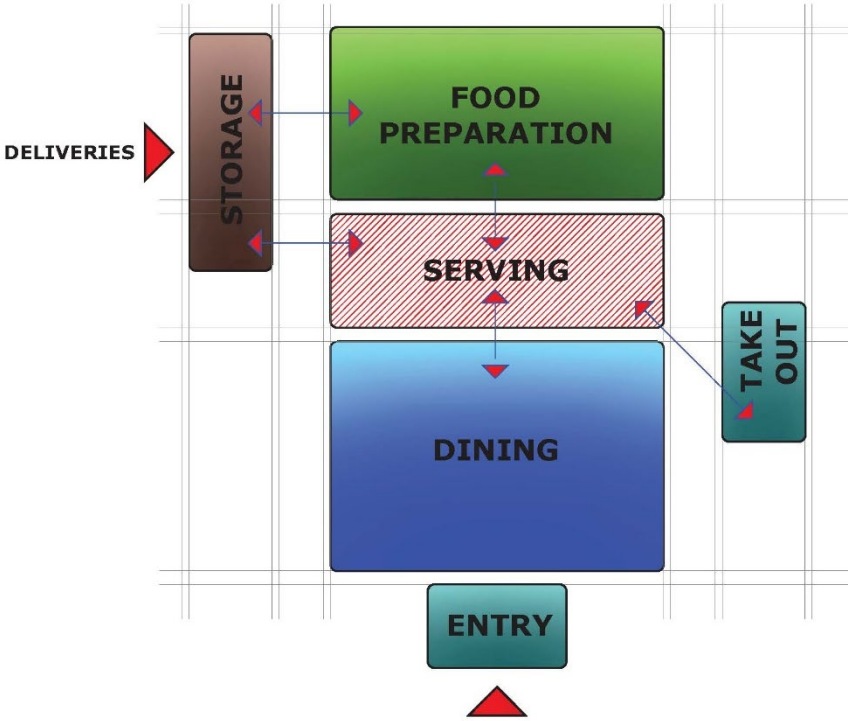
2-7 BUILDING LAYOUT

Foster efficient flow of people, materials, and work activities in the building layout. Visually and acoustically separate patron functions from food preparation and cleaning functions. Visible cooking stations are encouraged for individualized orders.

2-7.1 Flow Schematic.

Figure 2-1 schematically illustrates the building layout with major functional areas and displays the flow of people and material.

Figure 2-1 Dining Facility Flow Schematic



2-7.2 Functional Planning.

Carefully study the relationship among the various storage, preparation, cooking, serving, and cleaning functions to provide maximum flow and efficiency. Keep travel distances short and minimize crossover of circulation paths. Maintain open sight lines as much as possible and utilize mobile food service equipment for flexibility. Provide utility connections for mobile food service equipment. Plan for various serving styles.

2-7.3 Separate the Dining Area.

The dining area represents the conclusion of the patron process of arrival, queuing, identification, serving, and payment. To the extent possible, separate seated patrons from the congestion and movement of arriving and departing patrons. To avoid congestion within the dining facility, patron circulation space at the bussing area should be as large as possible.

2-8 BUILDING DESIGN.

Include the following design considerations in the planning and budgeting process. Emphasis is placed on the design of functional and pleasant food service facilities that help attract and retain patrons. Comply with command and installation architectural standards. The dining facility can represent a visual focal point on base, similar to a headquarters building, and its design can set the standard for the installation.

2-8.1 Design for Flexibility.

Planners and designers should recognize that future renovations, additions, and expansions of the facility are likely.

2-8.2 Aesthetics and Visual Image.

The dining experience represents a break in the patron's day. Its design should provide a visual respite as well. The designer should provide an aesthetic and visual image in keeping with the recreational functions of the facility.

2-8.2.1 Develop Architectural Character.

Create an appealing environment through interesting plan areas, spatial volumes, and other design elements. If outdoor dining is provided, consider the effect on both the facility layout and design character.

2-8.2.2 Signage.

Develop a comprehensive signage package (both exterior and interior) that addresses both way-finding and definition of all spaces within the facility. This may include signage that identifies serving stations. Signage should reflect and complement the environment through colors, images, and materials.

2-8.2.3 Menus.

Menus and their various versions are evolving into education/information instruments unlike anything envisioned a few years ago. As this evolution continues, the capacity to provide more locations and greater capabilities is a basic building block for the dining facility's target demographic.

2-8.3 Glazing.

The admission of natural light contributes significantly to the energy efficiency of the building and communicates a feeling of well-being and openness. Coordinate glazing design with the lighting design (see paragraph 3-6.4.3).

Direct sunlight on dining patrons can be uncomfortable and detracts from a positive dining experience. In addition to the site issues noted in paragraph 2-6.2, consider overhangs and other building features to preclude direct sunlight on the seating areas.

2-8.4 Design for a Quality Work Environment.

Ensure quality building systems, adequate employee facilities, easily accessible safety devices, and prevention of entry by vermin and insects.

2-8.5 Design for Durability and Maintainability.

The materials proven to be the most durable are shown in Table 3-1 and should be accommodated in the budget. The design should accommodate access for cleaning and maintenance in high-wear areas, including food preparation, dishwashing, and pot- and pan-washing areas.

CHAPTER 3 DESIGN CRITERIA, CODES, AND DESIGN STANDARDS

3-1 GENERAL.

Comply with UFC 1-200-01, which provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

3-1.1 Authorized Building Program.

A DD1391 funding document is developed for all new construction projects, which establishes project requirements and authorized building size. The designer can use the functional diagrams contained herein to create the logical flow and individual space allocations for approved functions within the facility; however, the design may not exceed the square footage allowances of the DD1391 or add functional areas to the facility if the functions are not authorized in the validated DD1391.

3-1.2 Accessibility.

Comply with UFC 1-200-01 requirements for accessibility.

3-2 SUSTAINABILITY.

DoD requirements for sustainability apply to construction, redesign, renovation, and modernization projects. Refer to UFC 1-200-02, *High Performance and Sustainable Building Requirements*, for high performance and sustainable buildings (HPSB) criteria.

3-3 FOOD CODE.

Design facilities to meet the Food and Drug Administration's (FDA) *Food Code*.

3-4 STRUCTURE.

Comply with UFC 3-301-01 requirements for structural design. In addition, comply with the following:

- Provide clear spans as required for the dining area.
- If the facility has been designated as a mass care feeding facility (see paragraph 2-2.9), then the building is classified as Risk Category IV per UFC 3-301-01.

3-5 ARCHITECTURE AND INTERIOR DESIGN.

3-5.1 General.

Comply with UFC 3-101-01, *Architecture*, and UFC 3-120-10, *Interior Design*, requirements for architecture and interior design.

3-5.2 Coordination.

The following items require coordination with the architectural design:

- Requirements for floor drains, wall recesses, stub walls, and any pads or piers needed for food service equipment;
- All bumpers, guards, and protective devices;
- The use of special materials such as quarry tile, noncorrosive ceiling grid, skim coat plaster on concrete masonry unit (CMU) walls, metal acoustic ceilings, plaster ceilings, and smooth-face lay-in tile;
- Incorporate materials used in commercial restaurants for dining areas. Visible CMU walls are not permitted in the serving and dining areas;
- E.g, all roof, ceiling, floor, and wall penetrations for ducts, control lines, refrigerant tubing;
- Floor elevation and slope requirements to ensure proper water drainage in wet areas; and
- Between loading dock and kitchen, provide minimum 8-ft (2.4 m) -tall doors with adequate widths to accommodate equipment movement.

3-5.3 Materials and Finishes.

Approved finishes for functional areas are in Table 3-1. For deviation requests, see paragraph 1-7. Floors that are slip-resistant, drain well, and clean easily are of paramount importance. Provide floors that will endure cleaning by high-pressure spray equipment. Coordinate finishes with the interior designer.

Also comply with the following:

- Provide protective guards in all areas subject to cart traffic, i.e., walls, doors, and corners. Locate equipment to minimize cart damage.
- Provide door systems with acoustical properties between kitchen/dishwashing areas and dining areas. Where feasible, design doors for wheeled traffic without raised thresholds. Provide vision panels in doors to permit views of anyone entering and exiting.
- Ensure all joints and intersections of materials are sealed, free of pocketed or porous materials, and accessible for cleaning.

Table 3-1 Interior Finishes

Space	Finishes				
	Floor	Base	Walls	Protect	Ceiling
Entry/Vestibule	PT, RM	PT	Note 1		Note 3
Queue	PT or RF	PT or Rubber	Note 1		Note 3
Public Toilets	PT	PT	CT		MR GWB
Check-in	PT or RF	PT or Rubber	Note 1		Note 3
Dining Area	Carpet*, PT	Rubber or PT	Note 1	Note 2	Note 3
Serving, Patron Side	QT or PT	QT or PT	CT or GSU	Wall, Corners	MR Vinyl ACT
Serving, Server Side	QT, EF, or CUF	QT, EF, or CUF	CT or GSU	Wall, Corners	MR Vinyl ACT
Dishwashing	QT, EF, or CUF	QT, EF, or CUF	CT or GSU	Wall, Corners	MR Vinyl ACT
Food Preparation Area	QT, EF, or CUF	QT, EF, or CUF	CT or GSU	Wall, Corners	MR Vinyl ACT
Utensil Wash	QT, EF, or CUF	QT, EF, or CUF	CT or GSU	Wall, Corners	MR Vinyl ACT
Storage, Freezer	QT, EF, or CUF		MIP		MIP
Storage, Chilled	QT, EF, or CUF		MIP		MIP
Storage, Dry	SC or VCT	Rubber	GWC on CMU	Corners	ACT
Storage, Non-Food	SC	Rubber	GWC on CMU	Corners	ACT
Storage, Carb. Beverage	QT, CT, or CUF	QT, CT, or CUF	GWC on CMU		ACT
Offices	Carpet, PT or RF	Rubber or PT	Painted CMU		ACT
Staff Toilets	PT	PT	GWC on CMU		MR GWB
Staff Lockers	QT or PT	QT or PT	GWC on CMU		MR GWB
Janitor Closet	SC, PT or QT	Rubber, PT or QT	GWC on CMU	Corners	Exposed
Can Wash	Acid-Resistant EF or CUF	EF or CUF	Epoxy or CT	Wall, Corners	MR Vinyl ACT
Loading Dock	SC		Exterior		Exterior
Mechanical	SC		Painted CMU		Exposed

Note 1: Walls in public areas may be a variety of durable materials such as brick, split block, exposed concrete, plaster, or other materials as approved.

Note 2: Provide wall guard protection at locations subject to cart traffic.

Note 3: Ceilings in public areas may be a variety of suspended acoustic ceiling, sound reflectors, or barrier materials to add both acoustic and visual interest.

General Note: All grout to be epoxy. Consider use of darker grout to hide soiling.

Legend for Table 3-1:

ACT–acoustic ceiling tile

CMU–concrete masonry unit

CT–ceramic tile

CUF–cementitious urethane flooring

EF–epoxy flooring

GSU–glazed structural unit

GWB–gypsum wall board

GWC–glazed wall coating

MIP–metal insulated panel

MR–moisture resistant

PT–porcelain tile

QT–quarry tile

RF–resilient flooring

RM–recessed walk-off mat

SC–sealed concrete

VCT–vinyl composition tile

*If carpet is introduced, limit to dry areas and use patterned, restaurant-grade carpet tile.

3-6 MECHANICAL AND ELECTRICAL.

3-6.1 Plumbing Design.

Comply with UFC 3-420-01, *Plumbing Systems*, requirements for plumbing systems design.

3-6.1.1 Plumbing Systems.

Provide freeze-proof wall hydrants at exterior wash areas in addition to other locations around the building.

3-6.1.2 Waste Systems.

3-6.1.2.1 Locate grease traps near the loading dock but outside of vehicle pathways and ensure easy accessibility for cleaning. Provide exposed covers of rust-proof and skid-resistant construction.

3-6.1.2.2 If grease interceptors are used in lieu of central grease traps to service individual equipment, locate to provide easy accessibility for cleaning, outside of food preparation areas, and which do not project above the floor in open walkways or work areas. Provide exposed covers of rust-proof and skid-resistant construction.

3-6.1.2.3 The base environmental office or waste management program will determine the type of waste permitted from food grinders, waste pulping system, and floor drains.

3-6.1.2.4 Apply an air gap of two pipe diameters to all kitchen equipment drains not having other backflow protection. Navy projects also use cross-connection control and backflow prevention program implementation.

3-6.1.2.5 Coordinate floor sinks of adequate size and non-splash receptor design with drained equipment requirements. Prime floor drains are not used as indirect waste receptors or provided with deep seal traps.

3-6.1.2.6 Do not locate waste piping above kitchen and storage areas.

3-6.1.2.7 Provide chrome plating or chrome sleeve copper pipe and fittings for visually exposed equipment waste and drain lines.

3-6.1.2.8 Coordinate drain requirements for HVAC, cold storage refrigeration equipment, and the can wash.

3-6.1.2.9 Avoid usage of large trench drains. Maintain a maximum size of 8 ft x 8 ft (2.4 m x 2.4 m) drains to minimize food waste becoming trapped.

3-6.1.3 Water Supply Systems.

3-6.1.3.1 Coordinate specialized food service equipment needs for hard/soft water, delime, descale, and pressure such as ware-washing and water-chilled equipment.

3-6.1.3.2 Provide a filtration system on the building main water line. However, if building water is not filtered as part of a central system, provide a kitchen-based central water filter with filters for 0.5-micron particulates and taste. Split discharge for two circuits: The first circuit connects to soda, cold beverage machines, and water hydration stations and the second circuit includes a polyphosphate additive before connecting to coffee brewers, equipment with boilers, self-generating steam, combi ovens, and ice makers.

3-6.1.3.3 Provide high-temperature water supply in accordance with UFC 3-420-01 for the dishwasher, pot and pan wash, can wash, and field feeding area (if provided).

3-6.1.3.4 Provide a centrally controlled low-pressure washing system with remote wall-mounted workstations in the kitchen, can wash, dishwashing area, and receiving platform. Required accessories include water broom attachment, hose reel, spray nozzle, and freeze-proof valves for exterior use in cold locations.

3-6.1.3.5 Diversity factors for water heating are based on food service equipment usage. Dining facilities may require two or more different hot water temperatures zones. Provide public and employee handwashing sinks with either temperature-limiting devices or different incoming hot water temperature than for food equipment.

3-6.1.3.6 Hot water storage and recirculation. **Note:** Where limited flow fixtures are required, provide piping and recirculation system adjustments to ensure adequate hot water at the fixture.

3-6.1.3.7 Provide backflow protection on all water connections, including connections to beverage machines that may include internal backflow prevention, in accordance with UFC 3-420-01.

3-6.1.3.8 Provide UL- and NSF-approved/certified/listed sinks.

3-6.1.3.9 Provide one 8-inch (203 mm) empty conduit with pull string from the remote beverage room to each beverage station in the facility.

3-6.1.4 Coordination.

These items require coordination with the plumbing design.

3-6.1.4.1 The food service designer determines the locations and specifications for all food service equipment (fixed and relocatable). Coordinate food service equipment layout and specifications with the facility mechanical designer for coordination of facility plumbing design.

3-6.1.4.2 Coordinate locations of all water, waste, steam and steam condensate, refrigeration condensate, chilled water supply and return, floor drains, and gas lines with equipment requirements. Conceal these lines but ensure all lines are readily accessible for maintenance. Provide washable covers where the lines are exposed.

3-6.1.4.3 Coordinate unavoidable exposed vents for island or freestanding equipment with the architect for enclosure.

3-6.1.4.4 Coordinate the design and location of required grease traps with the mechanical, plumbing, architectural, and, possibly, structural designers.

3-6.1.4.5 If under-floor conduits are used for routing the beverage system, ensure they are sealed conduits with cleanouts and pull boxes every 100 ft (30.5 m), installed with pull lines, and sealed upon product line installation.

3-6.1.4.6 Provide floor drains and a hose bibb in the beverage storage area.

3-6.1.4.7 Provide plumbing and allocated hot water capacity to the automatic wash-down system with a battery back-up wash timer for exhaust hoods, if appropriate.

3-6.1.4.8 Coordinate any special requirements for plumbing connections to utility distribution systems.

3-6.1.4.9 For connections to gas-fired equipment, provide 300 series braided stainless steel flexible connections, brass, or stainless-steel fittings. Specify hose coverings to have NSF-approved coatings and fitted with required restraints.

3-6.1.4.10 Provide easy access to waste traps and collectors for cleaning.

3-6.2 Heating, Ventilation, and Air Conditioning (HVAC) Design.

Comply with UFC 3-400-02, *Design: Engineering Weather Data*, and UFC 3-410-01, *Heating, Ventilation, and Air-Conditioning Systems*, requirements for HVAC systems design.

Refer to NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, ASHRAE 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, and UL 710, *UL Standard for Safety Exhaust Hoods for Commercial Cooking Equipment*, for kitchen exhaust and ventilation.

Additional HVAC requirements unique to dining facilities include the following:

- Provide variable-speed kitchen hood fans in accordance with ASHRAE 90.1
- Design the HVAC system to allow for control of the following:
  - Large daily load swings
  - High space latent loads
  - High and variable ventilation requirements

3-6.2.1 Coordination.

The following items require coordination with the HVAC design.

3-6.2.1.1 Coordinate the location and size of all ventilated equipment, such as exhaust hoods, dishwashing equipment.

3-6.2.1.2 Coordinate the special requirements for ductwork connecting to equipment, such as drip pans and pitched or vented duct work.

3-6.2.1.3 Coordinate the ventilation of remote refrigeration condensers.

3-6.2.1.4 Air-condition the entire facility except for storage and service areas. Ventilate and heat storage and service areas as required by code.

3-6.2.1.5 Condition the kitchen, dish wash, and pot/pan washing not to exceed 85 °F (29 °C) and heat to maintain temperature no less than 68 °F (20 °C). Maintain a negative pressure in the kitchen, dish wash, pot/pan washing, service spaces, janitor closets, and restrooms. Maintain a positive pressure in the dining, point of sale, and interior queuing areas.

3-6.2.1.6 Incorporate testing, balancing, and commissioning into all dining projects to ensure proper airflow and fan operation upon construction completion. Execute testing and balancing with all kitchen equipment functioning.

3-6.2.1.7 Provide air curtain fans over all personnel entry/exit doors and receiving vestibule doors. Specify air curtain fans the full width of doors and mounted on the

interior side immediately above the door. Emergency “Exit Only” doors and mechanical/electrical rooms do not require air curtain fans.

3-6.2.1.8 Provide stainless steel all-welded construction kitchen hood systems, including lights, filters, grease troughs, and fire protection systems. Specify UL- and NSF-approved/certified/listed hoods, certified to meet International Mechanical Code-required velocities for the service application. If face discharge hoods are utilized, provide with tempered makeup air. Temper makeup air to 85 °F (29 °C) for cooling and 60 °F (16 °C) for heating.

3-6.2.1.9 Provide an independent on/off switch for the hood exhaust fans.

3-6.2.1.10 Ventless cooking equipment is encouraged.

3-6.2.1.11 “Spot cooling” with field-adjustable diffusers at predictable workstations at the kitchen and serving areas is encouraged.

3-6.2.2 Controls.

Specify direct digital control (DDC) system per UFGS 23 09 23.02, *BACnet Direct Digital Control for HVAC and Other Building Control Systems*, or UFGS 23 09 23.01, *Lonworks Direct Digital Control for HVAC and Other Building Control Systems*. Coordinate the DDC specification to ensure a proper interface to the existing or planned base-wide DDC/EMCS system.

Tie HVAC controls into the central location on base for controlling and monitoring systems.

3-6.3 Fire Protection.

Comply with UFC 3-600-01, *Fire Protection Engineering for Facilities*, requirements for fire protection systems.

Provide a kitchen hood fire-extinguishing system in accordance with NFPA 96.

3-6.4 Electrical Design.

Comply with UFC 3-520-01, *Interior Electrical Systems*, requirements for electrical systems.

3-6.4.1 Local Conditions.

Evaluate local conditions for their impact on facility design and backup power generation requirements.

3-6.4.2 Emergency Power.

When the facility is designated as a mass care feeding facility, provide a permanent, external, self-contained emergency generator that powers the entire facility load. Provide 72 hours of fuel storage.

When the facility is not designated as a mass care feeding facility, provide a service entrance with an external temporary emergency generator hook-up for the facility. At a minimum, loads to be supported by the emergency generator include 100 percent cold storage and facility lighting. If required by activity, support additional loads as determined on a case-by-case basis. Ensure availability of a hard surface area adjacent to the building service entrance to accommodate the generator. Provide signage at the external generator connection indicating the minimum load requirement for the portable generator (kVA, voltage, ampere).

3-6.4.3 Lighting.

Comply with UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*, requirements for lighting systems design and illuminance levels.

3-6.4.4 Closed Circuit Television (CCTV).

When a CCTV system for monitoring and recording of activities in the server and dining areas is required, provide the supporting infrastructure.

3-6.4.5 Special Systems.

Provide supporting infrastructure as required for the following:

- Local area network for computerized communications, such as food service and payment management system
- Energy monitoring and control system when mandated or economically justifiable
- Public address and intercom systems
- Security systems, alarm systems, and closed-circuit television (CCTV) systems
- Cable television (CATV) and audio-visual (AV) systems for dining areas

3-6.4.6 Lightning and Cathodic Protection.

Comply with UFC 3-570-01, *Cathodic Protection*, and UFC 3-575-01, *Lightning and Static Electricity Protection Systems*.

3-6.4.7 Coordination.

The following items require coordination with the electrical design.

3-6.4.7.1 Coordinate the location of all spot connections for equipment requiring an electrical connection.

3-6.4.7.2 Coordinate all projected power requirements for food service equipment (coordinated with the food service designer as early as possible). In addition to the power characteristics, determine the type of electrical connection required (plug-in, junction box) for each piece of equipment.

3-6.4.7.3 Coordinate special requirements for equipment, such as overload protection and control panels, located at the equipment being protected.

3-6.4.7.4 Coordinate integration of food service equipment with fire suppression system controls.

3-6.4.7.5 Coordinate integration of electrical requirements for the equipment utility distribution system.

3-6.4.7.6 Coordinate the location of conduit required for computer and electronic cash register stations.

3-6.4.7.7 Specify electrical service requirements for all equipment in accordance with UFGS 11 05 40, *Common Work Results for Foodservice Equipment*.

3-6.4.7.8 Coordinate potential future equipment upgrades.

3-6.4.7.9 Floor-mounted flush receptacles and conduit stub-ups are not permitted in the kitchen area or serving line. For safety reasons, provide ceiling cord reels in these areas.

3-6.4.7.10 Provide 15 percent spare electrical load capacity throughout the building electrical system. This includes, e.g, switchboards, feeders, panelboards, transformers, branch circuits.

3-6.4.7.11 Provide a building-wide, zoned paging/intercom system with announcement and music (plug-in) capabilities from the administrative office. This paging/intercom system can be integrated with the building’s mass notification system.

3-6.4.7.12 Provide transient voltage surge suppressors (TVSS) at service entrance panels and panels supporting electronic equipment.

3-6.4.7.13 Provide cathodic protection for all ferrous underground pressurized piping systems and any ferrous underground structures. If plastic piping systems are used, then cathodically protect all ferrous valves and fittings. Provide a sacrificial anode type cathodic protection system designed for a 25-year life.

3-6.5 COMMUNICATIONS AND COMPUTER SYSTEMS.

General guidance for the design of telephone systems is provided in UFC 3-580-01, *Telecommunications Interior Infrastructure Planning and Design*. Guidance pertinent to the design of dining facilities is as follows.

3-6.5.1 Telephones.

Provide telephones with a page intercom system in coordination with the local command.

3-6.5.2 Electronic Cash Registers and Computers.

In preparation for future computer systems, provide empty conduit from the array of register terminals to a location in the food service officer's office for linkage to a computer in use by the food service officer. This office will have a variety of computer-based systems such as file server and POS terminals, credit card charge processing, digital menu boards, nutritional, and social media information, and computer systems for employee time clocks. Consolidate local email and systems for advance ordering of subsistence items in this office area. Install a primary telephone for the facility in the office with extensions at all register locations for operators and anti-robbery protocols. Provide CAT6 cabling for each separate system as determined by the end user in the overall communications plan.

3-6.5.3 Cable TV (CATV), and Audio-Visual (AV) Systems.

When required, provide the infrastructure for CATV, AV, and Wi-Fi systems. The Service contacts in paragraph 1-7 will determine if design and construction funds will be provided for Wi-Fi, CATV and/or AV equipment. Provide a CATV and/or AV system with structural supports, mounting brackets, electric, and CATV/AV jacks in each TV location. Provide mounting brackets suitable for minimum 50-inch flat panel televisions. Provide normal base/installation Wi-Fi in the dining area and facility for alerts, weather, and installation information management.

3-7 EQUIPMENT.

Provide the type, quantity, and size of equipment necessary and with sufficient redundancy and/or multi-function features to develop meals based on the following requirements:

- The facility's menu;
- The facility's staffing plan;
- The facility's hours of operation, meal schedule, and duration;
- Normal maintenance requirements;
- The standards of quality required in:
    - UFGS 11 41 11, *Refrigerated and Frozen Food Storage Equipment*

- UFGS 11 42 00, *Food Preparation Equipment*
- UFGS 11 44 00, *Food Cooking Equipment*
- UFGS 11 46 00, *Food Dispensing Equipment*
- UFGS 11 47 00, *Ice Machines*
- UFGS 11 48 00, *Cleaning and Disposal Equipment*

- All other code requirements in this UFC.

3-7.1 Walk-In Refrigerator/Freezer.

To retain refrigerated air and reduce insect infestations, provide vinyl slatted curtains hanging inside the doors or provide a blower-type air curtain outside the doors of walk-in refrigerators and freezers.

Provide a heated viewport window in the door of walk-in refrigerators and freezers to permit views of anyone entering or exiting and provide a means of egress on the interior side of each door.

3-7.2 Cashier’s Safe.

Provide a three-tumbler safe containing individual combination-locked compartments for each cashier plus one cash collection agent.

3-8 SITE WORK.

Comply with UFC 3-201-01, *Civil Engineering*, requirements for site work.

3-8.1 Landscape.

Comply with UFC 3-201-02, *Landscape Architecture*, and local installation landscape standards. Ensure the landscape accentuates the building's main entrance. Provide landscaping at the outside dining area when one is provided, including but not limited to specialty paving (i.e., precast concrete pavers, brick pavers), shade trees, foundation planting, and screen planting, as required. Design all landscaping with an emphasis on low maintenance (reduced pruning, fertilization, pest control, leaf, flower, and fruit clean-up), drought tolerance, and native plant selection.

3-8.2 Parking, Access Drives, and Other Site Features.

Provide separate access drives for parking and loading dock access. Use turning radii for loading dock access roads appropriately sized for delivery trucks. For facilities serving up to 400 personnel, use minimum 6-ft (1.8 m) -wide sidewalks. For facilities serving more than 400 personnel, use minimum 8-ft (2.4 m) -wide sidewalks.

When a facility is designated as a mass care feeding facility, locate parking areas and other critical-use areas out of the 100-year floodplain to the extent practical.

CHAPTER 4 AUSTERE DINING FACILITIES

4-1 PURPOSE.

The purpose of this chapter is to provide requirements for austere construction established by CNIC. These requirements were developed to address construction of support facilities in CNIC-designated operating environments.

4-2 DEFINITION AND SCOPE.

An austere facility is defined as a structure designed and constructed with minimal infrastructure, footprint area, and finishes, incorporating applicable building codes and facility criteria to ensure adherence to all health, accessibility, and life safety standards and regulations required to fulfill the mission, including anti-terrorism force protection (AT/FP) appropriate to each site. Austere facilities should be built with the least total ownership costs (TOC) possible, including purchase, maintenance, and use of consistently available alternative local goods.

4-3 APPLICABILITY.

This chapter applies to Navy dining facilities designated as austere by CNIC. This chapter modifies requirements provided in this UFC. Austere construction is intended for facilities in locations determined by CNIC and approved by OPNAV to be eligible for austere facilities construction. The austere standards are intended to be applied flexibly and in varying degrees to all facilities at locations designated as austere. The flexibility should be allowed to ensure the criteria are appropriate for individual austere locations. The Air Force and Space Force reserve the right to apply these requirements as applicable and approved by AFSVC.

4-4 MODIFICATIONS.

The following are modifications to this UFC when designated austere.

CHAPTER 2 PLANNING AND LAYOUT

2-2.7 Bussing.

Delete the UFC paragraph and add the following:

Patron self-bussing will be the standard mode of bussing.

2-3.1 Entrance Lobby.

Add the following:

Canopies will not be used in austere facilities unless needed for weather conditions.

2-3.4 Cashier Station.

Delete this UFC paragraph and replace it with the following:

The cashier station/sign-in station accommodates patron payment. The configuration, location, and number of stations are determined by the number of personnel served, food delivery methodology, and payment style. Payment options (credit, Smart™ cards) will be determined prior to design. No cash payments allowed.

2-3.11 Support Areas.

Delete the UFC paragraph and add the following:

Support areas accommodate staff needs such as offices, training, other administrative tasks, toilets, lockers, and janitor closets. These areas are determined by the mission and staffing requirements. For austere facilities, provide a single administrative office that can accommodate up to three people.

2-4.3 Navy and Marine Corps.

Delete the UFC paragraph and replace it with the following:

Determine the number of personnel to be served by multiplying the projected maximum unaccompanied housing occupancy by the utilization factors in Table 2-2. Include the average on-board count of ships entitled to rations-in-kind while shipboard facilities are out of service in the projected occupancy. Do not include personnel on separate rations in the projected occupancy.

Table 2-2 Personnel to be Served by Mission

Mission	Utilization Factor
Austere Locations	90%

2-5.3 Navy and Marine Corps.

Delete the UFC paragraph and replace with the following:

Refer to FC 2-000-05N for space planning spreadsheets for austere dining facilities.

2-5.3.1 Space Program Assumptions.

Modify the UFC requirements as follows:

Seating should be based on 12 ft^2 (1.1 m^2) per seat.

Bake shops are not allowed.

Separate meat and vegetable preparation areas will not be provided.

2-5.3.2 Storage.

Add the following to the UFC paragraph:

Austere facilities are identified the same as OCONUS rural/remote facilities due to infrequent delivery periods.

2-8 BUILDING DESIGN.

Add the following to the UFC paragraph:

For austere facility locations, the dining facility should not represent a visual focal point on base, nor will its design set the standard for the installation.

2-8.1 Design for Flexibility.

Delete the UFC paragraph.

2-8.2 Aesthetics and Visual Image.

Delete the UFC paragraph.

CHAPTER 3 DESIGN CRITERIA, CODES, AND DESIGN STANDARDS

3-2 SUSTAINABILITY.

Delete the UFC paragraph and use the following:

The Chief Engineer of NAVFAC has waived Sustainable Third – Party Certification requirements for projects designated austere (CONUS and OCONUS). However, requirements for the *Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (HPSB)* remain. Refer to UFC 1-200-02 for criteria associated with HPSB.

3.5.3 Materials and Finishes.

Delete Table 3-1 and use the following:

Table 3-1 Austere Facilities Architectural Finishes

General Space	Recommended Finishes			
	Floor	Base	Walls	Ceiling
Vestibule	CONCS/WM	RB	P	EXP/P, Note 1
Queue	CONCS	RB	P	EXP/P, Note 1
Public Toilets	CONCS	RB	P	EXP/P, Note 1
Check-in	CONCS	RB	P	EXP/P, Note 1
Dining Area	CONCS	RB	P	EXP/P, Note 1
Serving, Patron Side	QT, EF, or CUF	QT, EF, or CUF	P	EXP/P, Note 1
Serving, Server Side	QT, EF, or CUF	QT, EF, or CUF	P	EXP/P, Note 1

General Space	Recommended Finishes			
	Floor	Base	Walls	Ceiling
Dishwashing	QT, EF, or CUF	QT, EF, or CUF	P	P
Food Preparation Area	QT, EF, or CUF	QT, EF, or CUF	P	P
Utensil Wash	QT, EF, or CUF	QT, EF, or CUF	P	P
Storage, Freezer	QT, EF, or CUF	QT, EF, or CUF	P	P
Storage, Chilled	QT, EF, or CUF	QT, EF, or CUF	P	P
Storage, Dry	CONCS	RB	P	P
Storage, Non-Food	CONCS	RB	P	P
Storage, Carbonated Beverage	QT, EF, or CUF	QT, EF, or CUF	P	P
Offices	CONCS	RB	P	EXP/P, Note 1
Staff Toilets	CONCS	RB	P	EXP/P, Note 1
Staff Lockers	CONCS	RB	P	EXP/P, Note 1
Janitor Closet	CONCS	RB	P	EXP/P, Note 1
Can Wash	CONCS		P	EXP/P, Note 1
Loading Dock	CONCS		P	EXP
Mechanical	CONCS		P	EXP

Note 1: Ceilings are to be exposed and painted, including all exposed plumbing, mechanical, fire stops, and electrical conduit unless it is more cost-effective to provide a hard finish, painted ceiling.

Note 2: Provide wall and corner guard protection at locations subject to cart traffic.

Legend for Table 3-1:

CONCS–concrete, hardened and sealed (option: integrally colored for accent)

EXP–exposed P–paint QT–quarry tile

RB–rubber base EF–epoxy flooring

WM–walk-off mat (surface) CUF–cementitious urethane flooring

3-7.1 Walk-In Refrigerator/Freezer.

Add the following:

Bulk storage for chilled/frozen/dry goods may be located exterior to the building in appropriate environments.

3-7.2 Cashier's Safe.

Delete UFC paragraph and replace with the following:

In austere environments, there will be no cash taken at the facility and no safe is required.

3-8.1 Landscape.

Delete UFC paragraph. No landscaping is required.

3-8.2 Parking, Access Drives, and Other Site Features.

Delete UFC paragraph and replace with the following:

Apply austere decision-making to assess, modify, and incorporate requirements such as pedestrian circulation, bus access, service vehicle parking, and lighting plans appropriate to local conditions and to limit parking as much as possible while still meeting the facility mission. Review the security study and incorporate its requirements into the design. Ensure existing and proposed parking complies with antiterrorism requirements. In austere facilities, parking for residents, visitors, staff, and service personnel should be extremely minimal and directed only to the mission. Maintenance parking for service functions does not necessarily require dedicated space. Use the expected frequency of maintenance vehicles to determine whether dedicated parking is needed. Locate service access and parking to avoid disturbing residents.

APPENDIX A BEST PRACTICES

A-2 Acoustics.

Delete UFC paragraph. No acoustic provisions are required.

A-7 FOOD SERVICE EQUIPMENT.

A-7.1 Sample Equipment Schedules.

Delete Table A-1 and use the following.

Table A-1 Conceptual Equipment List for Austere Facilities

• Air curtain	• Microwave oven
• Anti-splash floor troughs	• Mixer, 20 qt (19 L)
• Area floor drain	• Mobile attachment shelving
• Braising pan, 40 gal (150 L)	• Mobile chemical shelving
• Bread display	• Mobile hot food cabinet
• Bussing cart	• Mobile mixer table
• Can opener	• Mobile pot/pan shelving
• Can rack	• Mobile slicer table
• Carbonator	• Mobile tray rack
• Cashier counter	• Mobile utensil soak sink

Table A-1 Conceptual Equipment List for Austere Facilities

• Chemical storage shelving	• Mop rack
• Clean dish table	• Office printers
• Cold food wells	• Open-front refrigerated display cabinet
• Combination oven/steamer	• Plate dispenser
• Computers	• Platform truck
• Condensers for walk-ins	• Pot/pan utensil rack
• Condensers for ice makers	• Pre-rinse faucet
• Condiment counter	• Rack dolly
• Condensate exhaust canopy	• Receiving scales
• Conveyor bagel toaster	• Refrigerated equipment stand with cold rail
• Cook & hold cabinet	• Reach-in refrigerator
• Counter with freezer base	• Remote rack refrigeration system
• Counter with sink	• Scale
• Cup dispensers	• Scanners
• Declining balance card dispenser	• Serving counters
• Dish carriers	• Sink heater
• Dishwasher	• Slicer
• Dishwasher vents	• Soiled dish table
• Disposer with pre-rinse faucet	• Stainless steel wall panel
• Double-deck convection oven	• Storage cabinet
• Dry storage shelving	• Strip curtain
• Dunnage rack	• Tray accumulator, five-tier
• Electric can opener	• Tray cabinet
• Evaporators for walk-ins	• Tray carriers
• Exhaust hoods, Type 1	• Tray return opening frame
• Exhaust hoods, Type 2	• Twin soft serve dispenser
• Fire-suppression system	• Two-compartment sink
• Griddle	• Under-counter refrigerator
• Hand sink	• Utensil rack
• Heat lamps	• Utility cart
• Heated shelf	• Vertical cutter/mixer
• Hose bibb	• Walk-in cooler shelving
• Hose reel	• Walk-in dunnage rack
• Hot food wells	• Walk-in cook's cooler
• Ice bin	• Walk-in meat/dairy cooler
• Ice machine	• Walk-in freezer
• Ice/soda dispenser	• Walk-in produce cooler
• Janitor sink with can wash	• Wall shelf
• Kitchen lockers	• Water temperature booster 180 °F (82 °C)
• Knife rack	• Work table with sink

A-8.2 Staff Lockers.

Delete UFC paragraph and replace with the following:

Lockers are for storage of personal items only. Male and female lockers need not be separate and may be combined within an appropriate area. Locate lockers close to the staff toilets. Locker quantities are as indicated in Table A-2. All lockers should be half height except for facilities for 1,001 patrons and over, where three-tier lockers are used. The number of lockers scheduled for each space exceeds the projected number of

workers for each category to accommodate the likely shifting balance of male to female workers. Equip all lockers with sloped tops.

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APPENDIX A BEST PRACTICES

The Best Practices Appendix is considered to be guidance and not requirements. Its main purpose is to communicate proven facility solutions, systems, and lessons learned, but may not be the only solution to meet the requirement.

A-1 INTRODUCTION.

The following material identifies good design practices for each functional area as outlined in the space program. The designer is expected to interpret this guidance and configure the functional areas according to the needs of the project.

A-2 ACOUSTICS.

All facilities should be designed or treated to provide a comfortable acoustical environment.

A-2.1 Finishes.

In key areas, use finishes that absorb sound, reduce noise reflection, and minimize the generation and impact of noise. These finish materials have a high noise reduction coefficient (NRC) rating.

A-2.1.1 Ceilings in the dining area should have a minimum 0.6 NRC rating. Ceilings in the kitchen should have a minimum 0.6 NRC rating, be washable, and be United States Department of Agriculture (USDA) -listed for this application.

A-2.1.2 Acoustic wall treatments in the dining area should be implemented above wainscot height, located away from high-traffic areas, and have a minimum 0.8 NRC rating. If located near high-traffic areas, incorporate an abuse-resistant finish.

A-2.1.3 Floor finishes in the dining area should be selected to minimize noise generation.

A-2.2 Partitions.

The partitions separating noisy areas (such as the kitchen, dishwashing, and pot and pan wash) from sound-sensitive areas (such as the dining area and offices) should have a partition assembly with a minimum 50 sound transmission coefficient (STC) laboratory rating.

Openings between the kitchen and the dining area should incorporate baffles or screens, where possible, to minimize a direct noise path between these spaces.

A-3 QUEUE.

Dining facilities that accommodate large training commands or functions will experience surge conditions and require a larger queue than comparable facilities that do not.

When the queue is adjacent to the dining area, use a screen to separate queued patrons from the dining area.

A-4 DINING AREA.

The dining area provides one of the principal facility functions. Issues of particular importance are as follows:

A-4.1 Space Division.

Dining areas should be capable of being subdivided by plan or partition to close off portions during off-peak serving periods.

A-4.2 Visual Separation.

Visually separate the eating area from all other facility functions.

A-4.3 Seating.

Provide a variety of table sizes and seating options. Use non-fixed and easily cleanable furnishings. See Figure A-2.

A-5 SERVERY.

Design the lines and stations for flexibility and good traffic flow. Beverage station locations should accommodate patron refills without disrupting the serving line flow. For Air Force/Space Force facilities, locate beverage and water refresh stations in the dining area, selling a refillable cup. This greatly increases flexibility and flow considerations and repurposes this space for retail grab & go merchandisers adjacent to easily accessible POS stations. This allows customers to access grab & go, get to POS stations, and then obtain beverages in the dining areas. Locate beverage and CO_2 tanks nearby. Secure CO_2 tanks with safety straps or in a cage designed for the application. Consider providing space at the loading dock area for refilling and bulk storage of CO_2 tanks. See Figures A-3 through A-8 and A-31 through A-34.

A-6 FOOD SERVICE AREAS.

Food service areas include receiving, storage, preparation, and cleaning areas.

A-6.1 Loading Dock.

Include a can wash area with high-temperature water supply and drain connected to the sanitary line. Confirm loading platform heights with the majority of trucks servicing the facility. Dock levelers may be provided to accommodate varying truck platform heights. Provide a non-skid dock surface and bumpers at the dock to prevent impact damage. In locations with extreme weather conditions, the loading dock may need to be enclosed. Provide a ramp to connect the loading dock with the vehicular area to facilitate the use of hand trucks/carts and provide cart stops at the edge of the dock to prevent rolloff. Provide a canopy that extends 48 in. (1220 mm) beyond the edge of the platform.

Confirm canopy heights with the majority of trucks servicing the facility and confirm door widths with common delivery item sizes. See Figure A-22.

A-6.2 Refrigerator/Freezer.

The floor under the box should be depressed and insulated so the finished height is level with the surrounding kitchen floor. Provide separate exterior exits from both the freezer and the refrigerator/chill box to the loading dock. The interior exit from the freezer to the food preparation area to be through a thaw box via a door that is lockable on the freezer side. The refrigerator/chill box to be divided by a wire mesh partition between the exterior exit to the loading dock and the interior exit to the food preparation area. This partition to have a door that is lockable on the loading dock side. See Figures A-1 and A-27. Provide safety handles.

A-6.3 Dry Food Storage.

Recommend exterior access from the dry food storage to exit directly to the loading dock and the interior access to exit directly to the food preparation area. The dry food storage to be divided by a wire mesh partition between the exterior exit and the interior exit. This partition to have a door that is lockable on the loading dock side. See Figures A-1 and A-21.

A-6.4 Nonfood Storage.

Separate cleaning product storage from food product storage.

A-6.5 Kitchen.

Provide individual or continuous floor grates with drains to facilitate cleaning and catch discharge from cooking equipment such as steam kettles and tilting frying pans. Provide sufficient separation between steam-generating cooking equipment and other open-type cooking equipment. See Figures A-16 through A-18.

A-6.6 Vegetable Preparation Area.

In some facilities, this area may be a separate, refrigerated room with its own dedicated walk-in refrigerator, sinks, slicers, choppers, mixers, worktables, and other equipment. See Figure A-19.

A-6.7 Bakery.

Some facilities may include a bakery. See Figure A-20.

A-6.8 Flight Kitchen.

Flight kitchens should have direct exterior access.

A-6.9 Field Feeding/Vat Chow.

Provide adequate power and amenities for food preparation. Provide direct access to the loading dock.

A-6.10 Takeout/Meal Replacement.

Provide adequate power and amenities for food preparation and packaging/storage. This area may have a separate entrance/exit and its own POS station.

A-6.11 Dishwashing Area.

The dishwashing area should be located as close to the dining area exit as possible to permit self-bussing by the patron. A tray conveyor bussing system or a cart bussing system may be incorporated into the design. See Figures A-10 through A-13.

A-6.12 Utensil/Pot and Pan Wash.

Ensure adequate moisture control and ventilation. See Figures A-14 and A-15.

A-6.13 Pulper/Extractor System.

Provide a pulper/extractor system adjacent to the dishwashing areas to reduce manpower and water consumption. Consider providing a piped connection to the trash areas to improve sanitation in the dish room and, depending on site layout, can eject directly into the trash dumpster, further reducing manpower.

A-6.14 Cashier Station.

See Figure A-9 for Cashier Station.

A-6.15 Miscellaneous Kitchen Details.

A-6.15.1 Provide doors in kitchen and dishwashing areas meeting industry standard, single or double swing, typically of metal construction, with appropriate door protection, safety vision panels, and door hardware. See Figures A-23 through A-24 for details.

A-6.15.2 Provide wall and corner guards in all kitchen and dining areas to protect walls from damage from mobile cart and chair movement. Provide wall guard rails of materials harmonious with the overall interior design and at locations subject to mobile cart movement and chair impacts. See Figure A-25 for details.

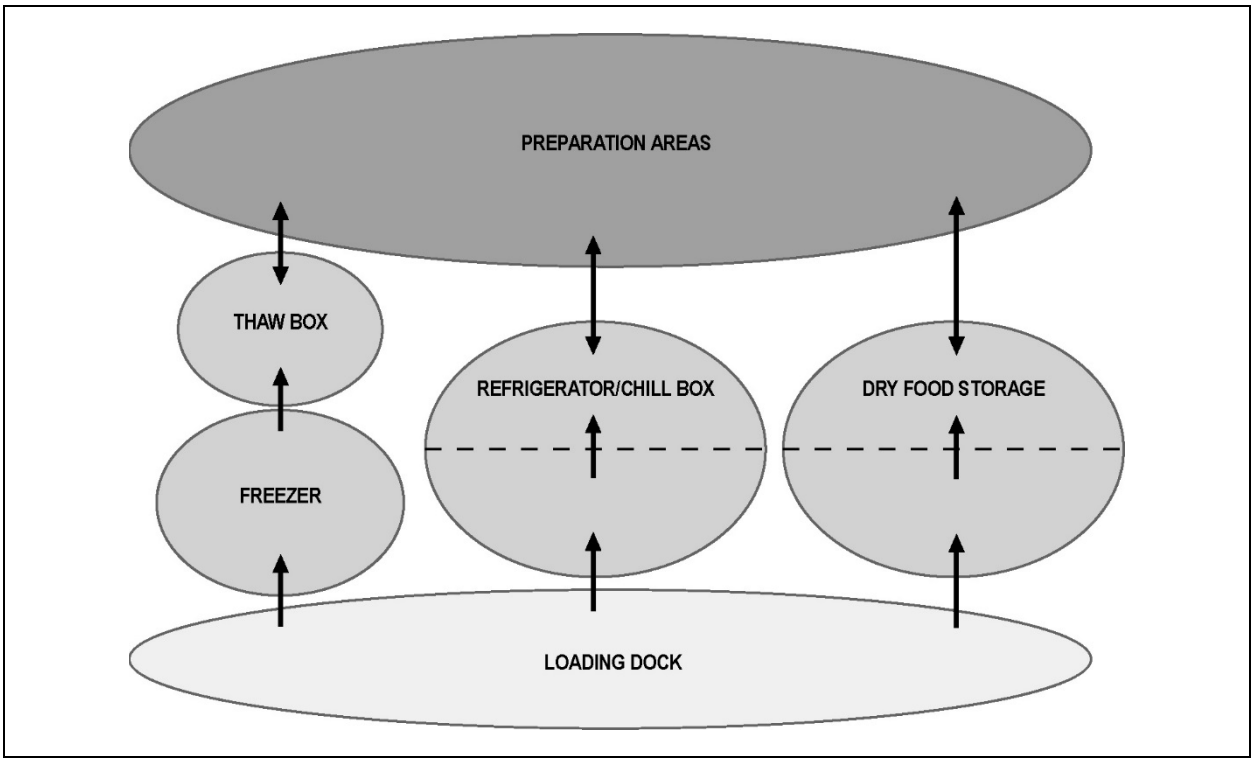
A-6.15.3 Provide serving line tray slides at configurations determined by overall facility design. See Figure A-26 for details.

A-6.15.4 For recessed cold storage coolers and freezers, provide insulated slab construction coordinated with the cooler and/or freezer manufacturer. See Figure A-27 for typical detail.

A-6.15.5 Provide sump drains as needed by kitchen equipment and UFC 3-420-01. See Figures A-28 through A-29 for details.

A-6.15.6 Provide dishwasher duct vents as required by dishwashing equipment. See Figure A-30 for details.

Figure A-1 Storage Access Diagram



A-7 FOOD SERVICE EQUIPMENT.

Present all design work relating to kitchen equipment separately for review. This design work is to include all information required for fabrication and installation of all kitchen equipment.

A-7.1 Sample Equipment Schedules.

The following is a conceptual equipment list. This is a partial list. Consideration should be given for all ventless equipment. Provide any equipment not listed here that is required to provide a complete working system for the stated demand per paragraph 3-7.

Table A-1 Conceptual Equipment List

- Air curtain
- Air pot brewer
- Air pots
- Anti-splash floor troughs
- Area floor drain
- Audio-visual system
- Bagel display
- Bagel toaster
- Bain marie
- Bar code scanner
- Benches
- Blast chiller
- Braising pan, 40-gal (150 L)
- Bread display
- Bussing cart
- Cable television system
- Can opener
- Can rack
- Cappuccino dispenser
- Carbonator
- Cash register
- Cashier counter
- Cashier scales
- Charbroiler
- Chemical storage shelving
- Clean dish table
- Closed circuit television system
- Coffee brewer
- Coffee dispenser
- Cold food wells
- Combination oven/steamer
- Computers
- Condensers for walk-ins
- Condensers for ice makers
- Condiment counter
- Condensate exhaust canopy
- Cone dispenser
- Convection steamer, 10 pan
- Conveyor bagel toaster
- Cook & hold cabinet
- Counter with freezer base
- Counter with sink
- Cup dispensers
- Declining balance card dispenser
- Dish carriers
- Dishwasher
- Dishwasher vents
- Disposer with pre-rinse faucet
- Double-deck convection oven
- Dry storage shelving
- Knife rack
- Maximizer heat recovery
- Menu duplex printers
- Microwave oven
- Mixer, 20 qt (19 L)
- Mixer, 60 qt (57 L)
- Mixer, 80 qt (76 L)
- Mobile attachment shelving
- Mobile chemical shelving
- Mobile hot food cabinet
- Mobile hot food cabinet/proofer
- Mobile mixer table
- Mobile pot/pan shelving
- Mobile range
- Mobile slicer table
- Mobile tray rack
- Mobile utensil soak sink
- Mop rack
- Office printers
- Open-front refrigerated display cabinet
- Panini grill
- Pastry case
- Pizza oven
- Pizza make-up refrigerator
- Pizza preparation table
- Plate dispenser
- Platform truck
- Pot/pan utensil rack
- Pre-rinse faucet
- Pulper/extractor
- Rack dolly
- Receiving scales
- Recirculating disposer
- Recycling containers
- Refrigerated cold pan
- Refrigerated cream dispenser
- Refrigerated equipment stand
- Refrigerated equipment stand with cold rail
- Reach-in refrigerator
- Remote rack refrigeration system
- Roll-in refrigerator
- Safe
- Scale
- Scanners
- Serving counters
- Silver-sorting table
- Sink heater
- Slicer
- Snack cabinet
- Soiled dish table

Table A-1 Conceptual Equipment List

• Dunnage rack • Electric can opener • Electronic programmable station signage • Electronic sandwich pre-ordering station • Espresso machine • Evaporators for walk-ins • Exhaust hoods, Type 1 • Exhaust hoods, Type 2 • Fire-suppression system • Floor troughs • Food guards • Food processor • Food cutter • Frost top • Frozen novelty freezer • Fryer battery with filter • Griddle • Hand sink • Handicapped kitchen worktable • Heat lamps • Heated display cabinet • Heated shelf • Hose bibb • Hose reel • Hot chocolate dispenser • Hot food wells • Hot/cold pan • Ice bin • Ice maker for soda dispensers • Ice machine • Ice/soda dispenser • Iced tea dispenser • Ingredient bins • Insect control equipment • Janitor sink with can wash • Kitchen lockers	• Soup wells • Spent oil cooler • Stainless steel wall panel • Steam kettles • Storage cabinet • Strip curtain • Tabletop oven • Time clock • Toppings dispenser • Tray accumulator, five-tier • Tray cabinet • Tray carriers • Tray return opening frame • Turbo-wash, three-compartment sink • Twin soft serve dispenser • Twin 12-gal (45 L) kettles with stand • Two-compartment sink • Under-counter refrigerator • Uniform hot top range • Utensil rack • Utility cart • Vegetable dryer • Vertical cutter/mixer • Walk-in cooler shelving • Walk-in dunnage rack • Walk-in cook's cooler • Walk-in meat/dairy cooler • Walk-in freezer • Walk-in produce cooler • Wall shelf • Water filter • Water temperature booster 180 °F (82 °C) • Worktable • Worktable with sink

A-7.2 Vibration.

Mount vibration-producing equipment on vibration isolators. Provide vibration-resistant pipe mounting and joints for equipment requiring plumbing.

A-7.3 Utilities.

Coordinate utilities with equipment selection. In general, steam-powered equipment is less expensive and easier to maintain than gas-powered equipment. To the degree possible, equipment should be standardized across an installation or region to facilitate maintenance and maintenance training.

A-8 STAFF FACILITIES.

A-8.1 Staff Toilets.

Government and contract personnel use staff toilets. Consult with the local command to determine staffing figures and shift population.

A-8.2 Staff Lockers.

Provide separate facilities for male and female personnel. Locate locker facilities adjacent to the toilets. Equip locker rooms with lockers, benches, and coat hooks to facilitate changing clothes. Locker quantities to be as indicated in Table A-2. All lockers should be half height except for facilities for 1,001 patrons and over, where three-tier lockers are used. The number of lockers scheduled for each space exceeds the projected number of workers for each category to accommodate the likely shifting balance of male to female workers. If equipment costs prohibit this number of lockers, provide space for the number of lockers in Table A-2. In this case, a portion of the lockers should be freestanding so they can be shifted from space to space as the staffing balance changes. All lockers to have sloped tops.

Table A-2 Staff Locker Count

No. of Staff	Military/Civilian		Contract	
	Male	Female	Male	Female
40 to 80	(Combined facilities, 10 male, 6 female)			
81 to 150	(Combined facilities, 16 male, 10 female)			
151 to 250	18	6	6	12
251 to 400	24	8	12	24
401 to 650	30	10	30	48
651 to 1000	48	12	44	70
1001 to 1500	64	16	64	96
1501 to 2200	96	24	88	132

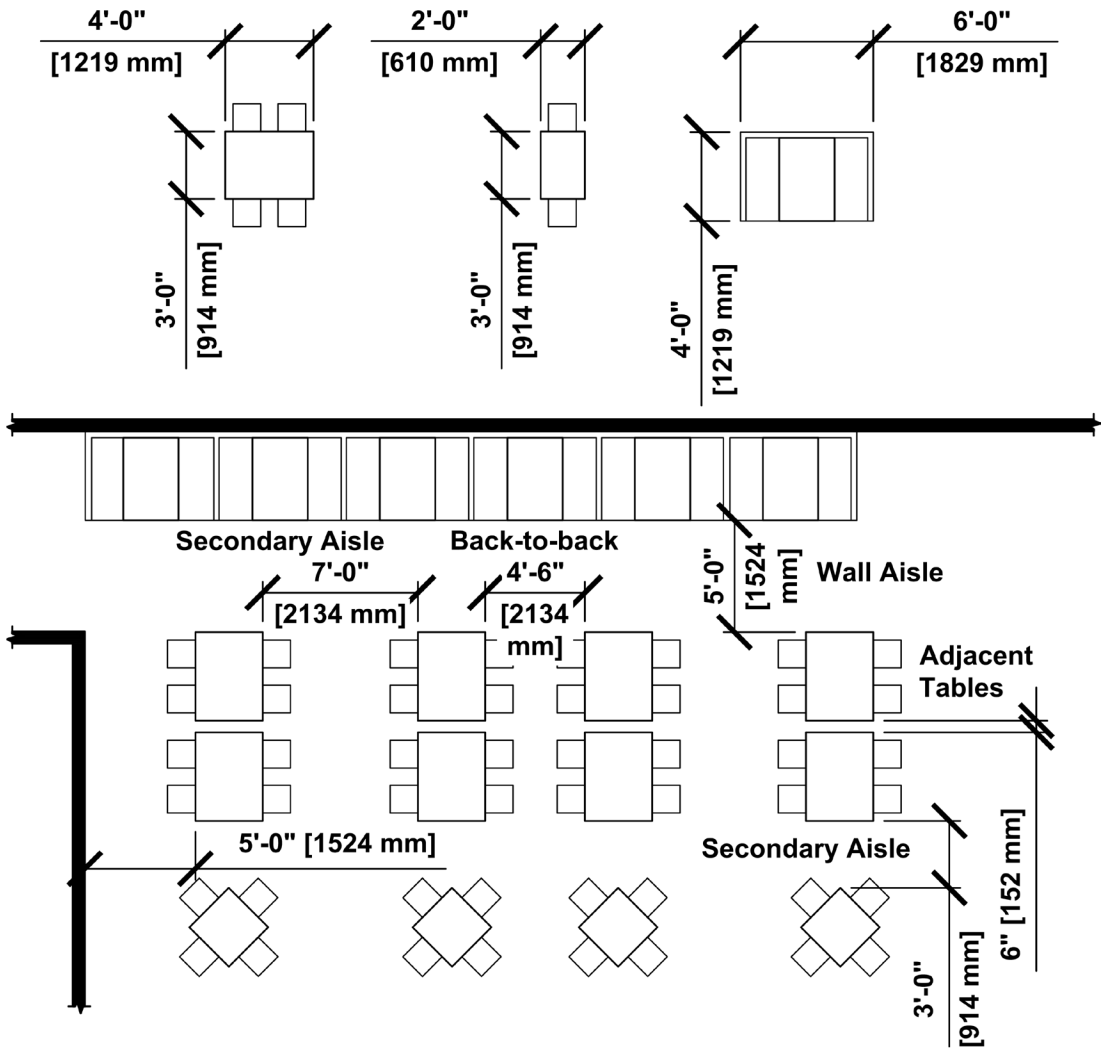
A-9 PLUMBING DESIGN.

Do not use cast-iron piping for sanitary waste lines in dining facilities due to susceptibility to deterioration.

A-10 HVAC DESIGN.

Where possible, use remote condensers to reduce internal heating loads (i.e., ice machines, built-in refrigerators and freezers).

Figure A-2 Table Sizes and Clearances



Notes:

1. A variety of table sizes and configurations should be used to avoid a monotonous arrangement. However, the use of round or square tables is not as space efficient as rectangular tables. Consideration should be given to avoid or minimize seating arrangements which cause one patron to disturb another for access or egress.
2. Aisle widths shown are minimum and must be verified with NFPA 101, *Life Safety Code*, requirements. Sizes may need to be increased for very long aisles.
3. If partitions at tables are desired, partition height should be not greater than 4'-6" (1372 mm) to maintain openness of space.
4. Booth seating should not exceed 30% of total seating.
5. Distribution of table capacities: 20% 2-top; 60% 4-top; 20% 6± top.

Figure A-3 Schematic Plan of Serving Line for Small Dining Facility

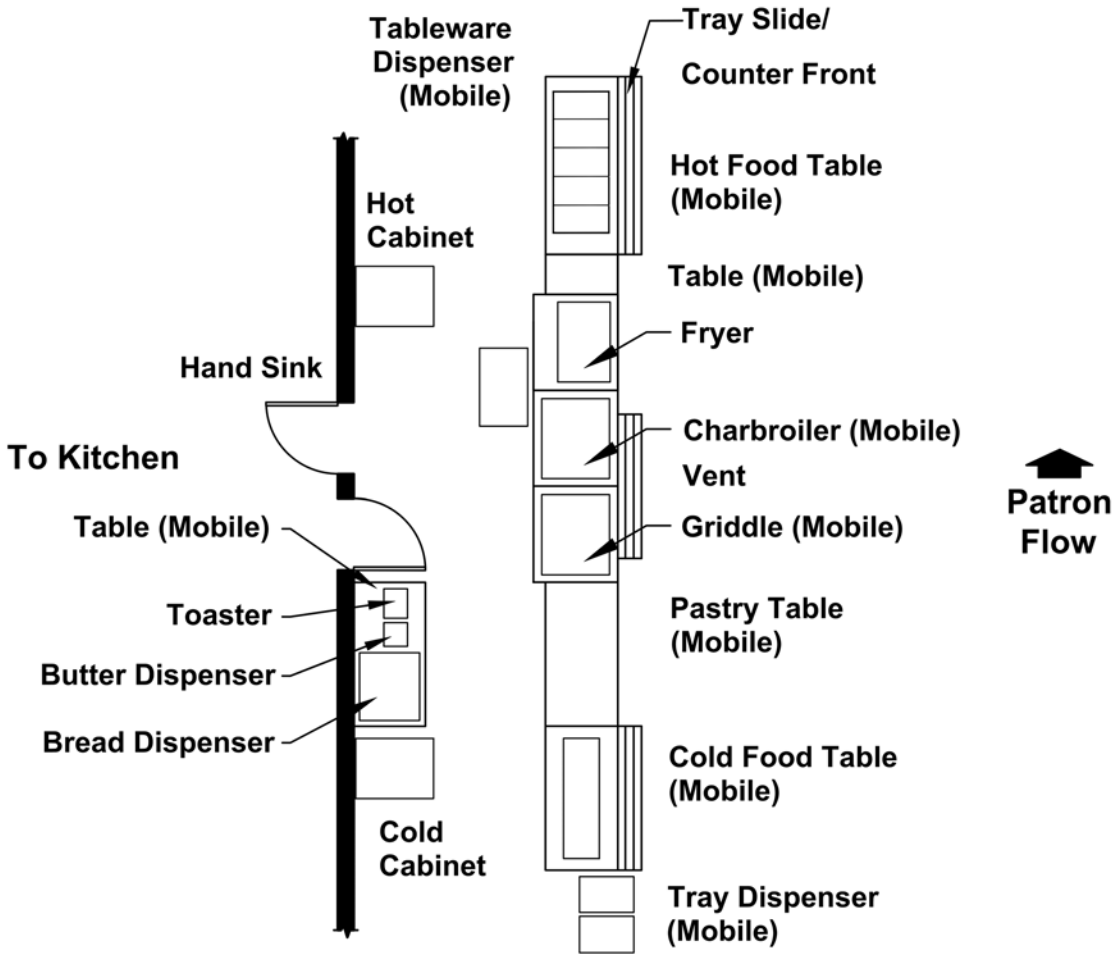


Figure A-4 Schematic Plan of Serving Line for Medium Dining Facility

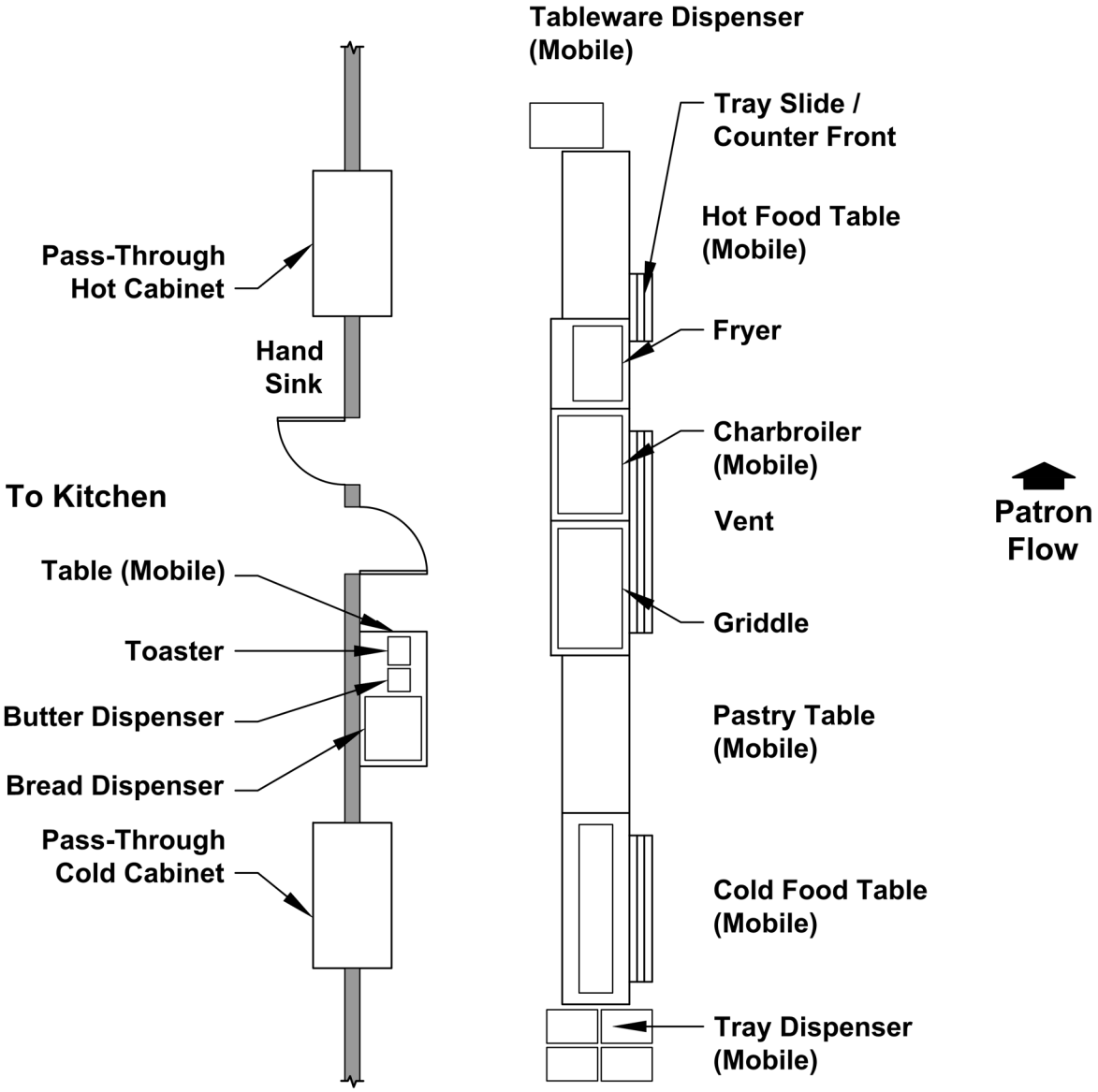


Figure A-5 Schematic Plan of Serving Line for Large Dining Facility

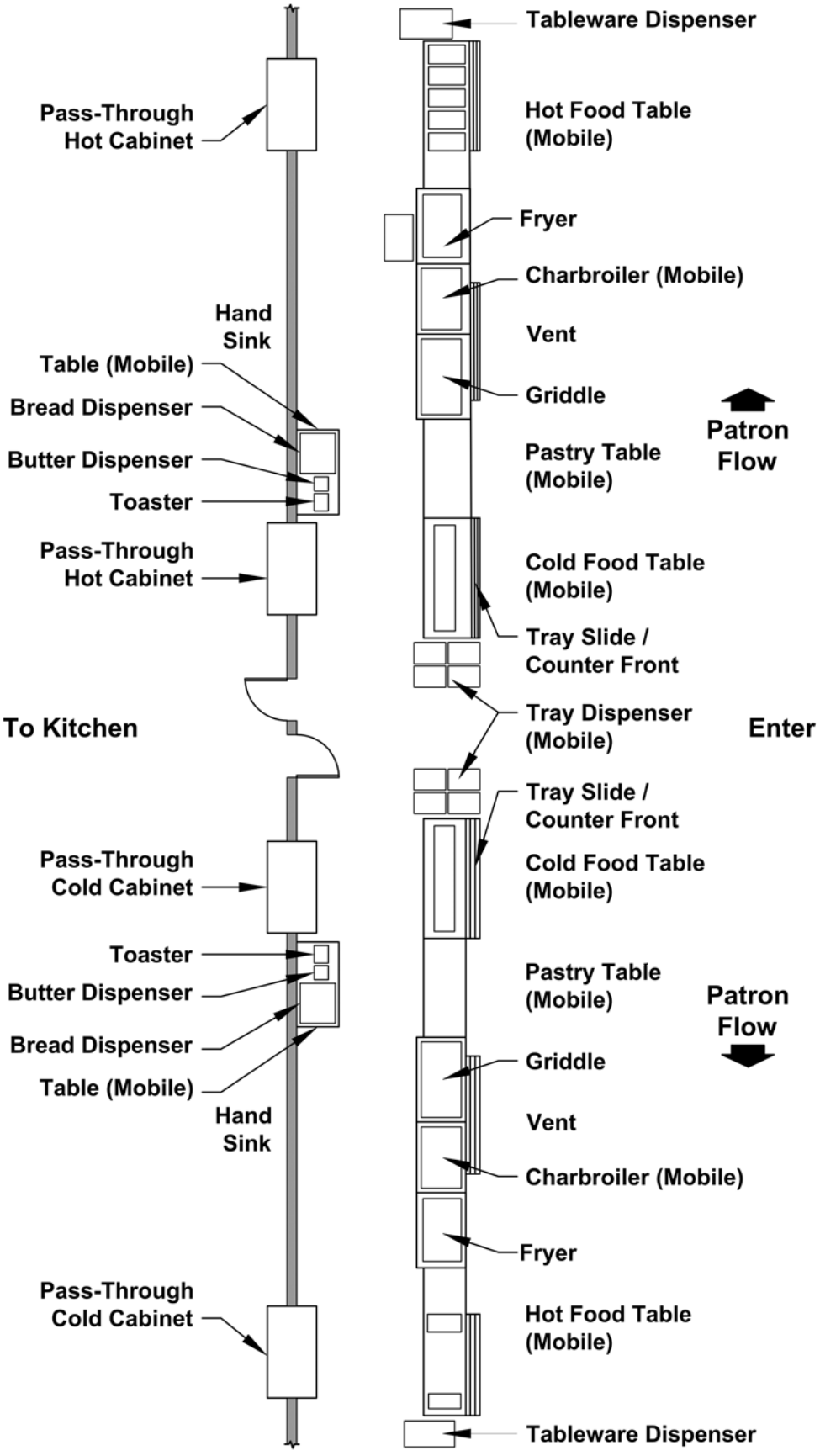


Figure A-6 Schematic Plan of Fast Food Serving Line

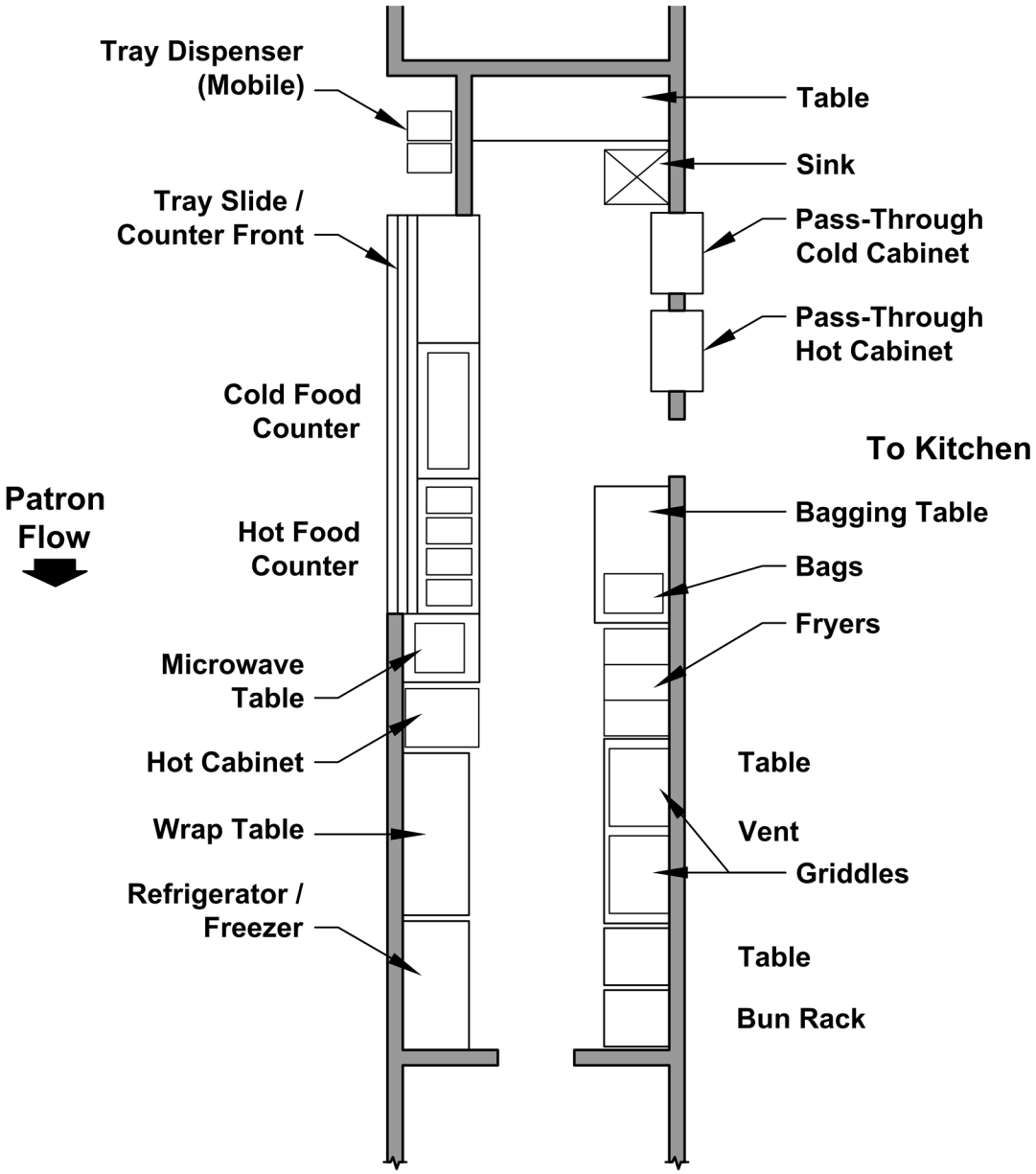


Figure A-7 Schematic Plan of Single Beverage Serving Line

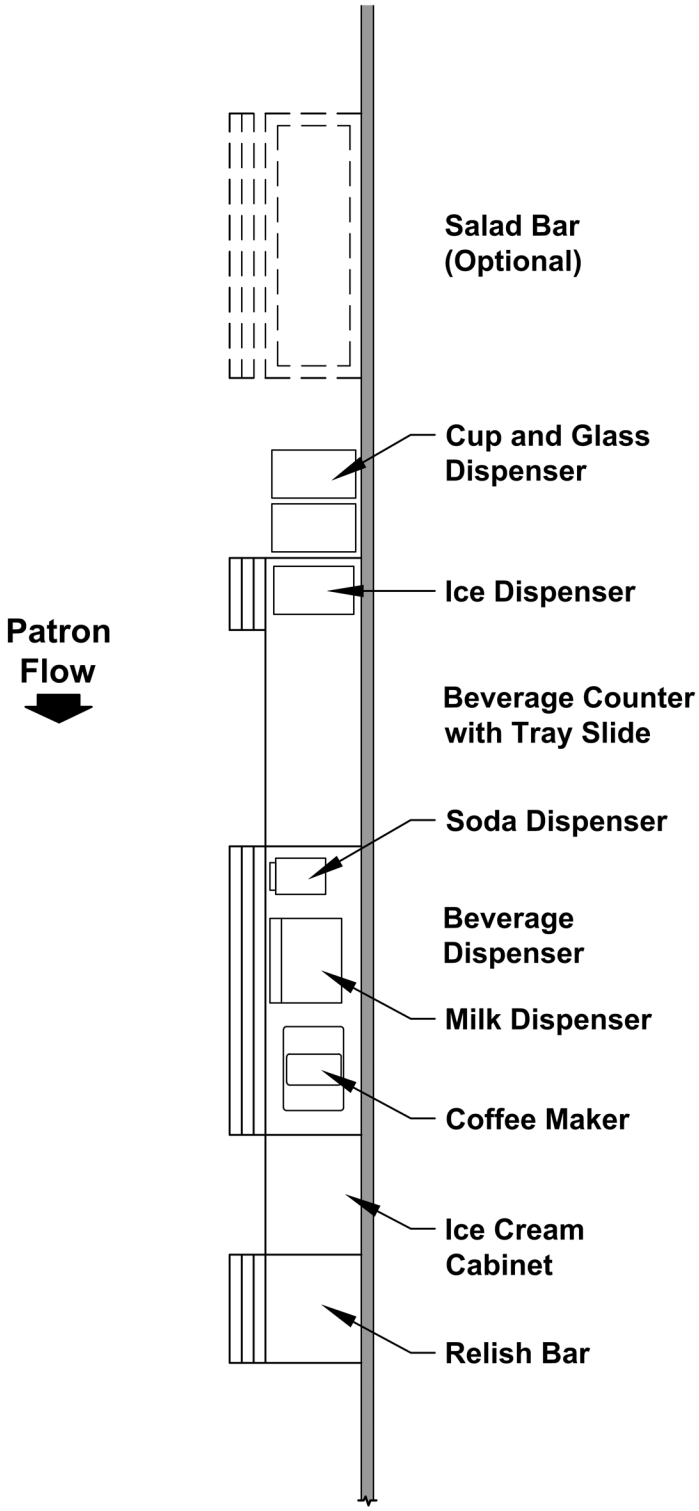


Figure A-8 Schematic Plan of Double Beverage Serving Line

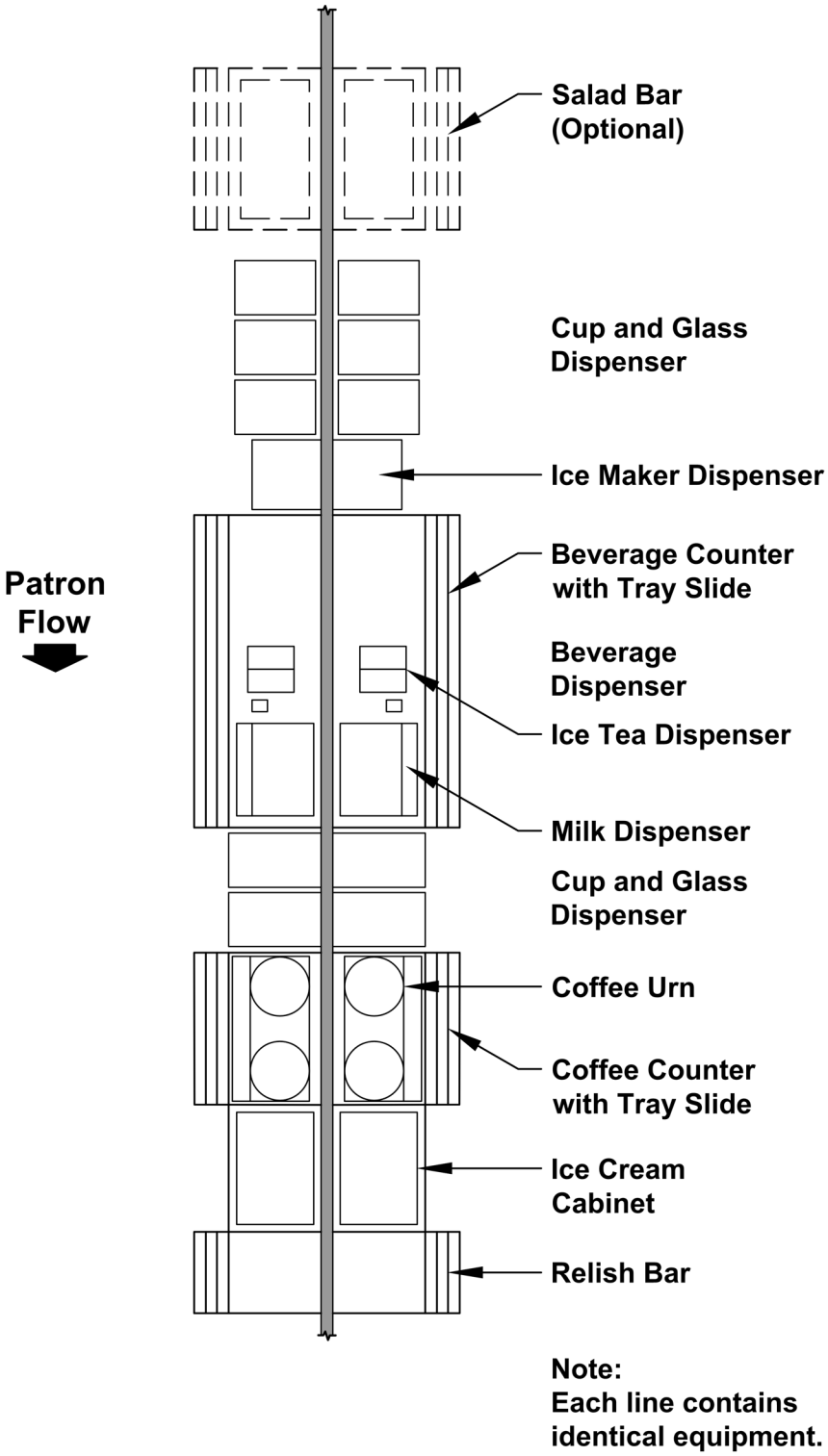
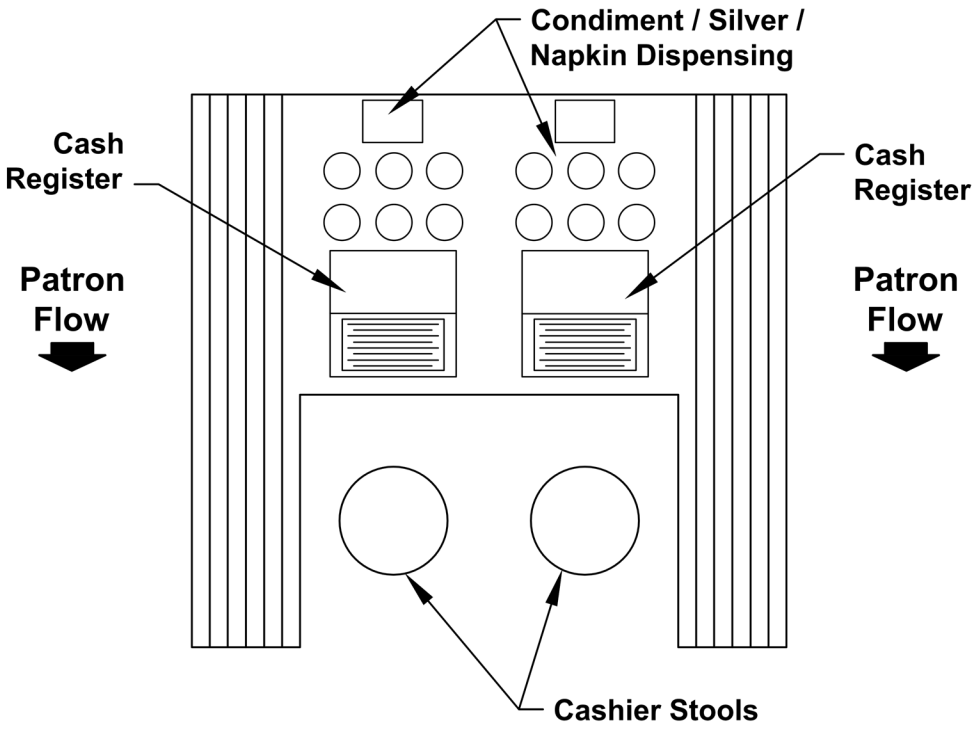


Figure A-9 Schematic Plan of Cashier Station



Note:
Cashier stands are produced in several configurations as standard items by several food service equipment manufacturers.

Figure A-10 Schematic Dishwashing Plan for Small Dining Facility

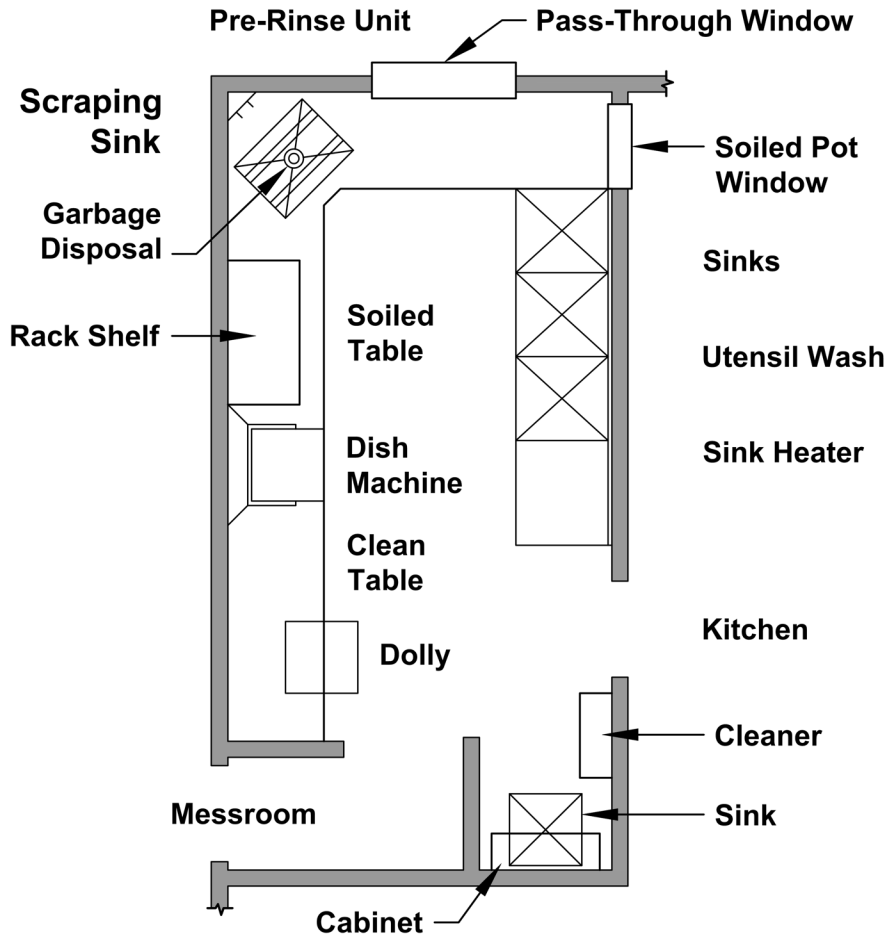


Figure A-11 Schematic Dishwashing Plan Medium Dining Facility

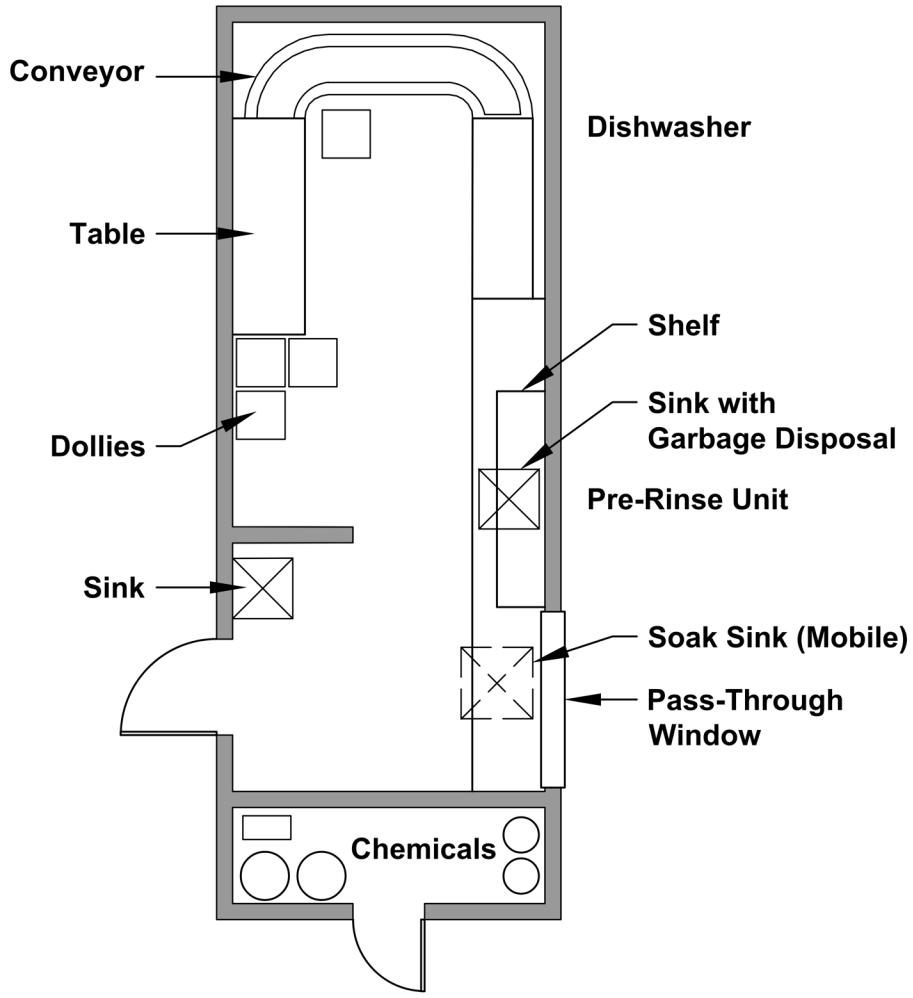


Figure A-12 Schematic Dishwashing Plan – Circular Type

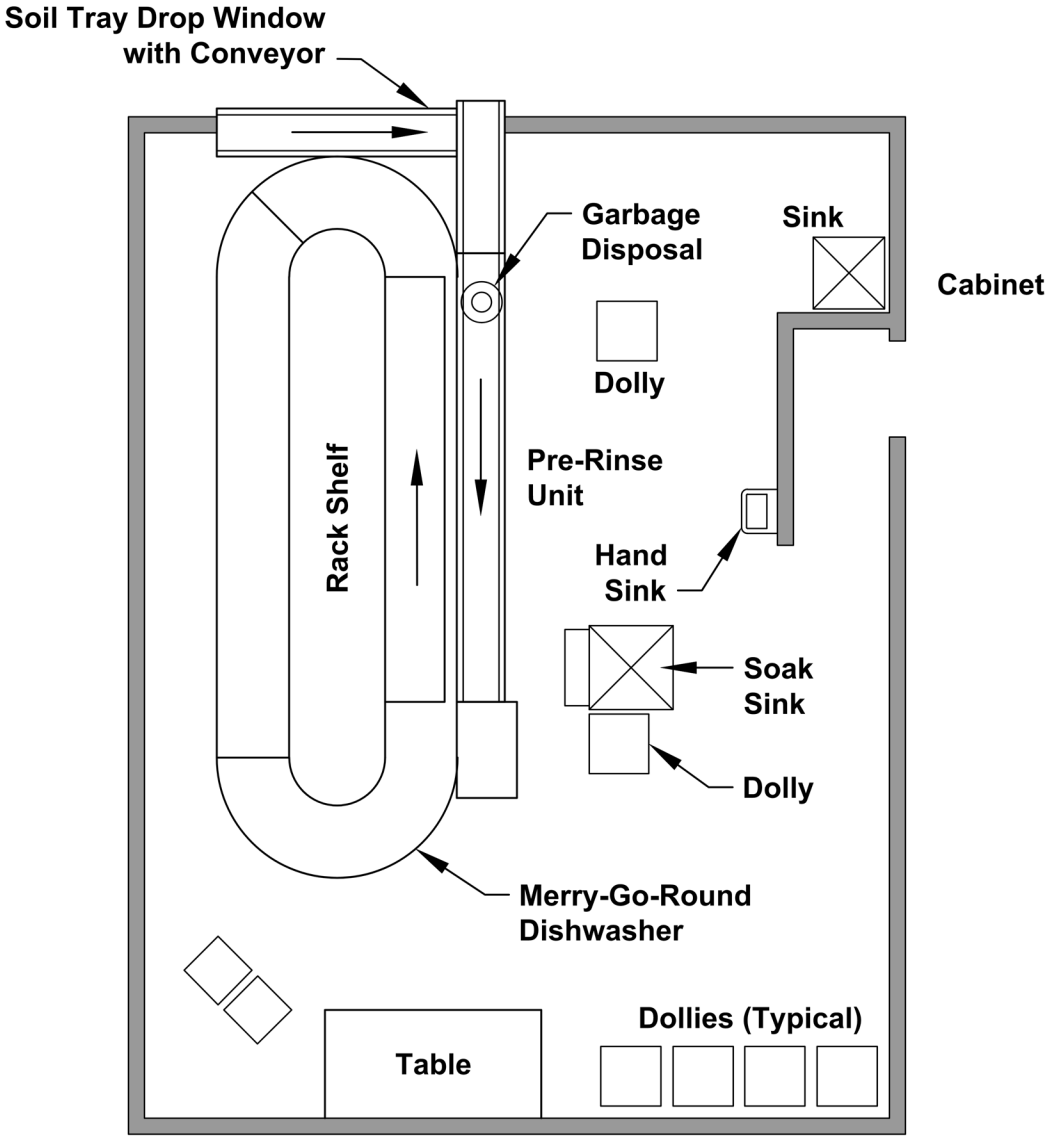


Figure A-13 Schematic Dishwashing Plan – Flight Type

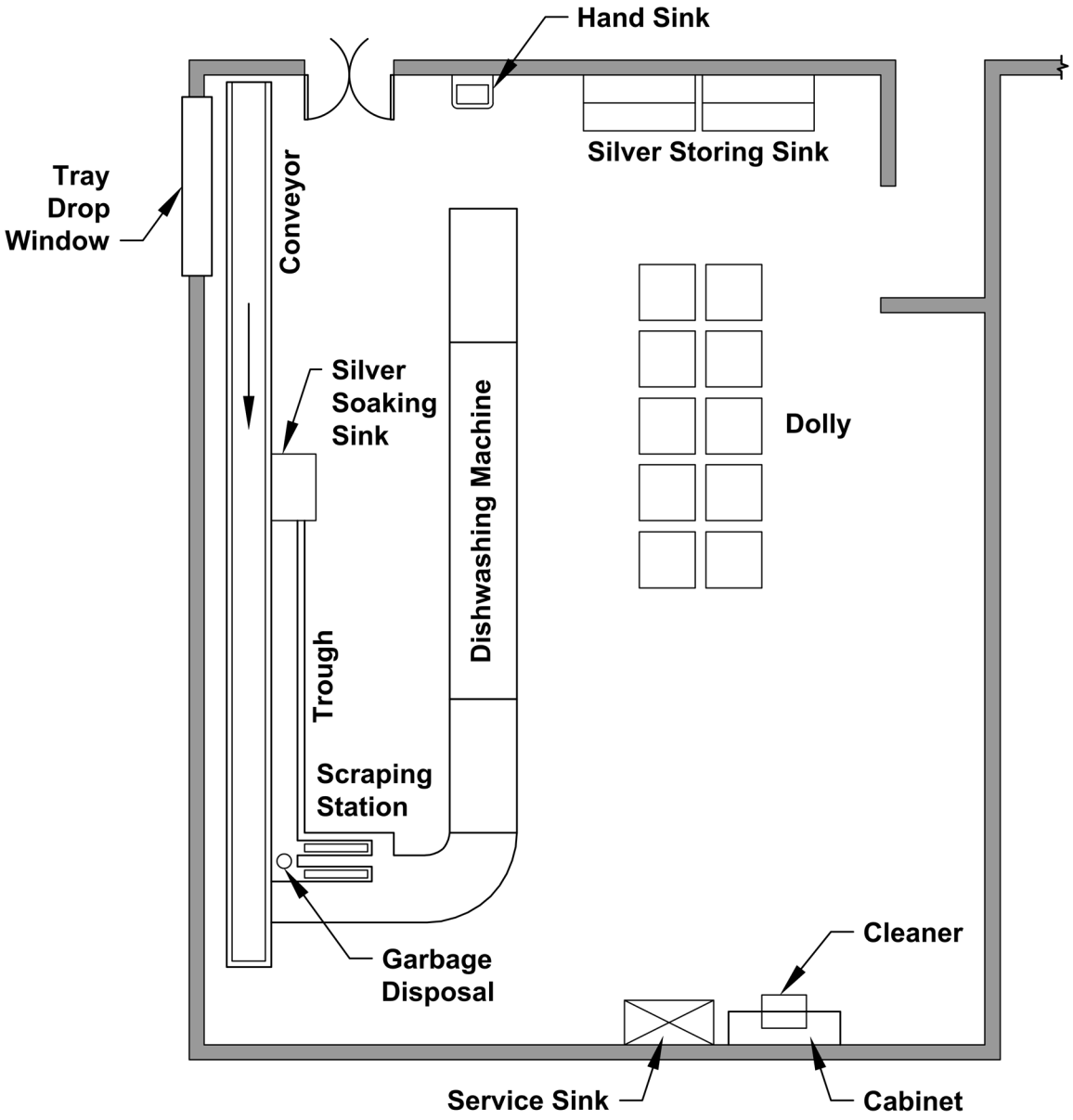


Figure A-14 Schematic Plan Utensil Washing

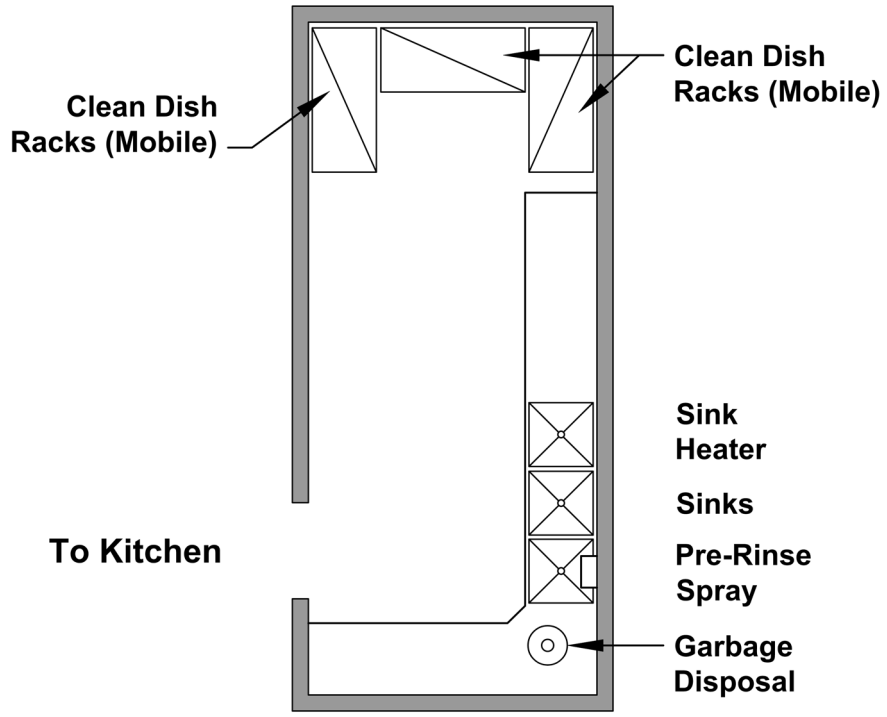


Figure A-15 Schematic Plan of Mechanical Utensil Washing

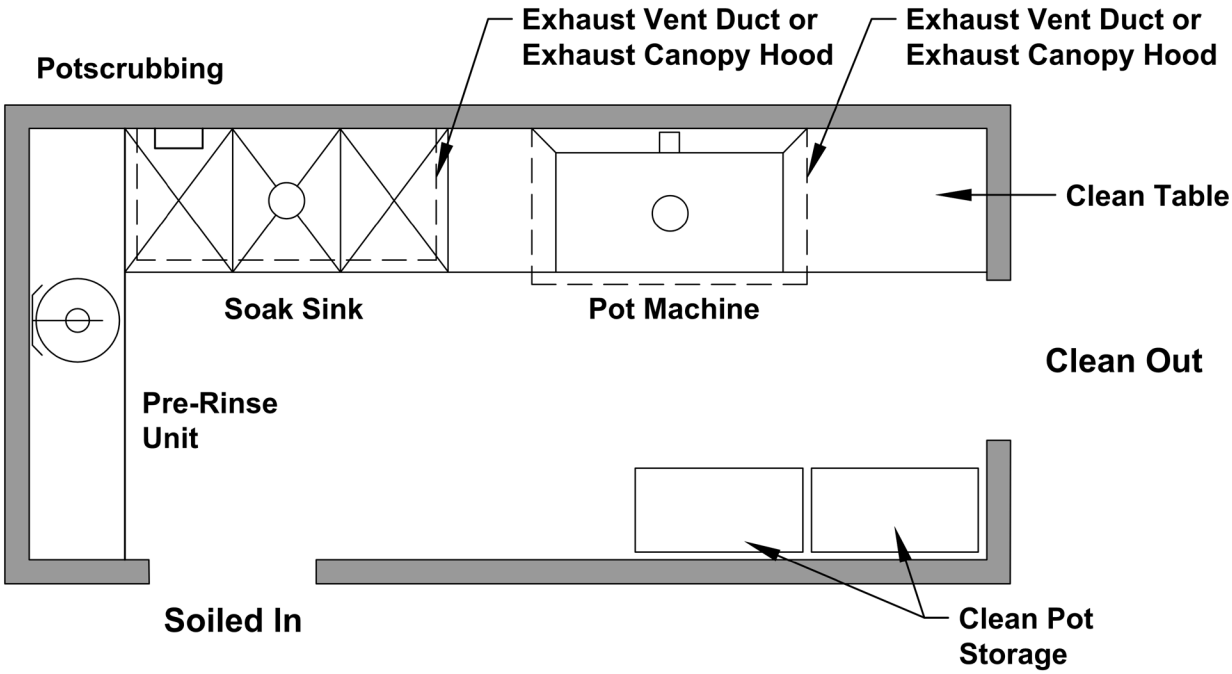


Figure A-16 Schematic Plan of Kitchen – Small Dining Facility (Pot Cookery)

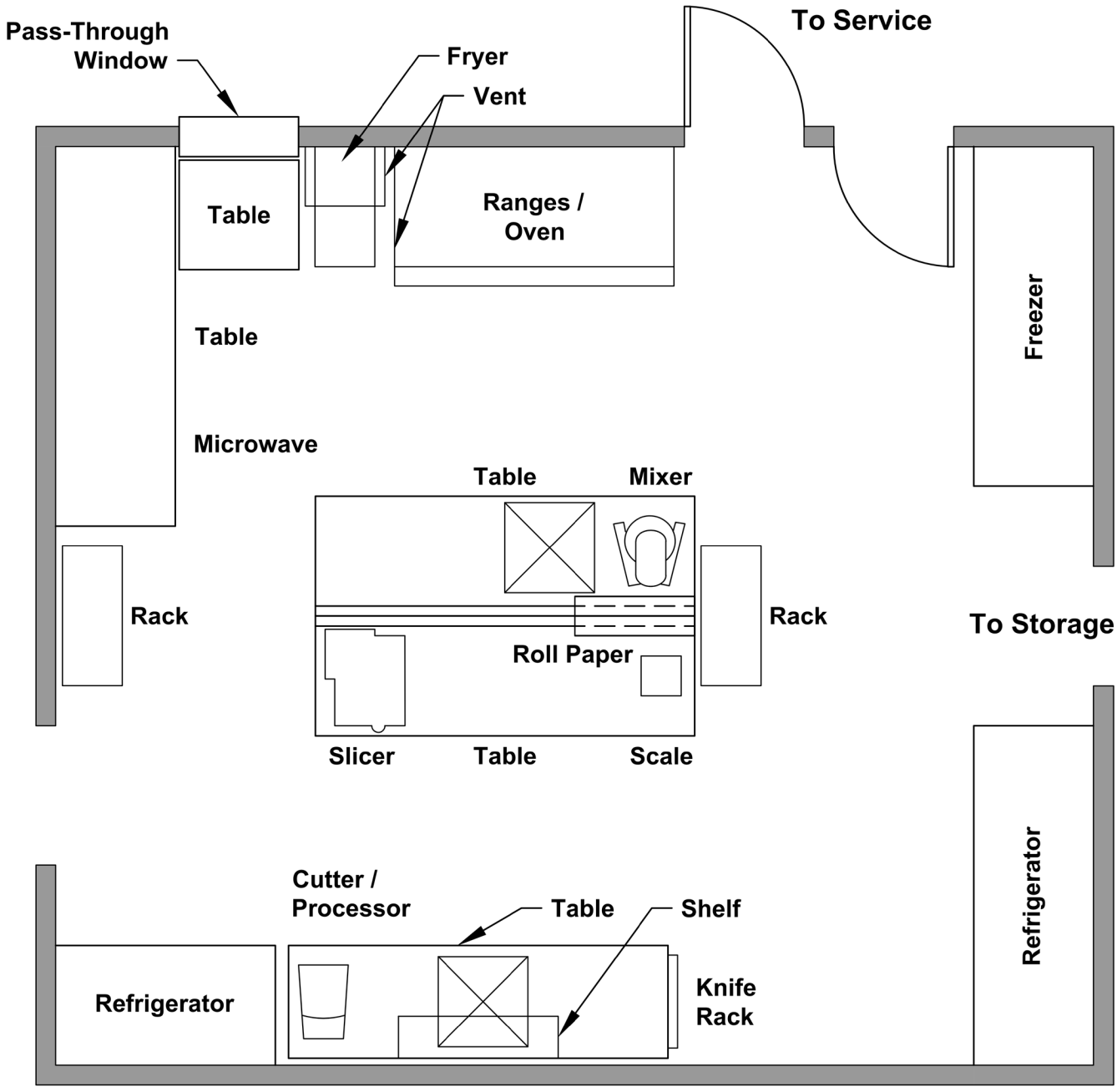


Figure A-17 Schematic Plan of Kitchen – Small Dining Facility (Ovens & Kettles)

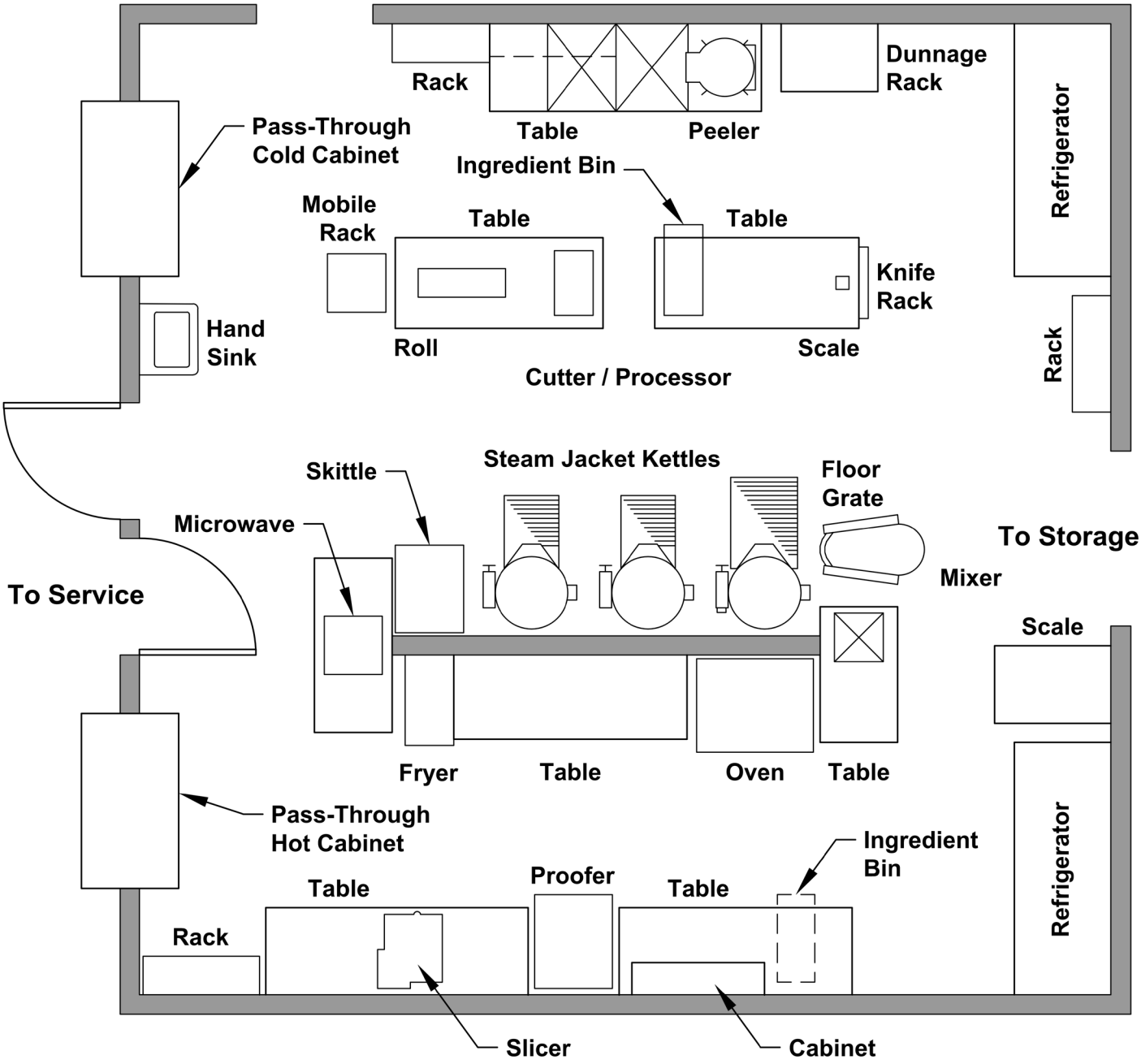


Figure A-18 Schematic Plan of Kitchen – Medium Dining Facility

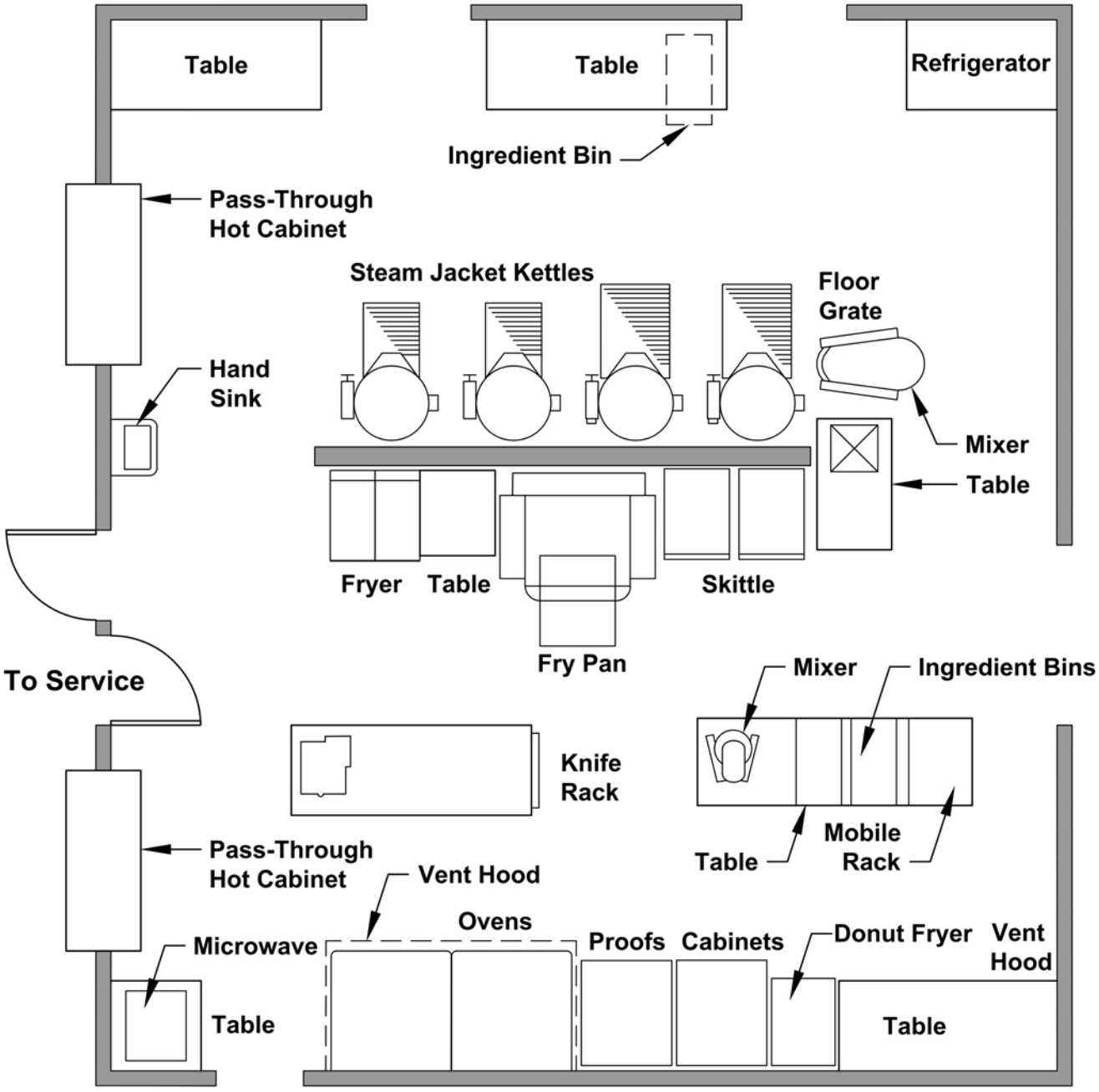


Figure A-19 Schematic Plan of Typical Vegetable Preparation

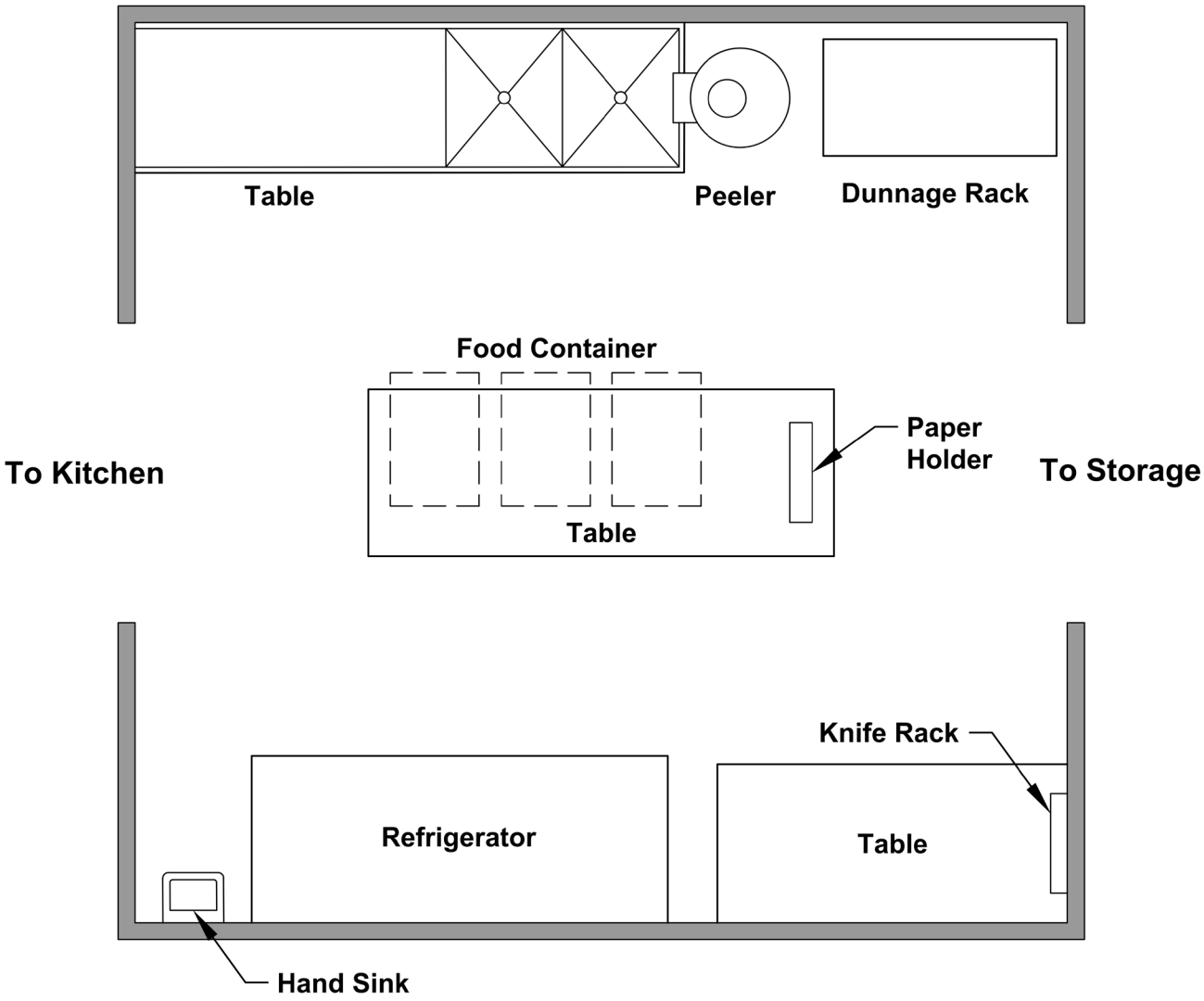


Figure A-20 Schematic Plan of Typical Bakery

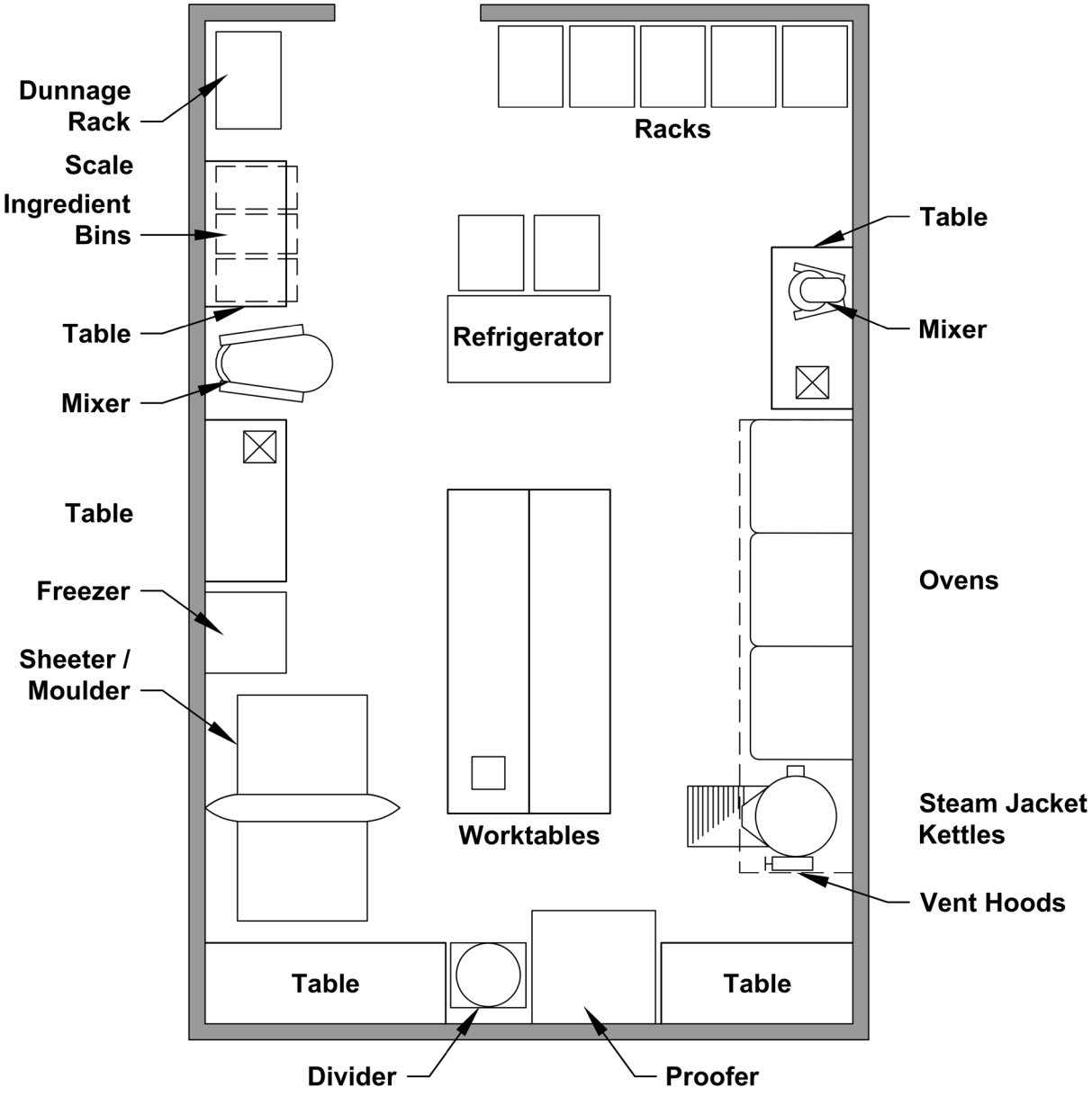


Figure A-21 Schematic Plan of Typical Storage Areas

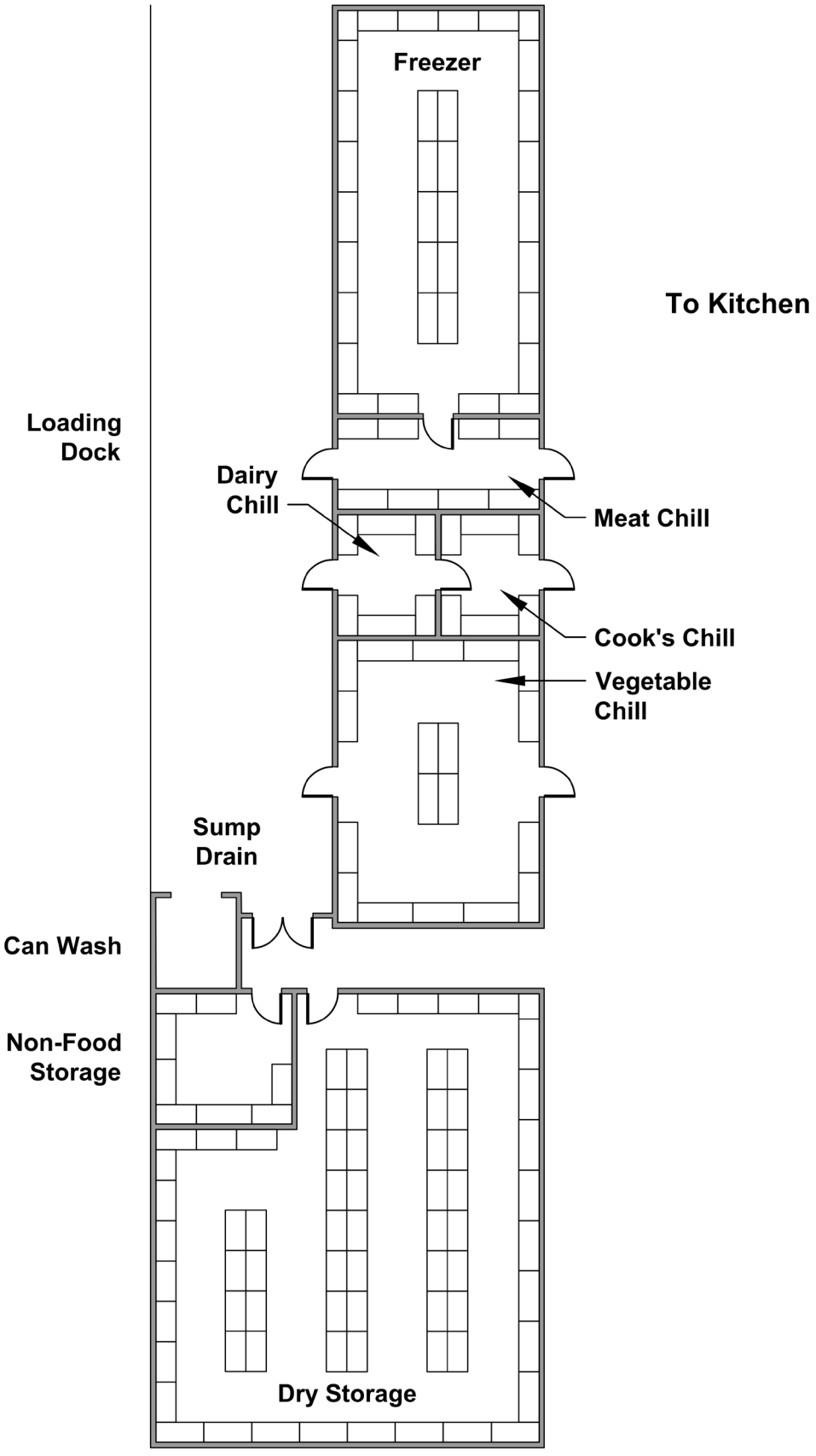
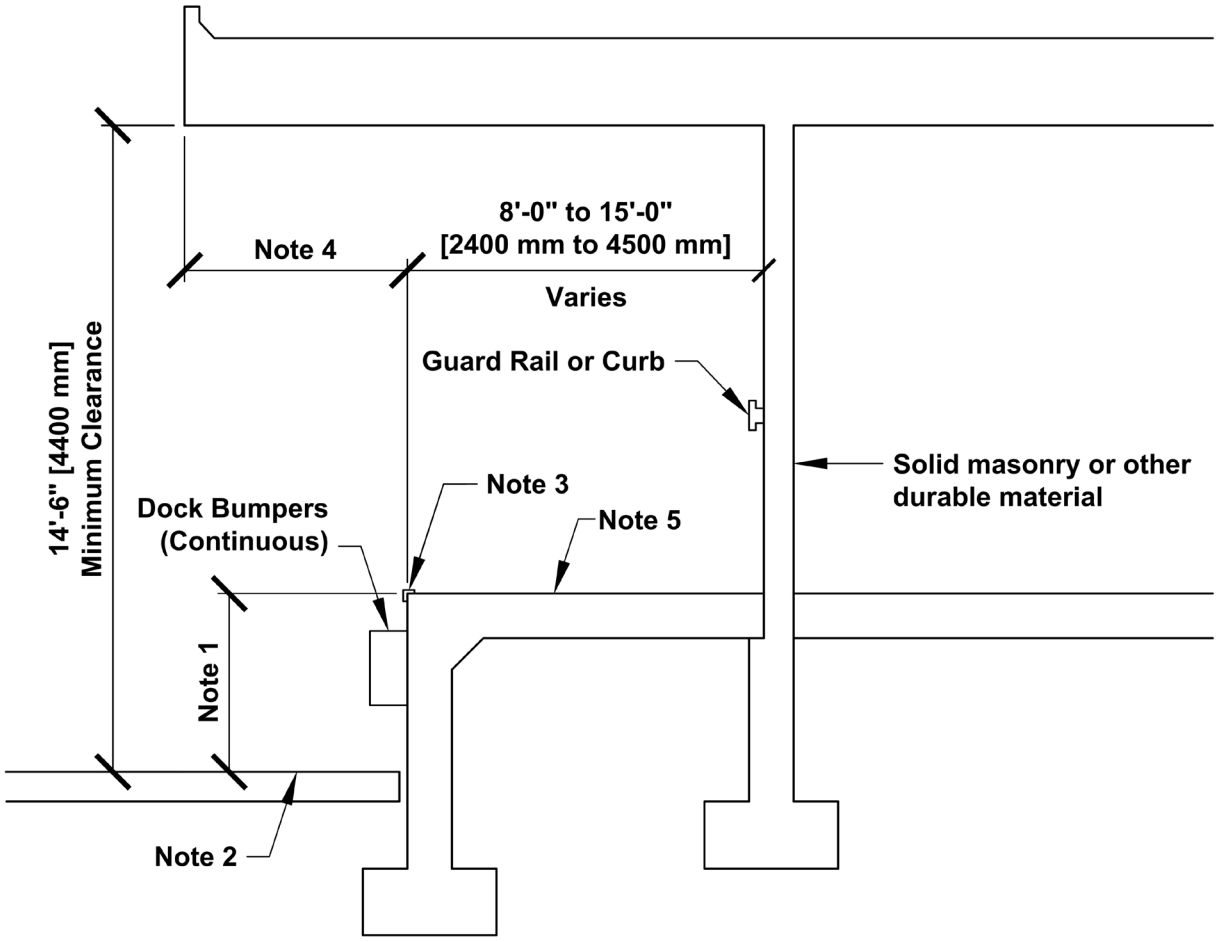


Figure A-22 Loading Dock Criteria



Note:

1. Coordinate height of loading dock with size of vehicles servicing facility. Standard height for larger facilities is 4'-0" [1200 mm].

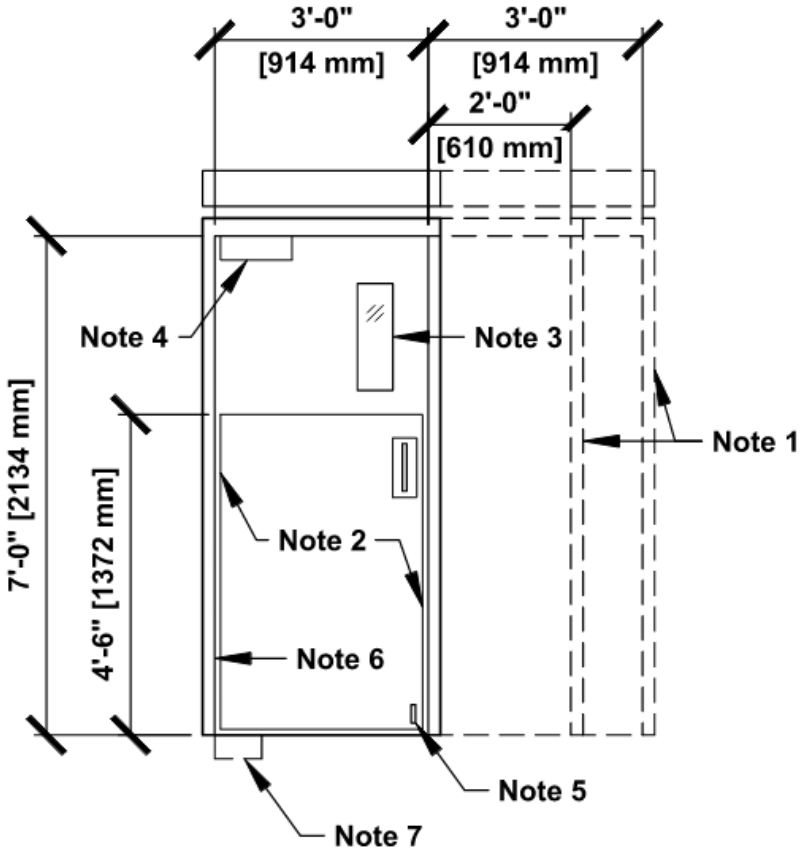
2. Slope dock away from building 1/8" in 12" [305 mm]. Dock is to be broom finish concrete.

3. 2" [50 mm] metal lip to protect concrete edge of dock and to prevent carts from rolling off edge.

4. Overhang as required for weather protection. In cold weather areas requiring enclosed loading docks use insulated rolling doors and dock seals and omit overhang.

5. Provide concrete ramp from dock to vehicle area for hand cart access.

Figure A-23 Doors in Kitchen Area



Notes:

1. **All doors in the kitchen area must be a minimum of 3'-0"x7'-0" [914 mm x 2134 mm]. Doors to storage and loading dock areas must be 6'-0" [1829 mm] wide double doors. If space limitations require the use of a 5'-0" [1524 mm] door, the inactive leaf should be 2'-0" [610 mm].**

2. **Provide 16 ga. stainless steel protection to all doors in areas having cart traffic.**

3. **Provide vision panel in all doors with two way traffic.**

4. **Provide heavy duty door closers with time delay closing feature at doors with heavy cart traffic.**

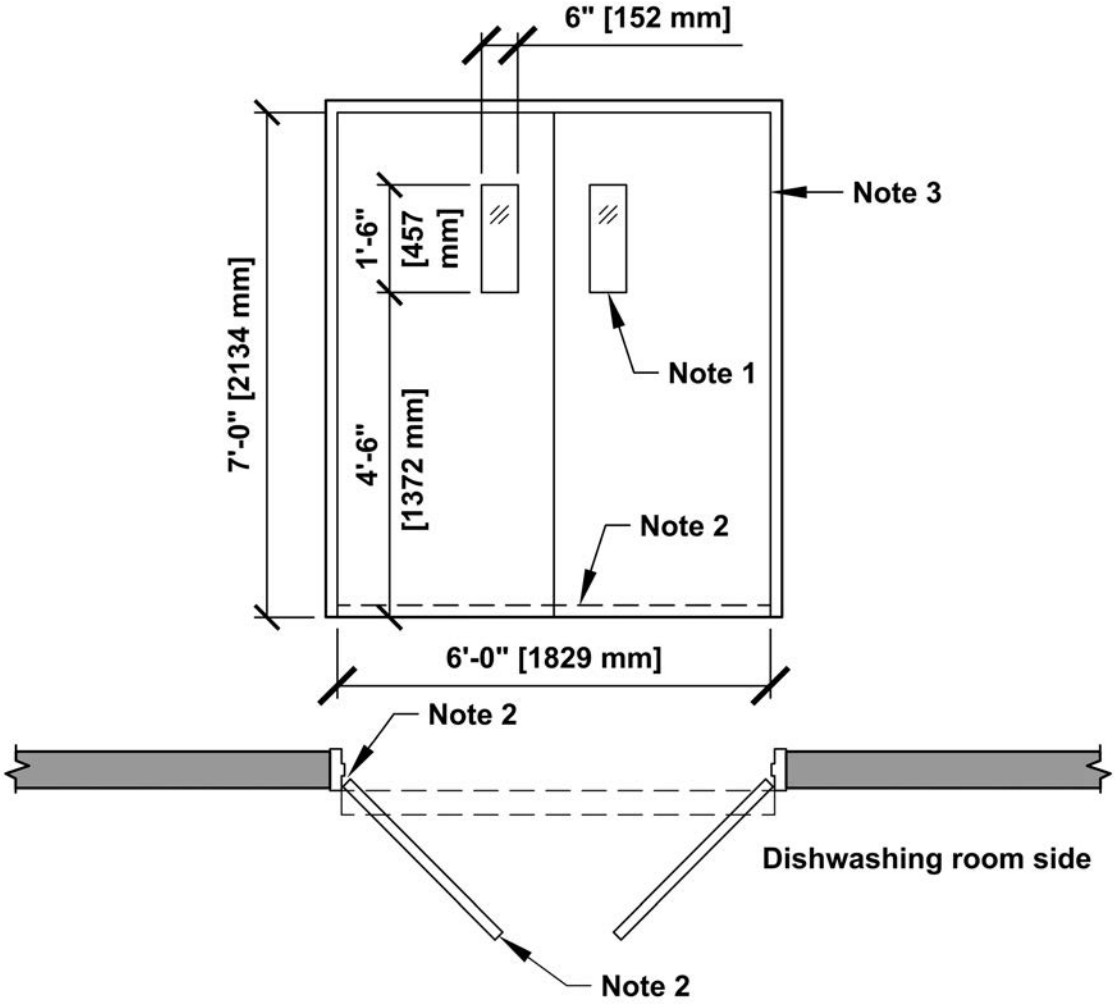
5. **Provide hold open device, either concealed indoor head or wall mounted. Floor mounted hold open devices are not approved.**

6. **Provide heavy duty ball bearing hinges at all single swing doors.**

7. **Provide heavy duty recessed pivot hinges at all double swing doors.**

8. **Provide plastic closure flaps at all exterior doors in cold storage spaces.**

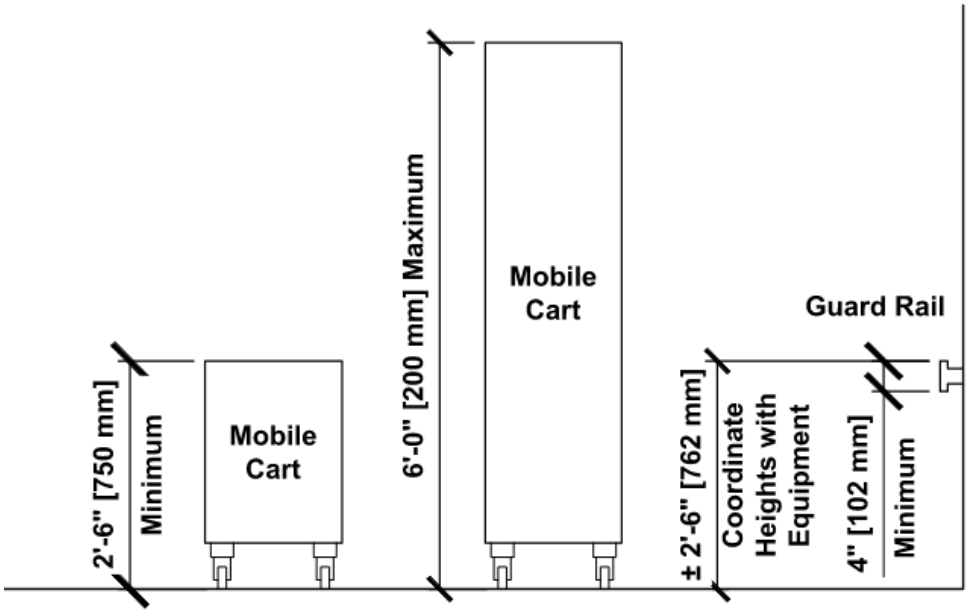
Figure A-24 Double Doors at Dishwashing Station



Notes:

1. Provide vision panels as indicated.
2. Provide sound seal hardware at all door edges.
3. Heavy duty ball bearing type hinges.

Figure A-25 Miscellaneous Guard Rail Locations and Corner Guards





Mount 14 ga. [1.90 mm] stainless steel corner guards flush with base. Attach with stainless steel fasteners and caulk with silicone sealant.

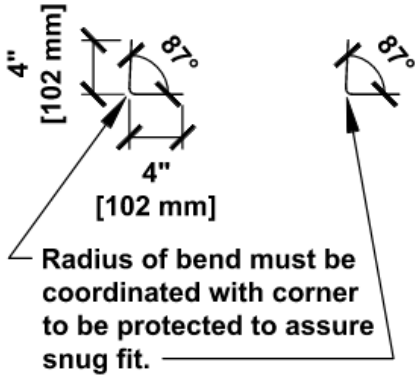
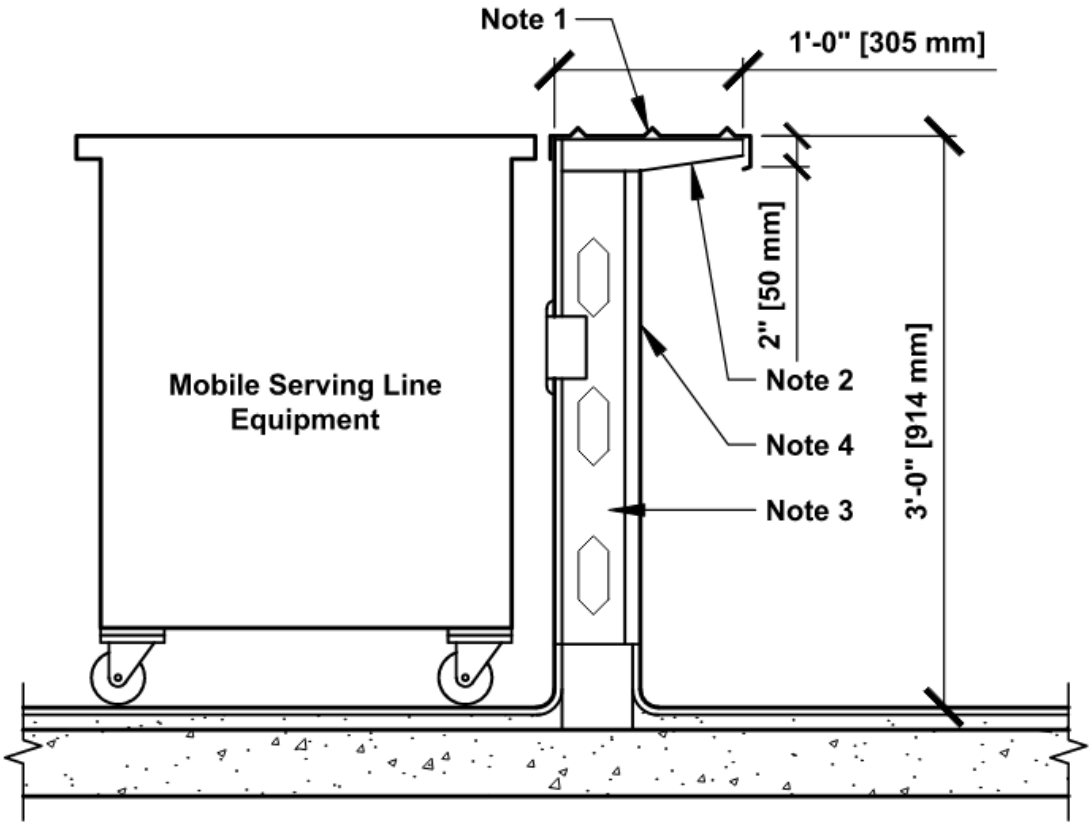


Figure A-26 Serving Line Tray Slide



Notes:
For more information on trayslide details, contract Food Service System Office for current standard drawing.

1. **14 Ga. [1.9 mm] stainless steel trayslide secured to bracket with welded studs.**

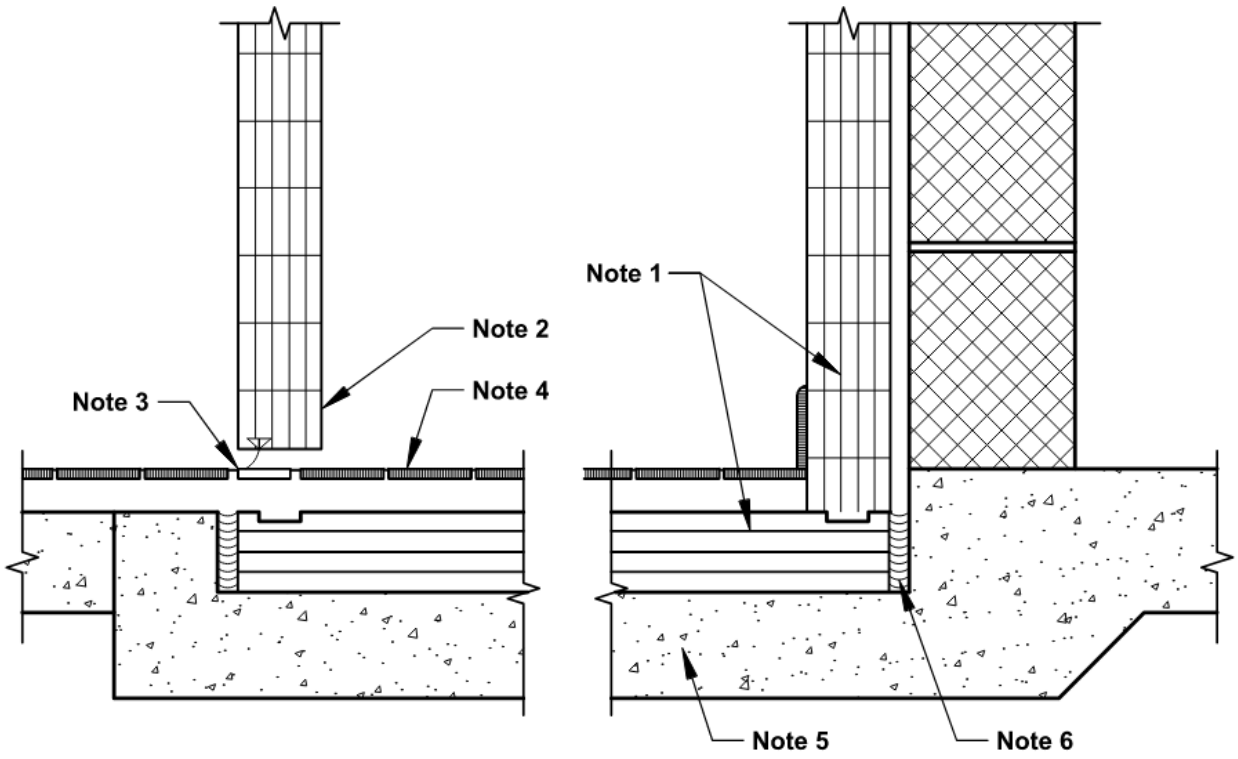
2. **Stainless steel trayslide bracket welded to continuous stainless steel channel at 4'-0" [1200 mm] on center.**

3. **16 Ga. [1.50 mm] structural steel stud frame at 16" [400 mm] on center, anchor bolted to concrete curb. Frame must turn corner at ends and run 2'-6" [750 mm] to stabilize free standing ends. Openings in stud work must be used as raceway for electrical wiring and other utilities as required.**

4. **Face panels may be plastic laminate, ceramic tile or approved wall surfaces.**

5. **Manufactured trayslide systems providing similar features to the above may be submitted for approval.**

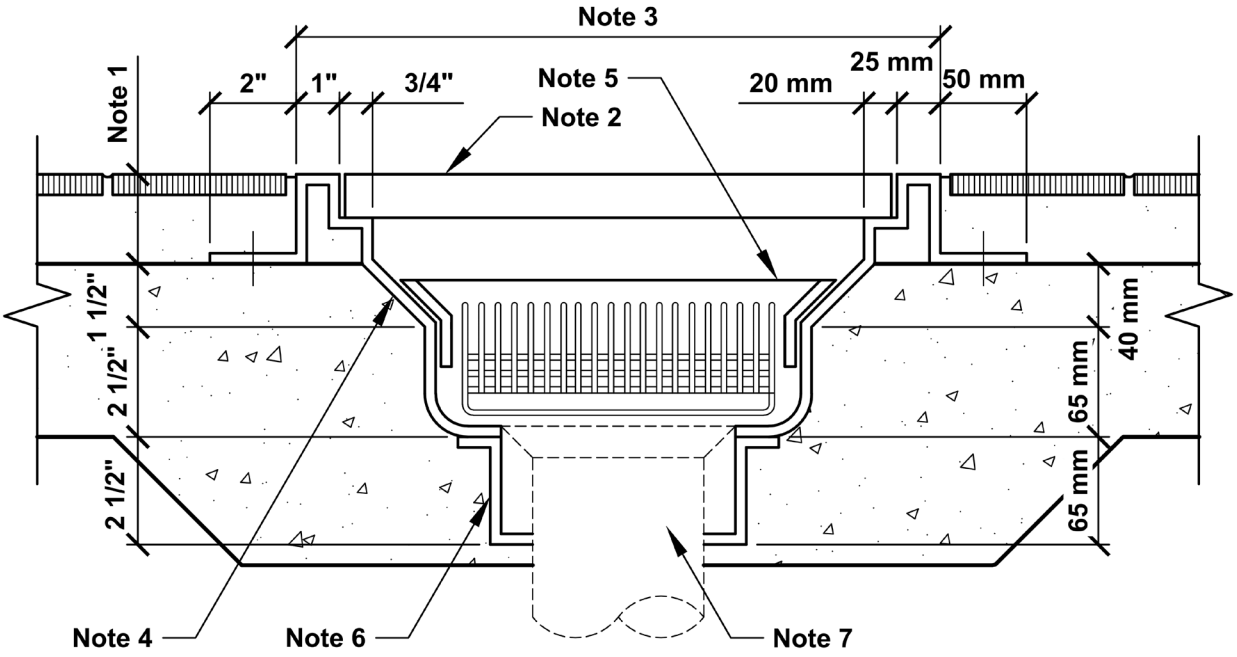
Figure A-27 Cold Storage Slab Insulation



Notes:

1. Metal covered insulated wall and floor panels.
2. Metal covered insulated walk-in door with adjustable floor wiper gasket.
3. Anti-sweat heater.
4. Quarry tile-in setting bed. Set tile dead level.
5. Recessed concrete slab on polyethylene vapor barrier. Depth of recess must be equal to thickness of insulated panel as specified and quarry tile and setting bed.
6. Provide sealant at edges of slab as indicated.
7. At freezer locations, if any portion of the slab is greater than 20'-0" [6000 mm] from the perimeter, the slab must be heated to prevent freezing.

Figure A-28 Sump Drain – Pan Type



Notes:

1. **Coordinate depth of frame with depth of quarry tile setting bed.**

2. **Grating to be 1/4" x 1" [6 mm x25 mm] stainless steel bars fully welded at all connections. Allow 1/8" clearance on all sides.**

3. **Size of grating to be determined by designer.**

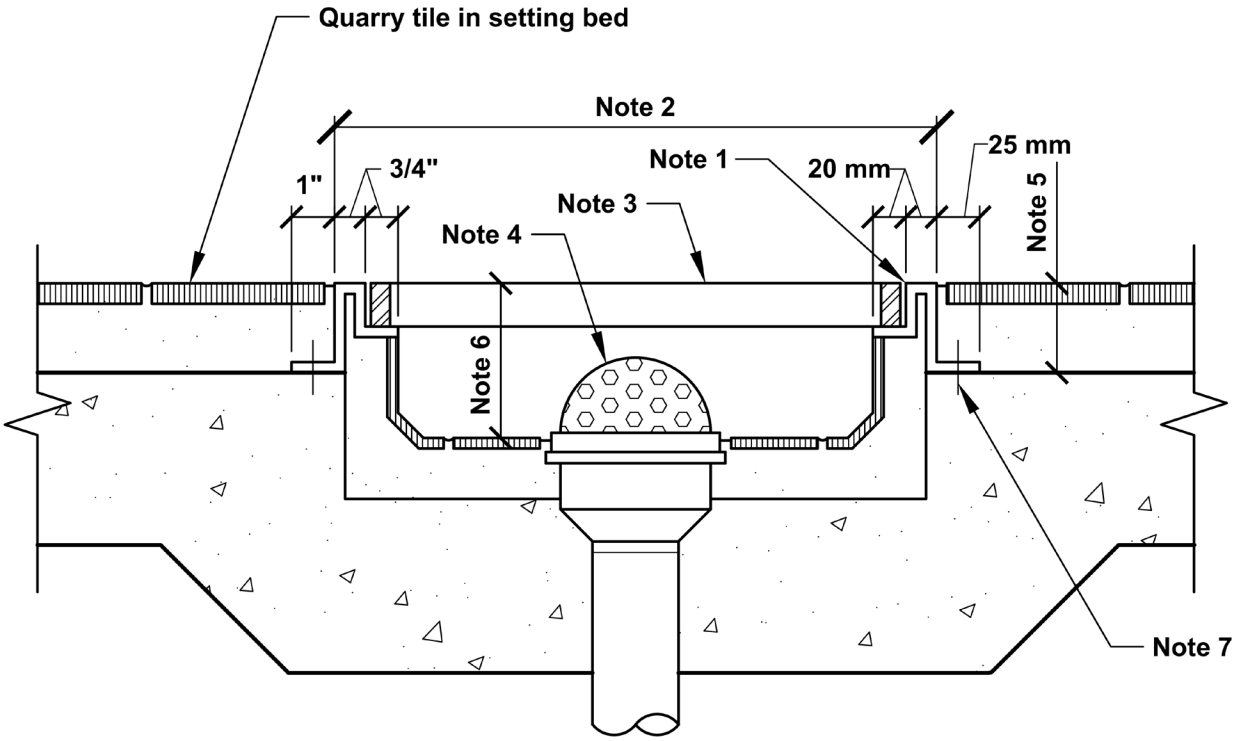
4. **14 Ga. [1.90 mm] stainless steel pan with all coved corners and fully welded seamless construction.**

5. **Removable mesh basket of #4 [5.75 mm] stainless steel wire mesh reinforced at top with 16 Ga. [1.50 mm] stainless steel perimeter frame.**

6. **12 Ga. [2.65 mm] stainless steel stuffing box.**

7. **4" [100 mm] waster plumbing with bell hub inside of stuffing box.**

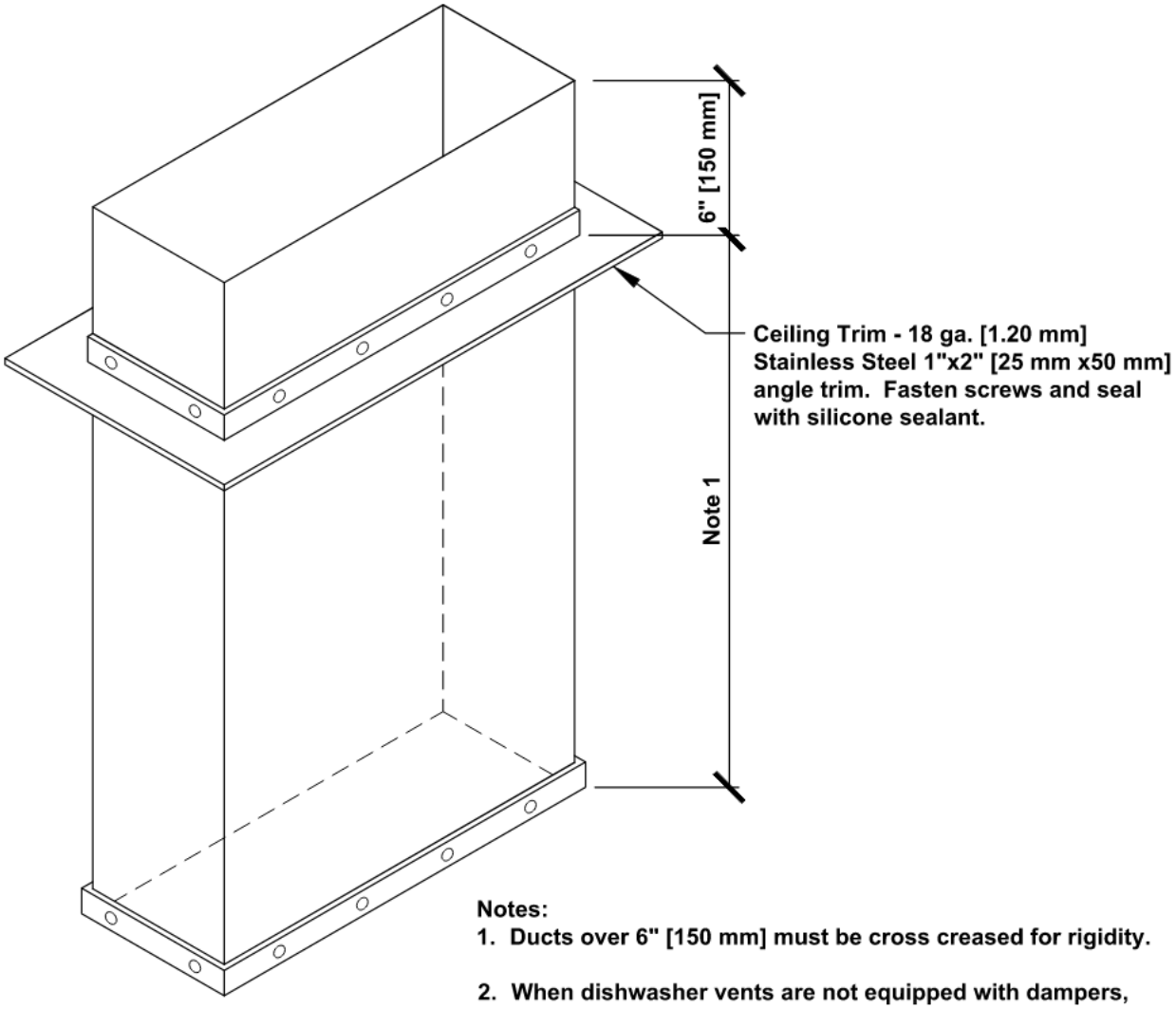
Figure A-29 Sump Drain – Tile Type



Notes:

1. **Grate frame is to be 12 Ga. [2.65 mm] stainless steel.**
2. **Width and configuration of trench drain is to be determined by designer.**
3. **Floor grate is to be pressure locked stainless steel grating as required to fit trench configuration. Maximum size of individual grate to be the lesser of 3'-0" [900 mm] or 30 lbs. (14 kg).**
4. **Adjustable beehive strainer.**
5. **Coordinate height of frame with specified depth of setting bed.**
6. **Finished depth of trench to be 4" [100 mm].**
7. **Fasten to slab with ram set concrete anchors.**
8. **Pitch trench at 1/8" per foot to drain.**

Figure A-30 Dishwasher Duct Vent



Notes:

1. **Ducts over 6" [150 mm] must be cross creased for rigidity.**
2. **When dishwasher vents are not equipped with dampers, duct must be provided with an 18 ga. [1.20 mm] stainless steel damper and locking quadrant located between the louvers and the dishwasher vent.**

Figure A-31 Schematic Plan of Scatter System Serving Line

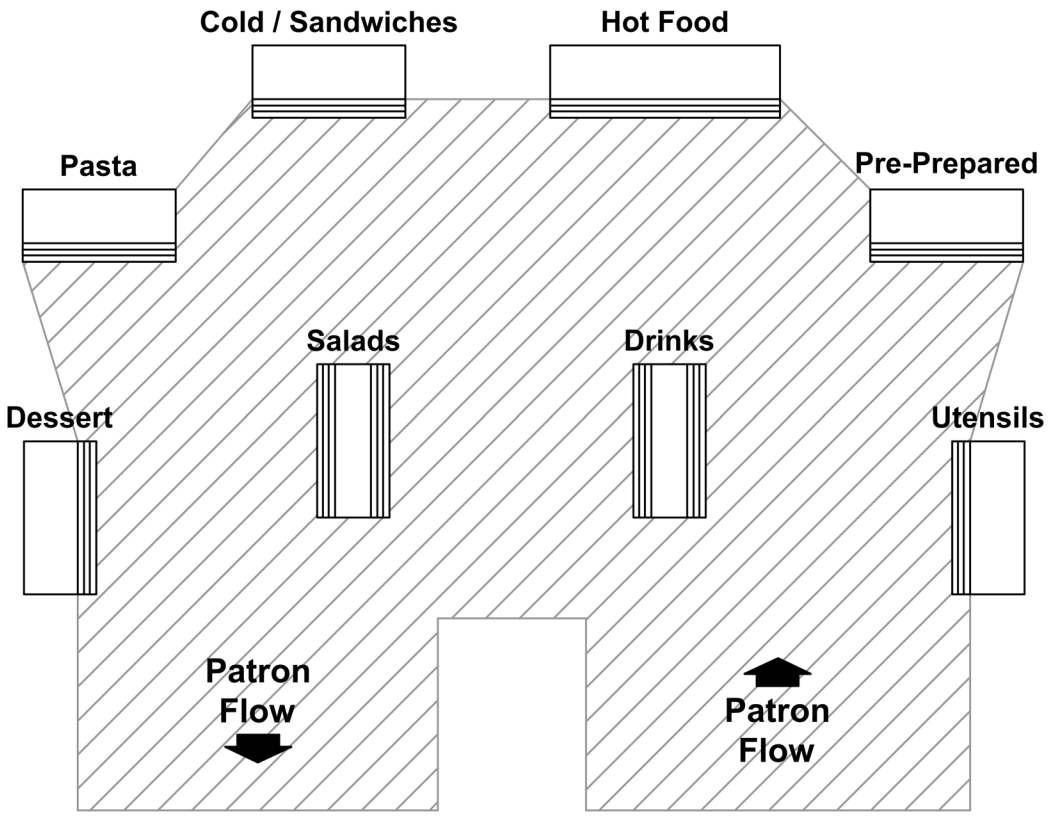


Figure A-32 Schematic Plan of Horseshoe-Shaped Serving Line

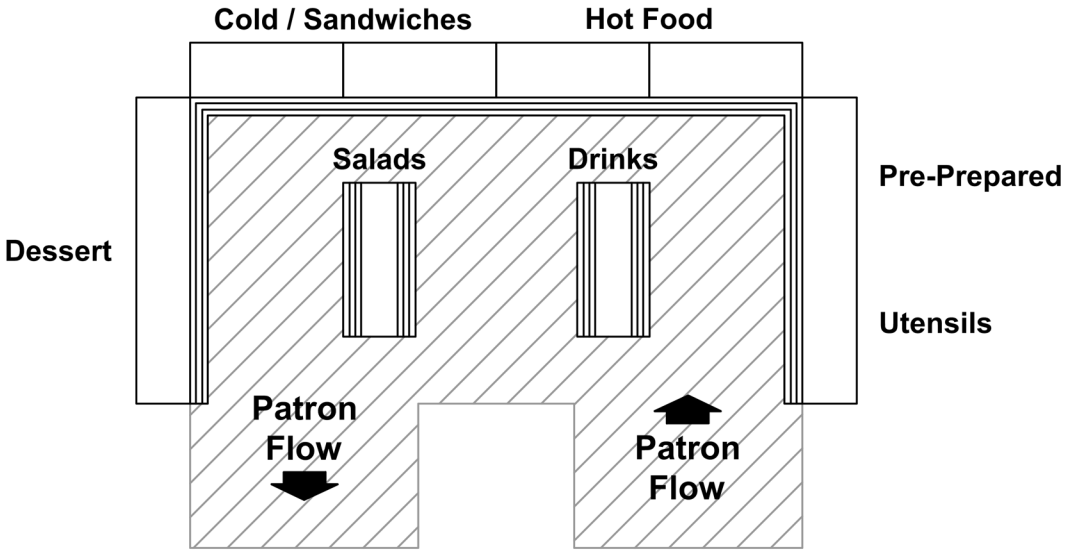


Figure A-33 Schematic Plan of Tee-Shaped Serving Line

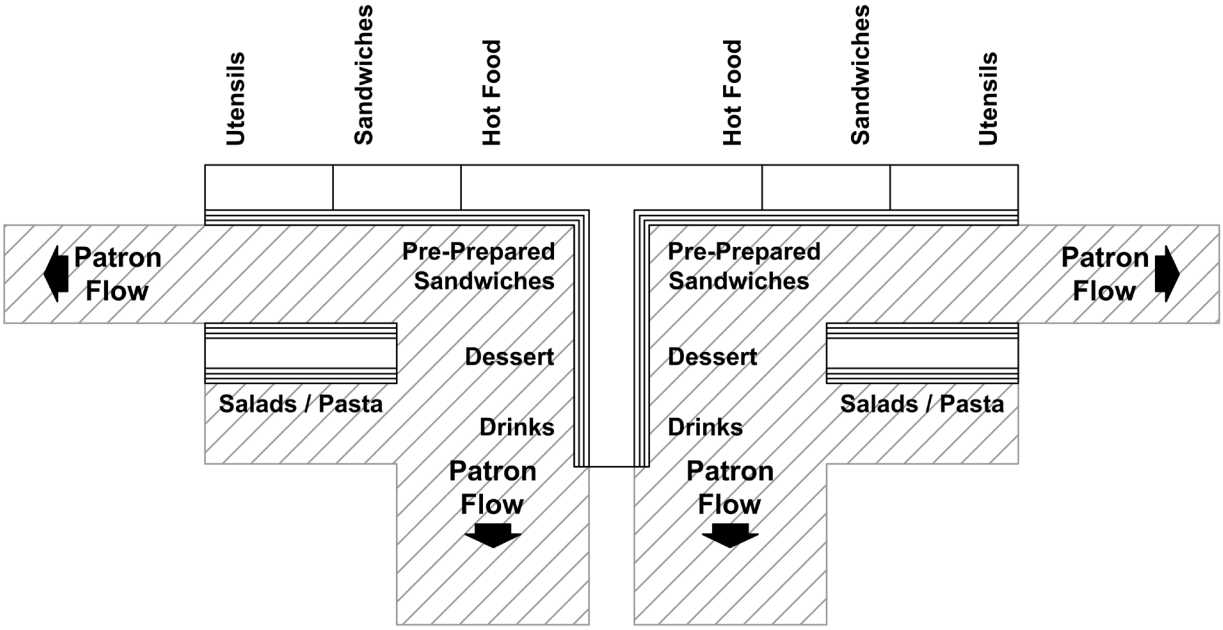
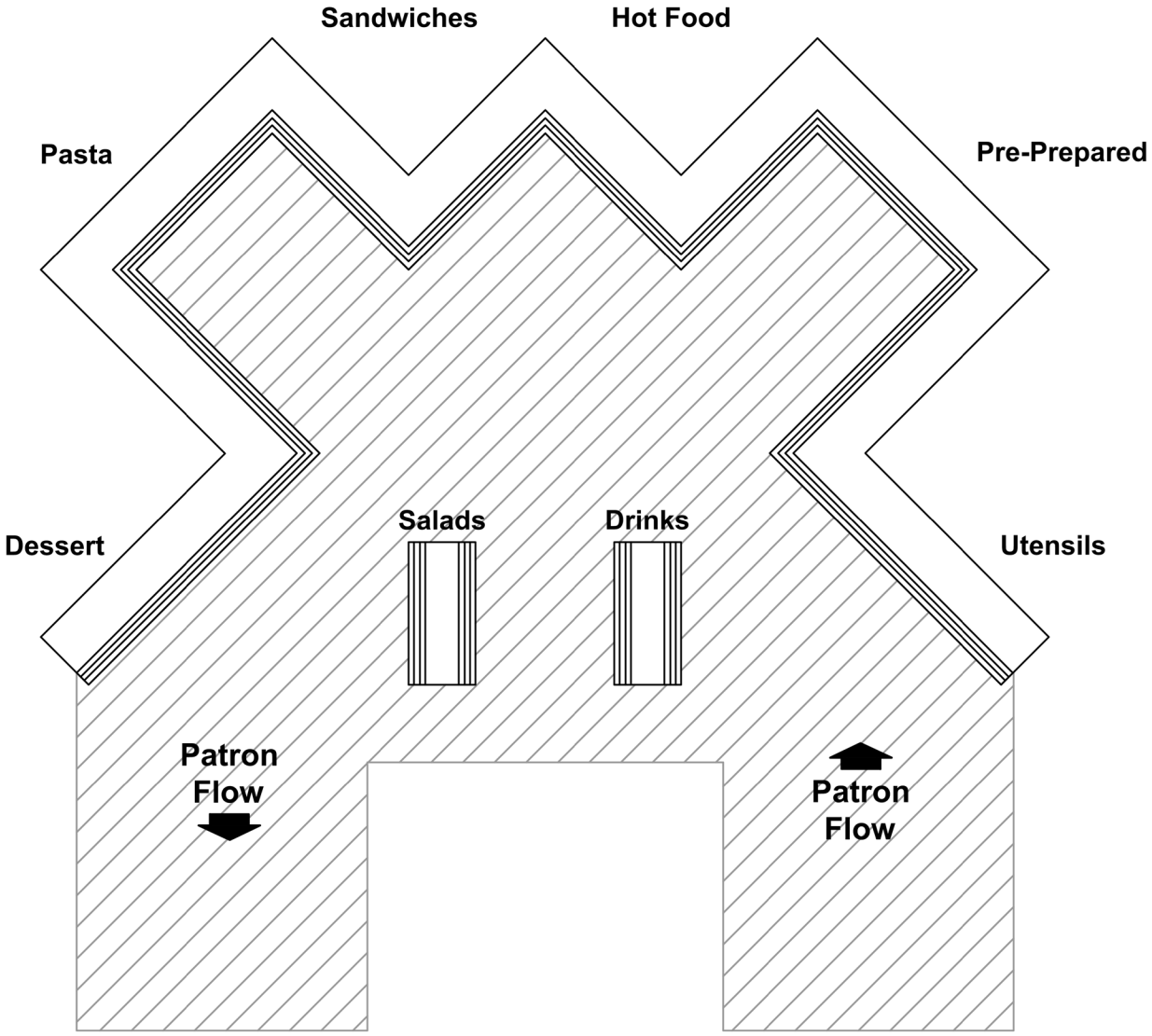


Figure A-34 Schematic Plan of Sawtooth-Shaped Serving Line



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APPENDIX B GLOSSARY

°C	Degree Celsius
°F	Degree Fahrenheit
AT	Antiterrorism
AV	Audio-Visual
CATV	Cable Television
CCTV	Closed-Circuit Television
CNIC	Commander, Navy Installations Command
CO_2	Carbon Dioxide
CONUS	Continental United States
DAFMAN	Department of the Air Force Manual
DD1391	DD Form 1391, *FY__ Military Construction Project Data*
DoD	Department of Defense
EMCS	Energy Management Control System
FC	Facilities Criteria
FSO	Food Service Officer
ft	Foot
ft^2	Square Foot
gal	Gallon
HVAC	Heating, Ventilation, and Air-Conditioning
in.	Inch
kVA	Kilovolt-Ampere
L	Liter
LEED	Leadership in Energy and Environmental Design
m	Meter
m^2	Square Meter

min.	Minimum
mm	Millimeter
NAVFAC	Naval Facilities Engineering Systems Command
NFPA	National Fire Protection Association
NRC	Noise Reduction Coefficient
NSF	National Sanitation Foundation
OCONUS	Outside the Continental United States
OPNAV	Office of the Chief of Naval Operations
PN	Personnel
POS	Point-Of-Sale
qt	Quart
TYCOM	Type Commander
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specifications
UL	Underwriters Laboratories

APPENDIX C REFERENCES

AIR FORCE

DAFMAN 32-1084, *Facility Requirements*, https://www.e-publishing.af.mil/

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS

ASHRAE 90.1 (latest edition), *Energy Standard for Buildings Except Low-Rise Residential Buildings*, https://www.ashrae.org/technical-resources/bookstore/standard-90-1

ARMY

Army Standard for Permanent Party Enlisted Personnel Dining Facilities (EPDF)

NAVY

OPNAV M-5100.23*, Navy Safety and Occupational Health Manual,* https://www.secnav.navy.mil/doni/manuals-opnav.aspx

FOOD AND DRUG ADMINISTRATION (FDA)

Food Code, https://www.fda.gov/food/retail-food-protection/fda-food-code

ENVIRONMENTAL PROTECTION AGENCY (EPA)

Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings, https://www.epa.gov/greeningepa/guiding-principles-sustainable-federal-buildings

INTERNATIONAL CODE COUNCIL (ICC)

International Mechanical Code, https://codes.iccsafe.org/content/IMC2021P1

NATIONAL FIRE PROTECTION ASSOCIATION

https://www.nfpa.org/Codes-and-Standards

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*

NFPA 101, *Life Safety Code*

UNDERWRITER'S LABORATORY

UL 710, *Standard for Exhaust Hoods for Commercial Equipment*

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 1-200-01, *DoD Building Code*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

FC 2-000-05N, *Facility Planning Criteria for Navy and Marine Corps Shore Installations*

UFC 3-101-01, *Architecture*

UFC 3-120-10, *Interior Design*

UFC 3-201-01, *Civil Engineering*

UFC 3-201-02, *Landscape Architecture*

UFC 3-301-01, *Structural Engineering*

UFC 3-400-02, *Design: Engineering Weather Data*

UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*

UFC 3-420-01, *Plumbing Systems*

UFC 3-520-01, *Interior Electrical Systems*

UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*

UFC 3-570-01, *Cathodic Protection*

UFC 3-575-01, *Lightning and Static Electricity Protection Systems*

UFC 3-580-01, *Telecommunications Interior Infrastructure Planning and Design*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems*

UNITED FACILITIES GUIDE SPECIFICATIONS

https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs

UFGS 11 05 40, *Common Work Results for Foodservice Equipment*

UFGS 11 41 11, *Refrigerated and Frozen Food Storage Equipment*

UFGS 11 42 00, *Food Preparation Equipment*

UFGS 11 44 00, *Food Cooking Equipment*

UFGS 11 46 00, *Food Dispensing Equipment*

UFGS 11 47 00, *Ice Machines*

UFGS 11 48 00, *Cleaning and Disposal Equipment*

UFGS 23 09 23.01, *Lonworks Direct Digital Control for HVAC and Other Building Control Systems*

UFGS 23 09 23.02, *BACnet Direct Digital Control for HVAC and Other Building Control Systems*

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APPENDIX D SUPPLEMENTAL RESOURCES

AIR FORCE

CC 721215, *Dining Hall in Airmen Dormitory*

CC 722345, *Fast Food Service Facility*

CC 722351, *Airman Dining Facility (Detached)*

CC 722356, *Officers Dining Facility (Detached)*

CC 723388, *Flight Kitchen*

UNIFIED FACILITIES CRITERIA

UFC 3-540-01, *Engine-Driven Generator Systems for Prime & Standby Power Apps*, https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 4-730-01
20 March 2023

UNIFIED FACILITIES CRITERIA (UFC)

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND

AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes UFC 4-730-01, *Family Service Centers*, dated 7 April 2006.

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FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States, its territories, and possessions is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Military Department's responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Technical content of UFC is the responsibility of the cognizant DoD working group. Defense Agencies should contact the respective DoD Working Group for document interpretation and improvements. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide website https://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

The Military Family Service Center (MFSC) is one part of the overall Family Readiness System (FRS), a network of agencies, programs, services, partnerships, and individuals which supports personal and family life readiness, mobilization and deployment readiness, and mobility and economic readiness.

In addition to installation MFSCs, the National Guard and Reserve Family Assistance Centers provide a variety of referral-based services to geographically dispersed families and retirees from all military components. As a gateway to these needed resources, the MFSC provides information, support, and services to help balance the demands of military life.

1-1.1 The Family Readiness System.

The mission of the FRS is to help Service members and their families manage the challenges of daily living experienced in the unique context of military service.

The FRS is defined and established by DoDI 1342.22, which also establishes policy, assigns responsibilities, and establishes procedures for the provision of military family readiness services. This includes requirements for financial education and counseling, relocation assistance, family readiness in the Reserve Components (RC), and Emergency Family Assistance (EFA). Oversight, monitoring, and implementing guidance of the FRS is provided by the Department of Defense (DoD) in cooperation and collaboration with the Secretary of each military department.

1-1.2 DoD Military Community and Family Policy Mission Statement, Touchstone Values.

Mission Statement: Empower and support our military community and family to thrive.

Touchstone Values: Mission Focused, collaborative, flexible, people-centric.

1-1.3 Formerly Family Services Centers.

In the previous edition of this UFC (7 April 2006), MFSC were known as Family Service Centers (FSC), and formerly within the Air Force as Airman and Family Readiness Centers (A&FRC). Any modification or work conducted at an MFSC/FSC must include updating the signage, labels, and directories to reflect the updated terminology.

1-2 REISSUES AND CANCELS

This UFC reissues and cancels UFC 4-730-01, *Family Service Centers*, dated 7 April 2006.

1-3 PURPOSE AND SCOPE.

This UFC provides requirements for evaluating, planning, and designing MFSCs. The information in this UFC applies to all new construction projects within these facilities, to include additions, alterations, and renovation projects. Alteration and renovation projects should update existing facilities to meet the guidance and criteria within budgetary constraints.

1-4 APPLICABILITY.

This UFC applies to all Service elements and contractors involved in the planning, design, and construction of MFSC worldwide.

1-5 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, which provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-6 CYBER SECURITY.

All facility-related control systems (including systems separate from a utility monitoring and control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06 and as required by individual Service implementation policy.

1-7 GLOSSARY.

Appendix B contains acronyms, abbreviations, and terms.

1-8 REFERENCES.

Appendix C contains a list of references used in this UFC. The publication date of a code or standard is not included; unless otherwise specified, the most recent edition applies.

CHAPTER 2 PROGRAMMING AND PREDESIGN

2-1 INTRODUCTION.

Criteria in this chapter apply specifically to the design of each functional area and space of MFSCs. Primary design considerations for each functional area include the anticipated use, performance, organization, character, and relationships between each area's component spaces. Specific criteria are not provided for space sizes, critical dimensions, storage requirements, furnishings, or specific equipment. This information must be informed by project goals, needs, and coordination amongst the project team. Technical requirements for each component space within each functional area are based on code, references, and industry practices. Descriptive requirements in this chapter address only items with special criteria or quality for a type of space/area. Chapter 3 contains general design considerations.

Guidance in this chapter applies to all sizes and types of family services facilities. Table 2-2 presents specific space allocation guidance for prototypical sizes. All guidance is based on recommended space sizes and capacities for each overall facility size, supplemented by standard use and size factors, as appropriate. These recommendations may be modified in the design of an individual project to reflect local program requirements and capacity needs.

2-2 SCOPE OF FACILITY.

MFSCs offer numerous programs to provide information and Military Family Service needed by qualified single and married DoD personnel and their family members to meet the unique demands of the military life style, as defined by DoDI 1342.22. These programs and services improve life skills by fostering competencies and coping skills, encouraging self-sufficiency, and offering short-term support and assistance when necessary. Specific programs vary among the Services, as each may provide some programs through facilities other than MFSCs. Table 2-1 lists the names of the various programs provided by each Service. While variation among the Services is significant, the programs provided and functions accommodated by the MFSC generally fall into one or more of four categories:

- Federally mandated program
- Additional programs
- Crisis action/response function
- Other administrative or support functions

2-2.2 Federally Mandated Programs.

Federally mandated programs that each Service must provide (but not necessarily in an MFSC) are defined by DoDI 1342.22 and similar in function among the Services. Table 2-1 lists the Services' various program names. The Army and Navy follow program names per DoDI 1342.22.

Table 2-1 Comparable MFSC Services Programs

Military Family Readiness, Services (per DoDI 1342.22)	Air Force (per AFI 36-3009)	Marine Corps (best matched to DoDI)	Program Category Name (outdated but may be found)
Relocation Assistance	Relocation Assistance Program (RAP)	Information, Referral and Relocation (IR&R programs)	Relocation Assistance
Non-Medical Individual and Family Counseling		Community Counseling Program (CCP)	
Personal and Family Life Education	Personal and Work Life	Family Life Education (Behavioral Programs and Marine Corps Family Team Building (MCFTB), Voluntary Education Substance Abuse program (SAP)	Family Advocacy Program
Personal Financial Management Services	Personal Financial Readiness (PFR) services	Personal Financial Management Program (PFMP)	Financial Management
Information and Referral	Information and referral*	(see IR&R)	Information and Referral
Deployment Assistance	Deployment	MCFTB	Deployment Support
Spouse Education and Career Opportunities (SECO)	Employment Assistance	Family Member Employment Program (FMEAP) credentialing services	Employment Support, or Employment Readiness
Exceptional family member support	Exceptional Family Member Program (EFMP)	EFMP	EFMP
Child Abuse Preven-tion and Response Services (governed by DoDI 6400.01)		*	
Domestic Violence Prevention and Response Services (governed by DoDI 6400.01)		Sexual Assault and Prevention Response Office (SAPRO)	
Morale, Welfare, and Recreation Services. (MWR) (governed by DoDI 1015.10)		Volunteer Management Single Marine Program (SMP)	Volunteer Programs

Military Family Readiness, Services (per DoDI 1342.22)	Air Force (per AFI 36-3009)	Marine Corps (best matched to DoDI)	Program Category Name (outdated but may be found)
EFA	Air Force Aid Society (AFAS)	Navy-Marine Corps Relief Society (NMCRS)*	Aide/Emergency Support
Transition Assistance	Transition Assistance Program (TAP)	Transition Readiness Program (TRP)	Transition Assistance
Family Readiness in Reserve Components			

*Optional program

2-2.3 Additional Programs.

Additional programs that are typically (but not necessarily) provided through an MFSC include the following as appropriate for the installation or population served. Programs are defined by DoDI 1342.22 and similar in function among the Services. Table 2-1 lists the Services' various program names.

- Employment support
- Family advocacy
- Exceptional family member support
- Volunteer programs
- Other support programs, including New Parent Support, Child Care, and Preventative Education Section (PES)
- AFAS
- Air Force Families Forever
- Air Force Warrior and Survivor Care
- Casualty Assistance
- Survivor Benefit Program

2-2.4 Crisis Action/Response Room.

The MFSC facility must be equipped with workstations and telecommunications and monitoring equipment to assist in an emergency with non-medical support, and should provide connections to medical emergency services. Provide space within the MFSC facility as a Crisis Action/Response Room in times of emergency. This space typically takes the form of communications specifications and configurations for a classroom or other large space within the MFSC. Refer to UFC 4-023-10.

2-2.5 Additional Program Areas.

Additional functional areas include the administrative spaces and building support, utility, and amenity functions. Services provided by other DoD entities that contribute to the overall MFSC mission -- such as New Parent Support Programs (NPSP), Child Development Programs, Youth Programs, Child Care, USMC's Children and Youth Programs (CYP), the Air Force Wounded Warrior (AFW2), or Casualty and Survivor Benefit Plan (SBP) -- may collocate.

2-3 LOCATION AND SIZE DETERMINANTS.

Several factors determine the most appropriate and cost-effective location for an MFSC. Requirements in this UFC define the program for design of an example project, including functional relationships, program requirements, and design criteria. This includes the space programming guidance found in this chapter, plus the site design, building design, and building systems concepts in Chapter 3. Any unique local requirements concerning building programs, design criteria, and technical systems should be identified and communicated among the designers, builders, base/Installation command, and occupants.

Each base may also determine that different or additional requirements are relevant to its local program. These considerations may affect the required functional areas and spaces and their relative sizes and consolidation of MFSC into shared facilities with libraries, Base Education Centers (BEC), places of commerce, or others mutually beneficial to Quality of Life and service functions. Co-locating MFSC may also affect required program spaces and sizes, such as public computers or administration meeting rooms.

2-3.1 Population Served.

The population served by the MFSC is determined by adding a multiplier to the active-duty population. The multiplier varies depending on the location of the proposed MFSC.

- CONUS: MFSC population equals active duty (AD) population times 1.6.
- OCONUS: MFSC population equals AD population times 2.4.
- **Service Exception:** For Navy Fleet Concentration Areas, MFSC population equals AD population times 2.4.

- **Service Exception:** For Air Force facilities, refer to AFI 38-101 to determine population served.

2-3.2 Facility Size Classifications.

Once the size of the MFSC population has been determined, classify the size of the facility according to Table 2-2. Within each size classification, other factors that affect the facility size include the variations among the Services and the optional program areas (see Table 2-1 for more information on optional spaces).

Service Exception: For Air Force facilities, refer to DAFMAN 32-1084 to determine facility size classifications.

Table 2-2 SIZE CLASSIFICATIONS

Size Classification	Population Served
Small	500-3,000
Medium	3,001-10,000
Large	10,001-40,000
Extra Large	40,001+

2-3.3 Optional Spaces.

Once the size classification has been determined, select the desired optional spaces (see Table 2-1). The base/Installation/station representatives must decide which optional spaces to provide.

2-3.4 Locate for Availability to Service Population.

When the total population is broken down into distinctive geographic locations, consider providing multiple facilities sized individually for the geographic populations. This is particularly important since access to the facility is a key issue for MFSCs. In these cases, each facility should be size-classified for the population to be served and the functions to be provided. Efficiencies may be gained by consolidating management and administrative functions. Consider including virtual/remote or tele-counselling spaces for improved access and diversifying functions connected to limited space.

For populations less than 500, accommodate the MFSC functions in other, non-dedicated facilities. Consider multiple facilities for very large or geographically dispersed populations.

2-3.5 Customer Access and Visibility.

Design the MFSC to be easily accessible by all potential facility customers. The importance of access by spouses, dependents, or non-active-duty personnel that may

be coming from off-Installation must not be overlooked. Consider locations such as near the Installation gate or other high activity or population centers such as the commissary, retail exchange, medical facilities, or “one-stop shopping” areas. Access through base/Installation or public transit infrastructure is a program goal and assumed by locating in such areas. As an alternative, consider locating the MFSC off-installation at sites like the installation visitor’s center or local high-traffic commercial/retail centers. If the MFSC is located off-base, consider the antiterrorism impacts in the design of the facility.

Also consider that while the primary MFSC facility may need to be located on base, additional remote, off-base facilities can be used to serve the non-active-duty customers. See Architectural Barriers Act (ABA) for additional accessibility requirements.

2-3.6 Site Size.

Ensure adequate site space for the following elements when selecting the MFSC site:

- Parking space for customers and staff,
- Space and access for the Lending Locker loading dock/exterior access,
- Service drive, and
- Antiterrorism Force Protection (AT/FP) setback criteria.

Assure the selected site will accommodate an adequate number of parking spaces convenient to the MFSC entrance and the AT/FP setback requirements provided in UFC 4-010-01. A preliminary site design should be prepared to ensure the basic building and site criteria can be accommodated.

2-3.7 Site Placement.

Locate the building on the site to provide the most convenient access and to take advantage of desirable views and natural site features. Examples may include providing protection from undesirable winds and glare and shading the building, especially glazed areas, from excessive sun in warm climates.

2-3.8 Access and Visibility.

Provide easy access by automobile and base traffic. Choose a site with a prominent, visible location. The facility should be easily identifiable from approaching cars, base transportation, and pedestrian pathways. See the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) for latest traffic control device requirements.

2-3.9 Site Utility Requirements.

MFSC must be located for access to major utilities, including water, sewage, electricity, telephone, and gas lines. Provide water service, sanitary and storm systems, natural gas, steam service or fuel oil system (whichever is used), electricity, telephone, and fire

alarm service to the building in accordance with requirements in UFC 1-200-01 and local service procedures. Include connections to the base computer network and communication systems.

2-3.10 Building Layout and Adjacencies.

Consider the relationship to adjacent buildings, transportation routes, services, and activities to reinforce the MFSC's secondary mission to contribute to the quality of life. Managers, base personnel, and design teams should work to locate the MFSC within the base community and built environment to create places or spaces that are destinations and facilitate the programs and services that improve the quality of life for active-duty personnel, their families, retirees, and other authorized customers. The planned creation of destinations with many amenities and attractions in a place for the base community to come together is a quality-of-life force multiplier. This quality-of-life support is an important function of most facilities; however, Installation mission support is always the first priority.

2-4 BUILDING FUNCTIONAL AREA RELATIONSHIPS.

Spatial relationships in the MFSC are best described in terms of the transition from public spaces to private spaces. In developing an individual facility space program, consider the overall building design and relationships discussed in Chapter 3 and Chapter 4. The space allocations provided in this UFC are approximate, and intended as guidance for the facility being discussed.

2-4.1 Public Spaces.

These are spaces that customers need ready access to and may be able to enter unattended. Locate public spaces near the main entrance. Public spaces Include:

- lobby/waiting area
- reception/information/referral area
- computer resource center
- toilets
- classrooms

2-4.2 Semipublic Spaces.

These are spaces that customers need access to but will usually enter accompanied by a staff member. They include:

- relocation assistance (including Lending Locker)
- transition assistance
- employment support
- short term alternative child care

2-4.3 Private Spaces.

These are spaces that customers will not normally enter, or that customers will enter only with a staff member. They require a high degree of privacy (such as a counseling office). Private spaces include:

- program offices requiring privacy, such as those under Financial Management, EFMP, Casualty Assistance/SBP, Personal and Work Life, Deployment
- counseling offices
- decompression
- waiting room (optional for counseling or crisis)
- file storage, and copy/graphics room
- staff offices and work areas

Acoustic modeling and testing may be used to confirm acoustic privacy. Testing of defined assemblies may yield disparate results if not constructed to accurately match the approved assemblies. Mock-ups, early testing, or qualified construction crews may be considered where acoustic privacy is necessary. Consider acoustic control, design, testing and mitigation to best serve the project.

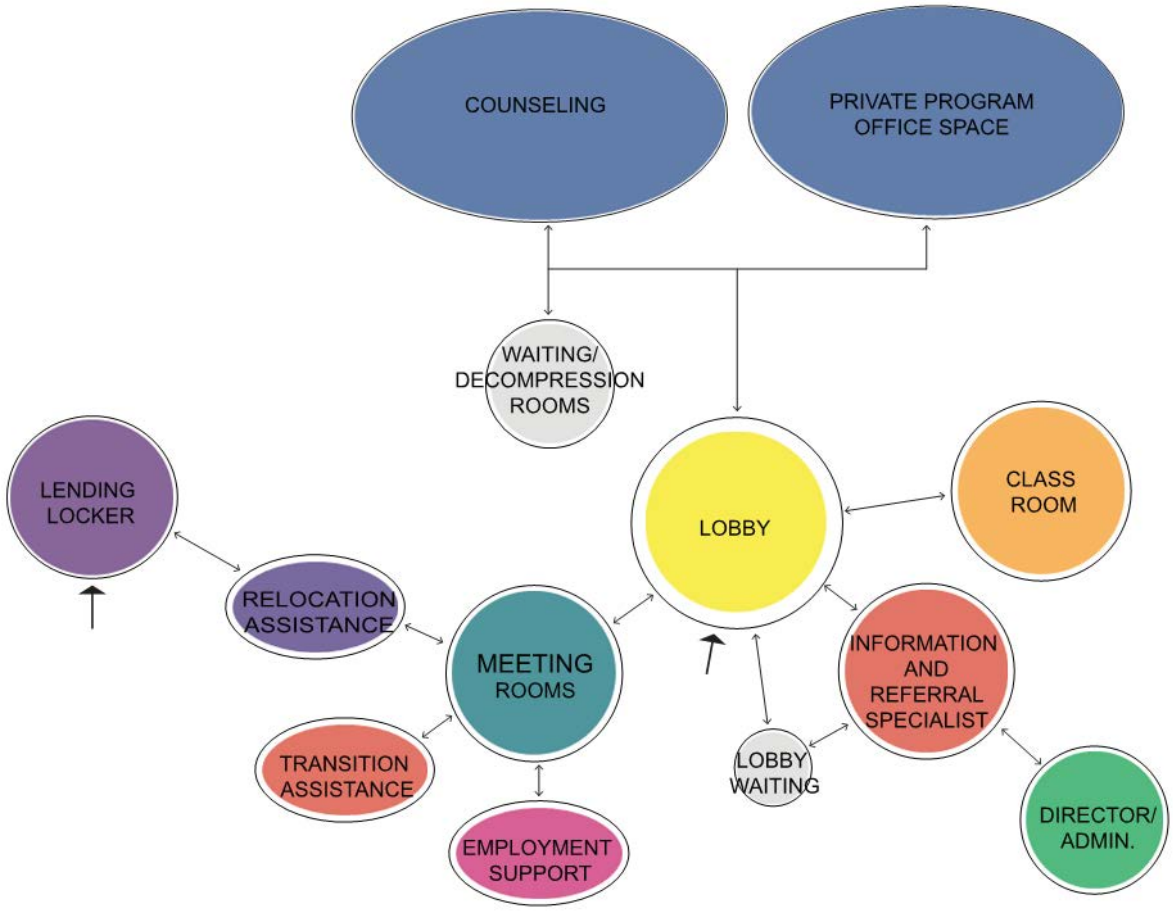
2-4.4 Functional Relationship Diagram.

Figure 2-1 illustrates acceptable relative adjacencies of the key functional spaces.

2-4.4.1 Illustrative Diagrams.

Figure 2-2 and Figure 2-3 illustrate a possible layout for an MFSC. These diagrams are not mandatory or even suggested layouts, but are provided to expand on Figure 2-1 and illustrate the relative sizes of the functional spaces along with the acceptable adjacencies. By including the relative sizes of the spaces, these diagrams convey a method to accommodate needed adjacencies. Of the two diagrams provided, one accommodates a traditional operational approach, and one accommodates an alternative operational approach. These two operational approaches vary in terms of space usage and operational flexibility. When planning an MFSC, consider these issues along with mission requirements.

Figure 2-1 Functional Relationship Diagram

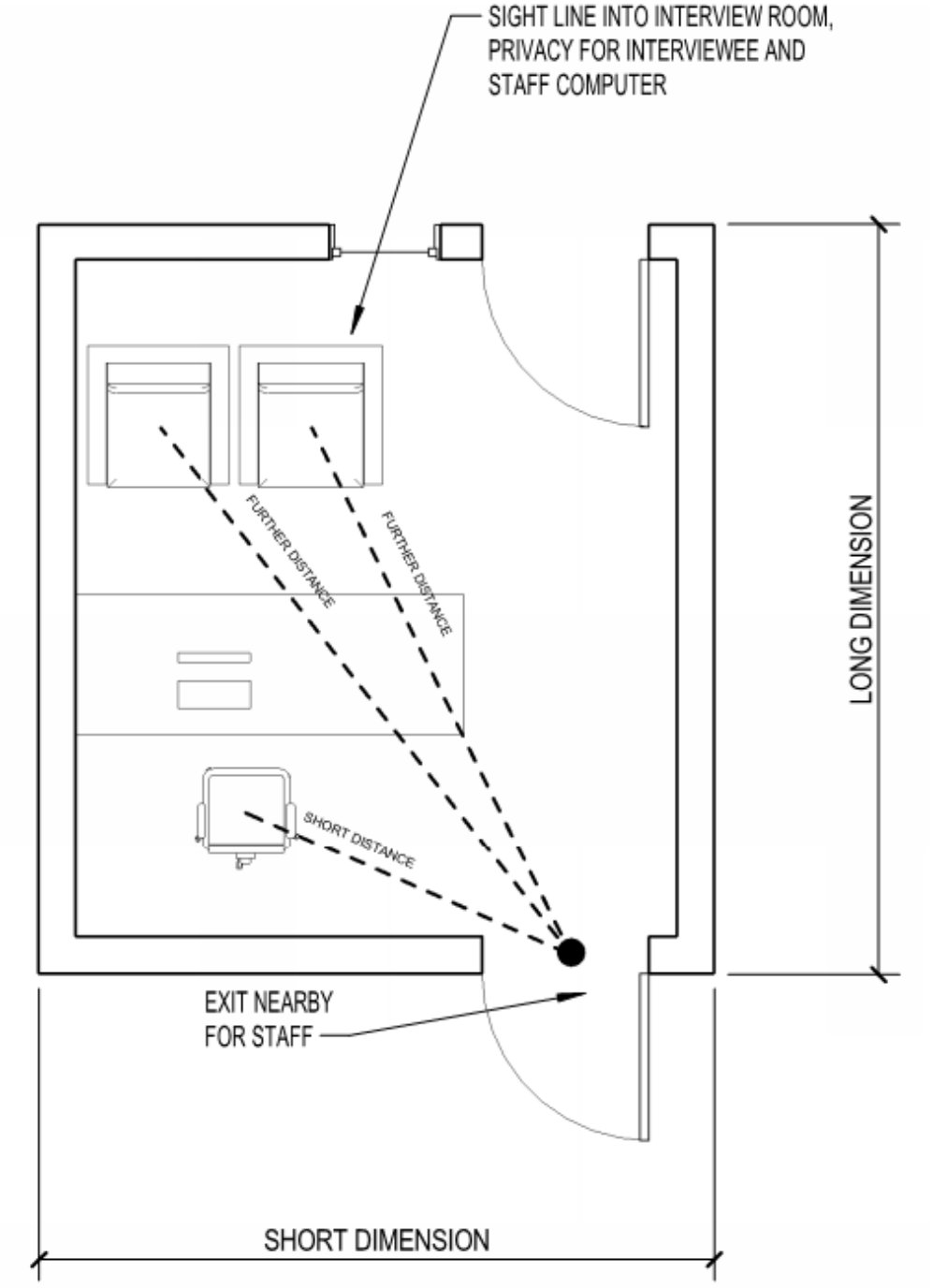


2-4.4.2 Traditional Operational Layout.

Staff members meet with customers in dedicated offices.

Service Exception: The Army supports and maintains this traditional operational approach with private offices.

Figure 2-2 Dedicated Office with Safety Exit



2-4.4.3 Alternate Operational Layout.

In this approach, program staff members do not normally meet with customers in their own offices or workspaces, but use interview rooms shared by all programs. The net effect is that the administrative/office area grows to accommodate cubicles for program staff, but that growth is more than offset by the reduction in the number of dedicated program offices. In some cases, programs that do not use the alternate operational approach will also use interview rooms for other functions and have a similar building configuration.

Service Note: The alternate operational approach is optional for the Navy, Air Force, and Marine Corps. For Air Force, consider using the alternate operational approach for Air Force Reserve Unit MFSCs.

Figure 2-3 Alternative Operational Diagram



2-5 FACILITY SPACE PROGRAM.

Once the size classification has been determined and service programs selected, the facility space program is determined using Table 2-3. This table shows the basic functional spaces and the appropriate area for those spaces organized by size classification.

The space programs listed in Table 2-3 provide guidelines for the MFSC planning team. The final space requirements for elements such as toilets, mechanical spaces, and parking are governed by codes and must be determined by qualified designers. Additionally, the final space requirements for the MFSC programmed spaces will also need to be carefully determined by Installation representatives and the appropriate Service program office, guided by governing codes and criteria.

Service Exception: For Air Force facilities, refer to DAFMAN 32-1084 for MFSC space requirements. Some spaces not included in DAFMAN 32-1084 may be required for MFSCs. The minimum space requirements for those spaces are included in Table 2-3.

Table 2-3 Example MFSC Space Program

SPACE/ROOM	#	SMALL	#	MED.	#	LARGE	REMARKS
Admin/General Public Facing							
Display and bulletin boards	1	42	1	42	1	50	
Lobby + waiting area	1	120	1	350	1	420	
Reception desk	1	90	1	120	2	240	
Information/referral	1	80	1	100	1	160	
Computer lab (w/printer)	1	220	1	260	2	440	
Classroom	1	1,000	1	1,200	2	2,200	
Office Information Referral Specialist	1	100	2	200	4	400	
Food pantry	1	64	1	84	1	120	
Teaching kitchen	1	144	1	144	1	168	
Utility/cleaning area	1	16	1	16	1	20	
Lending Locker	1	180	1	240	1	300	
Relocation assistance storage	1	125	1	180	1	240	

SPACE/ROOM	#	SMALL	#	MED.	#	LARGE	REMARKS
Exceptional Family Member Program							
EFMP office	1	125	1	125	1	125	
EFMP common area	1	100	1	150	1	400	
EFMP file storage	1	24	1	36	1	52	
Support Areas, Public Meeting Rooms							
Group meeting, conference	1	120	1	140	1	200	
Group meeting, small	1	50	1	100	1	150	
Storage closet	1	40	1	80	1	120	
Day Care Areas							
Day Care play/general room	1	150	1	200	1	400	
Childrens' restrooms	1	40	1	80	1	120	
Childrens' computers/tech	1	16	1	20	1	24	
Childrens' story alcove and activities	1	150	1	200	1	400	
Storage	1	40	1	105	1	175	
Childrens' area lobby	1	48	1	48	1	48	
Administration Areas							
Office (1x, Director)	1	125	1	125	1	125	
Admin Assist	1	64	1	64	2	128	
Copy/graphics room	1	120	1	200	1	200	
General/open office	1	128	1	260	1	400	
Break room	1	125	1	125	1	150	
Storage	1	42	1	112	1	200	
Secure storage	1	36	1	36	1	52	
Conference room	1	160	1	200	1	240	(May be combined with staff break room)
Staff restroom	1	64	1	64	1	64	
Staff lockers area	1	24	1	64	1	80	
Shower facilities	1	24	1	24	1	32	
IT workroom/server room	1	125		125	1	125	
Volunteer office	1	100	1	100	1	120	

SPACE/ROOM	#	SMALL	#	MED.	#	LARGE	REMARKS
Clinical Support Spaces							Spaces indicated are for a varied number of service programs: 1 in small, 2 in medium, and 4 in large; Confirm need with base.
Counseling offices (125 SF each)	2	250	4	500	8	1000	(Equip half of rooms as tele-counseling)
Group treatment	1	280	2	560	4	1,120	
Waiting/decompression	1	42	2	84	4	168	
Central file storage	1	36	1	36	1	36	
Interview/meeting	1	80	2	160	4	320	
Counseling supervisor	1	120	2	240	4	480	
Support Areas, Facility/Utility							
Mechanical room	1	300	1	600	1	800	
Pump room (fire/water)	1	64	1	80	1	100	
Electrical room	1	80	1	120	1	160	
Vestibule	1	80	1	100	1	120	
Janitor closet	1	64	1	80	1	160	
Circulation/corridor (~10%)		700		1,000		1,600	
Public toilet	1	128	1	350	1	720	
Vending	1	18	1	36	1	48	
Shower facilities	1	32	1	64	2	144	
Water fountain (bottle filling)	1	20	1	20	1	40	
Elevator	0	--	0	--	1	128	
TOTAL PROGRAM AREA		6,515		10,125		17,032	

2-5.1 Public Facing Spaces.

2-5.1.1 Lobby.

The lobby is the entry point for staff and customers. It should be a warm and relaxing space that is simple and straightforward in design. The lobby should allow for easy circulation to and between the many public functions within the facility. Provide an airlock at the main entrance. Provide additional data and electrical outlets (beyond code minimum) for flexibility should the lobby be used for alternate activities.

Beyond standard ambient lighting, consider decorative lighting to provide a focal point. This will make the lobby, and in turn the whole facility, feel more welcoming and inviting. Also consider free-standing or built-in display cases and elements such as an integral/recessed walk-off grate and an umbrella rack. Note: If the recommended separate exterior entrance to the Lending Locker is not provided, consider providing a power-operated door from the lobby to the Lending Locker to ease moving equipment in and out.

2-5.1.2 Waiting Area.

Directly accessible from the lobby, the waiting area serves as a public waiting room for customers of the center. The space should be warm, comfortable, and secure. The seating arrangements should be intimate and allow for a sense of privacy. There should be distractions such as a wall- or ceiling-mounted TV, or magazines to allow each customer an opportunity to focus his or her attention away from other customers. Consider providing a space within the waiting area where children might sit and play quietly under parental supervision. This sub-space may be partitioned from the rest of the waiting area. As with the lobby, consider providing decorative task lighting such as table and/or floor lamps. Provide Architectural Barriers Act- (ABA-) accessible toilet facilities and water fountains conveniently located near the lobby and waiting area. Accommodate a wall-mounted clock. As with the lobby, provide additional data and electrical outlets for flexibility if/when the lobby is being used for alternate activities. Provide furniture such as upholstered armchairs, side tables, bookshelves, and magazine racks.

2-5.1.3 Short Term Alternative Child Care.

Space and staff for short-term child care provided within the facility or in a nearby facility, such as a fitness center, improves accessibility for military personnel and families with young children.

Coordinate such spaces with the Installation to the standards provided by the Installation Service or indicated by the Installation command, which include but are not limited to: UFC 4-740-06, FC 4-740-14N, and UFC 4-740-15.

2-5.1.4 Information and Referral (I&R).

I&R, also known as discovery research center, is located adjacent to, or within the lobby; it can serve as the welcome desk for the center. It should also function as the entry security point, but should not be intimidating or overwhelming. Staff should sit comfortably at the desk and perform office functions as well as interact with customers, assisting them with directions and information. The I&R desk should have direct visibility to the many public functions accessible from the lobby. There may be an office component to the I&R in larger facilities. Use durable materials for the countertop and front surface. Additional lockable wall and base cabinets for storage of equipment and supplies should be incorporated.

2-5.1.5 Classroom.

Much of the center's mission focuses on information and education. Classrooms are central to the mission and their importance to the facility should not be underestimated. Locate classrooms near the entrance and easily accessible from the lobby. They should be configured to allow flexibility in size and configuration and be designed with the infrastructure to allow for a wide variety of media presentations. When required, design one of the classrooms to easily transform into the crisis action/response room. If there is only one classroom in the facility, provide a sound-rated, operable partition. Even if the facility contains multiple classrooms, consider using movable partitions to increase programmatic and scheduling flexibility. Also consider providing built-in casework with a solid-surface countertop and small sink.

2-5.1.6 Teaching Kitchen.

This optional space accommodates instructional programs where military personnel and/or their families can learn cooking and serving techniques for family meals. Consider adjacency to the classrooms and the staff break room, as there may be opportunities to accommodate dual functions in this space.

Plan viewing angles for all workspaces to ensure that students can see the activities. Consider creating an island work area for ease of demonstration. This work area should include cook top, sink, and preparation area. Consider providing an adjustable mirror over the preparation area to allow students to view the activities. If the kitchen is located separately from the staff break room, consider accommodating an eat-in area with tables and chairs.

Service-specific Exception/Requirement: The Navy does not typically include teaching kitchens. The Air Force requires teaching kitchens at every installation.

2-5.1.7 Computer Resource Center.

Similar to the classrooms, the computer resource and information lab is central to the MFSC's mission and consolidates all the center's information for use in a more individualized and independent manner. Directly accessible from the lobby, this lab should be well-organized and allow for information displays, computer kiosks, research carrels, and general work space. The room should be friendly, comfortable, and inviting. Staff work spaces adjacent to the lab should also be inviting and open to encourage questions.

2-5.2 Professional Program/Service Counseling.

2-5.2.1 Interview Room.

Interview rooms provide a private space where program staff can meet with service members and family. Where the alternate operational approach is used, interview rooms replace a portion of private offices. In larger facilities, these rooms may also be provided to allow flexibility. This shared office space is used on an as-needed basis when program staff members who use open workstations need to meet privately with

customers. These rooms should be acoustically private, but visually accessible to other staff in case a situation arises in the room. After the session is over, staff will return to their workstation in the semipublic office space to continue working so that the individual interview room may be used by other staff.

2-5.2.2 Tele-counseling Room.

A room should be provided to accommodate tele-counseling. Acoustics should be a priority in this room to allow clinicians to communicate clearly to clients, and designed to prevent acoustic feedback during a session. Equipment should be provided such as a webcam, microphone, and appropriate lighting.

2-5.2.3 Semipublic Office Space (Open Offices).

These areas of the MFSC house the office space for relocation assistance, transition assistance, and employment support programs/services. They are distinguished as semipublic for two reasons: one, they are directly adjacent to public spaces such as the lobby or the computer resource and information lab; and two, the programs offered from these offices require a more casual and impromptu interaction with customers than in the private program office space. Design these offices to accommodate general staff office functions as well as customer interaction and personalized discussions. These office spaces may support the computer resource and information lab.

Furniture will include modular office furniture consisting of a desk or workstation, credenza with overhead storage, file cabinet, desk chair, and an additional two chairs. The furniture configuration allows the staff member to hold working consultations with customers and for both parties to use the desk as workspace. Provide a quad power/data/telephone outlet on at least three walls of the office, or at least one per staff member. Provide additional outlets as needed to operate additional equipment. Provide vision panel doors or sidelights.

2-5.2.4 Counseling Office Space.

Individual office spaces for staff can be used with clients so that they have a private but safe place to meet. Staff members who use this type of office space provide more intimate counseling functions, such as EFMP or clinical counseling. The alternative layout option will use few, if any, of these spaces. The traditional layout will have many. This office space will consist of acoustically private but visually accessible, individual offices. Design to comfortably seat at least three adults in a quiet, non-threatening setting. Provide LED dimmable lights in the office so that the lighting can be dimmed to calm a client, or increased for specific tasks.

2-5.2.5 Waiting/Decompression Room.

The waiting/decompression room must have two access points: one directly from the counseling offices, and one that leads to public space within the MFSC. This room provides space for distraught customers waiting to see a counselor or allows the customer to compose him or herself after an emotionally difficult session prior to

reencountering the public. It requires a high degree of acoustical privacy but should be visible to staff for safety.

2-5.3 Private/Secure Spaces (Staff Only).

2-5.3.1 Copy/Graphics and Office Supply Storage Room.

This optional space is typically included only in larger facilities. It provides room for staff to design and produce the numerous brochures and pamphlets generated for the MFSC programs. It should be located away from programmatic distractions, be conducive to computer-based design work, and have space for document production such as work tables and photocopiers. This room should also house office supplies.

Provide the following design elements:

- Casework for storage of supplies and equipment. Casework should consist of base and wall cabinets with a minimum 24-in (610-mm) deep countertop.
- Dedicated power and data outlets for computers, network printers, scanners, and copiers.
- Additional data outlets as needed to operate equipment such as a light table and poster/banner maker.

Consider providing a work/layout table for collating printed documents and laying out graphics. If a door is provided, include a vision panel or a sidelight.

Service-specific Requirement: The Army and Air Force require a copy/graphics room in every facility.

2-5.3.2 Staff Break Room.

This staff-only space is used for staff training, meetings, breaks, and lunches. If a Teaching Kitchen is provided, consider locating the staff breakroom immediately adjacent to the kitchen or designing the kitchen in such a way that it can be used as the staff breakroom when it is not used programmatically.

Provide the following design elements:

- Accommodate either a large table or multiple tables with chairs; and
- If located separately from the Teaching Kitchen, provide a residential-style refrigerator with icemaker, dishwasher, and microwave oven.

If a door is provided, include a vision panel or a sidelight.

2-5.3.3 Storage.

Generally, two types of storage are required. One area provides storage of brochures, program materials, and general office supplies. Another secure storage area is required

to support the computer lab and classrooms' audio/visual equipment and computers. The secure storage room must have a lockable door.

2-5.3.4 Lending Locker.

This subset of the relocation assistance program is a storage room for items such as pots, pans, and irons that may be loaned to recently relocated military personnel and their families. Design with adequate and varied shelving to accommodate the many different types of items in the locker's inventory. As many of the items may be bulky or heavy (such as a futon), provide direct access to an exterior loading area for easy customer loading and unloading. If a separate exterior entrance is not possible for a retrofit project, locate the Lending Locker adjacent to the lobby and with direct access to the front entrance.

Include the following design elements:

- Lockable interior and exterior doors,
- A commercial-grade dishwasher and a deep, utility-style sink with adjacent drying area for cleaning returned items.
- Heavy-duty metal storage shelving units and
- Temperature controlled.

Service Exception: Dishwasher and sink are optional for the Army.

2-6 ALTERATIONS TO EXISTING FACILITIES.

2-6.1 Design Considerations.

MFSCs are frequently placed in existing facilities; therefore, special consideration is required when selecting an appropriate existing facility to modify for MFSC functions. Consider only permanent facilities for conversion to an MFSC. Exceptions may be made for other buildings that are in excellent condition, subject to the location determinants in paragraph 2-3.

Consider adaptability to the intent of the building program. For instance, vehicular access for the Lending Locker, services as an emergency crisis response center, or access by non-active-duty personnel and family members may not be achievable in a conversion, alteration, or addition. Barrier-free design requirements and antiterrorism requirements must be provided for MFSC in existing facilities.

2-6.2 Regulatory Authorities.

- **Army:** Engineer Regulation (ER) 1110-345-100 and Army Regulation (AR) 608-1.
- **Navy and Marine Corps:** Authorities are contained in OPNAVINST 11010.20H and OPNAVINST 11010.45A. When planning alterations to an existing facility to convert it to an MFSC, for Navy, consult with Fleet and

Family Support, and for Marine Corps, consult with HQ USMC, Manpower and Reserve Affairs, Code MR.

- **Air Force:** AFCEC for architectural, landscape, interior design, and publication coordination; Facility Engineering Directorate (AFCEC/CF) for technical issues relating to fire, life safety, and certification. Reference the Airman and Family Readiness Operations Division (AFPC/DPFF) for functional requirements and policies.

2-7 SECURITY.

Provide only one public entrance/exit that is a prominent architectural component to facilitate customer wayfinding and monitored for security. A separate staff-only entrance may also be provided that is not in a prominent location, but near dedicated staff parking areas. Staff entrances are usually near the service delivery door or at the side of the building to provide convenient access to remote drop boxes. All other exits should be for emergency use only and alarmed, or for low-value material access such as the Lending Locker. Refer to UFC 4-022-01, UFC 4-026-01, UFC 4-023-10, and UFC 4-010-06 for more information.

2-8 COST.

Design MFSCs with the objective of achieving a low life cycle cost. To do so, the project's design program must adequately define the scope and performance requirements and match those needs against a budget. Conversely, the budget must adequately support an appropriate and high-quality program and the performance and technical requirements (such as sustainable design and antiterrorism criteria) identified in this UFC.

CHAPTER 3 DESIGN

3-1 INTRODUCTION.

This chapter provides general design and material guidance focusing specifically on MFSC issues. This guidance addresses design considerations for site and architectural character, function, circulation, and facility systems. Functional diagrams and other guidance regarding potential layout configurations for different styles of building design are provided to illustrate how the functional area could potentially be organized. Use UFC 1-200-01 for guidance on the use of model building codes for design and construction of DoD facilities. See paragraph 1-4 for direction to the appropriate governing codes for building services.

Refer to UFC 3-101-01 for more information regarding design quality and processes to modify the example program described in Chapter 2 to a population-specific MFSC. General guidance for the concepts and design phase is addressed as part of this chapter. Chapter 4 provides detailed design guidance for each functional area not contained in other UFCs. Preliminary and working drawings should exhibit the specific space criteria, technical issues, and functional area requirements.

3-2 SITE WORK.

For MFSC, Civil Engineering must provide connections to utilities, including water, sewage, electricity, telephone, and gas lines. Provide water service, sanitary and storm systems, natural gas, steam service or fuel oil system (whichever is used locally), electricity, telephone, and fire alarm service to the facility in accordance with UFC 1-200-01. Include connections to the base computer network and communication systems.

Facilitate alternate access via base or public transportation infrastructure to the MFSC by all potential facility customers (spouses, dependents, or non-active-duty personnel that may not have privately-owned vehicles). Site work, site improvements, and coordination with adjacent/context site improvements may be used to provide alternate access. Customers coming from off-Installation must also be supported.

3-2.1 Landscaping.

Landscaping should be appropriate to the professional nature of the facility and reflect the local geographical environment. Plants selected should be easy to maintain and enhance the visual quality of the facility in all seasons. Indigenous species are preferred. Comply with UFC 3-201-02 and the local installation landscape standards.

Service Exception: For Air Force, also refer to base's Installation Facility Standards.

3-2.2 Parking and Access Drives.

Provide adequate parking for both staff and patrons with appropriate access drives. The facility should be easily identifiable from approaching cars, base transportation, and pedestrian pathways. Consider locating bicycle racks near the facility entrance in a

secure location. Comply with UFC 3-210-01. Consider providing site walls, evergreen vegetation hedgerows, or screening features at the perimeter, road, or public way for privacy and anonymity for personnel approaching the facility. Patrons may wish to avoid stigma and shame from approaching programs/services for help. Alternative measures, such as co-locating the facility with other routinely-visited or popular destinations provides patrons with justification for visiting the area.

Service-specific Requirements: The Army and Air Force must work with the program manager and applicable codes and regulations to determine the appropriate number of parking spaces; and provide handicapped accessible parking spaces per requirements of the ABA. Consider the need for a dedicated staff parking area that is located near the staff-only entrance to the building. Spaces for electric vehicle charging, motorcycles, and bicycles should also be provided as required by the base population. If the installation provides bus or shuttle van service, create a path for convenient access for military and family members without personal vehicles.

3-2.3 General Site Lighting.

Ensure that parking areas and the facility have adequate lighting for safety, evacuation, and security measures. Comply with UFC 3-530-01. Consider hours and seasons of use for application of site lighting on pedestrian and bicycle paths.

3-3 ANTITERRORISM REQUIREMENTS.

Design the facility to comply with UFC 4-010-01.

3-4 STRUCTURE.

Comply with UFC 3-301-01. Limit the number of floors to two stories or fewer in height, where possible, or costs associated with progressive collapse criteria will need to be incorporated in the design.

3-5 ARCHITECTURE AND EXTERIOR DESIGN.

The exterior design of an installation's building should be of a character, quality, and detailing that reflects the surrounding community and extends or reinforces the "community fabric." The program and interface with surrounding improvements must create destinations or places that improve the installation Quality of Life (QoL). According to the DoDI 1342.22, the MFSC must be visually conspicuous and conveniently accessible to service members and their families, and furnished in a way that welcomes Service members, their families, and other clients.

Create an individual theme for the facility that may be host nation or installation-related. Refer to UFC 3-101-01 standards and current guidance. Many thematic environments can best be presented in lobbies, primary circulation areas, and shared spaces. Theming should apply continuously to the entire design of the facility, from overall architectural expression to specific interior development. The architectural and interior design of the MFSC must be integral and related. They both involve functional analysis and consideration of the appropriate environmental character, building organization,

circulation, supervision, and flexibility requirements, as well as finishes and furnishings. Provide controlled, indirect daylight into work and learning areas through clerestories, skylights, or windows.

3-5.1 Entrance.

The main entrance should incorporate a clearly identifiable point of reference or landmark that serves as a welcome and a transition. A transition such as a covered entry is very desirable at the main entry. In cold climates, provide a canopy (or a recess) at required egress doors to ensure that doors can open completely without obstruction from snow and ice.

3-5.2 Exterior Finishes.

The color, texture, and design should be consistent with the building material available to the area and therefore be appropriate for the building type and comply with any applicable installation design standards, as well as UFC 3-101-01. The design intent and character of the MFSC should provide the appearance and environmental setting of a professional business office. The MFSC should always present an expression of informality, comfort, and clear organization. The design should invite relaxed conversation, suggest discretion, and above all, promote confidence in the professional services offered. Coordinate the exterior finishes with the Service-specific design standards.

3-5.3 Exterior Signage.

Equip the main entrance with an attractive, clearly-visible sign that provides the program hours of operation. Ensure that signage complies with UFC 3-120-01 and installation requirements. Sign placement and type are site-specific, but signs must be strategically located, adequately lit, and of sufficient size to permit proper viewing by individuals approaching the facility.

3-6 INTERIOR DESIGN.

Construction and finishes (walls, floor, and ceiling) should support the image and theme of the facility and be consistent with the programs offered. The interior design should offer interest, refuge/comfort, and professionalism. Design the interiors of the facility following the process and requirements UFC 3-120-10 along with any individual installation standards. Provide professional interior design services in the same manner as standard A/E services. Coordination and planning between the architect and interior designer is critical.

3-6.1 Interior Construction.

Provide counters, casework, and cabinets of high quality and durable construction. Specify AWI Premium or Custom for finishes per AWI *Architectural Woodwork Quality Standards Illustrated*. Provide casework, cabinet doors, and drawer faces as veneer panel core. Doors, drawers, and casework faces should be plastic laminate at a minimum. Where no water source is present, countertops should, as a minimum, be

plastic laminate with hardwood or solid surface edging. Where a water source is present, provide countertops of solid surface/solid composite plastics only. Specify 0.75-in (19-mm) minimum thickness for plywood, plywood backing, and solid wood panels.

All interior glass must be tempered safety glass, and mirrors must be made of break-resistant materials. There may be extreme cases that require behavioral health self-harm resistant or ligature resistant areas or restrooms. Consult with installation and MFSC staff during design for confirmation. Provide window treatments to control light levels and glare within all offices and classrooms (occupied spaces). Take specific efforts to manage glare, UV, and heat gain. Manual or automatic shades or control devices (programmable) are sufficient to block UV exposure. Refer to UFC 3-101-01, Section C-1.

3-6.2 Finishes.

Finishes should be suitable for the intended use and be appropriately durable. They must meet the requirements listed in NFPA 101.

Do not cover the inside of exterior walls with impervious materials such as mirrors or vinyl wall coverings. This will help prevent mold development in the wall, as moisture can originate within a building and no waterproofing is perfectly designed or installed.

Service Exceptions: Also ensure interior (and exterior) design complies with the following Service-specific standards:

- **Army:** DG 1110-3-122, and Installation Design Guide Standards.
- **Air Force**: Air Force Corporate Facility Standards (AFCFS) and applicable Installation Facility Standards (IFS).

3-6.3 Furnishings, Fixtures, and Equipment (FF&E).

Choose furniture that is durable, comfortable, and attractive. Local wood is a good choice and natural finishes can accentuate the interior décor. Consider modular furniture components designed specifically for office and conference rooms. Counter fronts are high maintenance and require highly durable materials due to wear and tear. System furniture’s storage and power capabilities, as well as stackability, provide an incredible range of flexibility and options to serve the many needs of an office and education and counseling center.

Consider graffiti-proof furniture and materials in bathrooms, small group areas, and other secluded places not easily visible by staff members. Consider floor material colors and textures when selecting and coordinating furniture and equipment.

3-7 BUILDING SERVICES.

3-7.1 Fire Protection.

Design fire protection and life safety to comply with UFC 3-600-01.

3-7.2 Heating, Ventilation, and Air Conditioning (HVAC).

Design the HVAC system to meet the requirements of the most current edition of the International Mechanical Code (IMC), UFC 3-410-01, and UFC 3-410-02. Comply with antiterrorism requirements in the design of the HVAC system. Consider climate conditions, high humidity, industrial atmosphere, saltwater exposure, or other adverse conditions to ensure durability when selecting exterior HVAC components.

3-7.3 Electrical.

Provide electric service and distribution equipment, wiring receptacles and grounding, interior and exterior lighting and control, emergency lighting, telephone and communication systems, and intrusion systems in accordance with NFPA 70; UFC 3-520-01; UFC 3-501-01; and the latest installation design requirements. See the latest edition of International Trade Association (ITA) index web site **"**Electric Current Worldwide" to determine voltages and cycles in overseas locations. Service grounding system and all wiring methods must meet current NFPA 70 requirements. All service equipment must be Underwriters Laboratories (UL) listed. Alternately, published proof from an approved independent testing laboratory may be provided.

Provide lighting and control systems throughout the facility in accordance with UFC 3-530-01.

3-7.3.1 Communications and Data.

Telephone and data outlets may be independent of each other or combined into a single junction box. If these connections can be combined into a single junction box, the cover plate to that junction box must allow for multiple connections. In some unique situations, the cable television (CATV)/internal video connection can be combined into a single junction box with an appropriate cover plate.

Confirm the preference for individual or combined telephone/data/video outlets with the following Service-specific contacts:

- **Army and Air Force:** Installation Manager.
- **Navy Marine Corps:** Marine Headquarters Program Managers.

3-7.3.2 Security Alarm System.

Consider providing an alarm system for intrusion detection to protect equipment and assets. Provisions for an alarm system must be justified during the planning/programming process.

Service Exception: The Navy does not fund security alarm systems. If desired, the individual Navy installation must provide the funding for an alarm system.

3-7.3.3 Duress Alarm System.

If clinical counseling services are provided, an internal, silent duress alarm system may be required. This system usually includes activation buttons at the I&R area and in the counseling offices. When pressed, the button activates an alarm at the I&R and management areas. This allows the counselor or staff member to signal for help if necessary.

3-7.4 Plumbing.

Design domestic hot and cold water, sanitary and storm drainage, propane, fuel oil, or natural gas systems to meet the requirements of local Installation standards and UFC 3-420-01.

3-8 SUSTAINABLE DESIGN.

Follow the guidance in UFC 1-200-02.

3-8.1 Whole Building Design Guide.

The Whole Building Design Guide (https://www.wbdg.org/) further explains the environmental issues related to building materials and provides technical guidance on green building material selection.

CHAPTER 4 FUNCTIONAL DATA SHEETS

4-1 TYPICAL FUNCTIONAL DATA.

The functional data sheets provided in this chapter are limited to specialized or unique requirements. Typical spaces such as offices, building support/utility, and circulation areas are excluded from this chapter for brevity. Requirements for such spaces are assumed to be understood or outlined in other UFC, code, or standard documents.

4-2 FUNCTIONAL DATA SHEETS.

The following room data sheets provide the minimum requirements for the respective rooms and spaces specific to MFSCs.

Figure 4-1 Exceptional Family Member Program Common Area

Description/Usage	Multi-purpose space for families and Exceptional Family Member program participants to wait, socialize, and engage in leisure or educational activities
Minimum Ceiling Height	9′-0" (274 cm)
Finishes	**Walls:** Provide a low-maintenance, durable finish in materials, patterns, and colors for the needs of exceptional family members expected by the Installation. **Floors:** Flooring should be sound absorptive, durable, and easy to maintain with activities and often relocated furniture. **Ceiling:** Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-7.2.
Fire Protection	Provide system per paragraph 3-7.1.
Power	Provide outlets per paragraph 3-7.3.
Lighting	Provide system per paragraph 3-7.3.
Communication	**CCTV:** None required. **CATV/Internal Video:** None required. **PA/Audio:** Coordinate with installation needs, processes, and equipment. **Telephone:** None required. **Data:** Required. **Security:** Coordinate with installation needs, processes, and equipment.
Acoustics	Provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	Seating and tabletops optional for child and/or adult reading or activities.
Furnishings Fixtures and Equipment (FF&E)	Seating, tables, and activity support furniture should be mobile and multi-function.
User-provided Equipment	Determined by users
Special Requirements	Multi-use space and multi-function amenities

Figure 4-2 Counseling Offices

Description/Usage	Private office w/counseling seating
Minimum Ceiling Height	8′-0" (244 cm)
Finishes	**Walls:** Provide a low-maintenance, durable finish on full height partitions. **Floors:** Flooring should be sound absorptive, durable, and easy to replace in sections or maintain. **Ceiling:** Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-7.2.
Fire Protection	Provide system per paragraph 3-7.1.
Power	Provide outlets per paragraph 3-7.3.
Lighting	Provide system per paragraph 3-7.3.
Communication	**CCTV:** None required. **CATV/Internal Video:** None required. **PA/Audio:** Coordinate with installation needs, processes, and equipment. **Telephone:** None required. **Data:** Required. **Security:** Coordinate with installation needs, processes, and equipment.
Acoustics	Meet Clinic/Health Unit criteria from UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	None
Furnishings Fixtures and Equipment (FF&E)	Workstation furniture and equipment with additional work surface or countertop, two side chairs and end table for interviewees
User-provided Equipment	Determined by users
Special Requirements	See plans provided

Figure 4-3 Group Treatment Room

Description/Usage	Conference room for staff led group counseling and education
Minimum Ceiling Height	9′-0" (274 cm)
Finishes	**Walls:** Provide a low-maintenance, durable finish. **Floors:** Flooring should be sound absorptive, durable, and easy to replace in sections or maintain. **Ceiling:** Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-7.2.
Fire Protection	Provide system per paragraph 3-7.1.
Power	Provide outlets per paragraph 3-7.3.
Lighting	Provide system per paragraph 3-7.3.
Communication	**CCTV:** None required. **CATV/Internal Video:** None required. **PA/Audio:** Coordinate with Installation needs, processes, and equipment. **Telephone:** None required. **Data:** Required. **Security:** Coordinate with Installation needs, processes, and equipment.
Acoustics	Meet Conference Room criteria from UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area. Provide walls with a sound transmission coefficient (STC) rating of 50 to 55, and acoustic door with seals.
Casework/Built-in Equipment	None
Furnishings Fixtures and Equipment (FF&E)	Adjustable office chairs and accessories, with conference table white board and tray, clock
User-provided Equipment	Determined by users
Special Requirements	Acoustic privacy

Figure 4-4 Waiting/Decompression

Description/Usage	Dedicated for stressed or over-stimulated persons to be isolated and undisturbed for a limited time
Minimum Ceiling Height	8′-0" (244 cm)
Finishes	**Walls:** Provide abuse resistance, durable finish in calming color-patterns. See special requirements below. **Floors:** Flooring should be durable, easy to clean, and abuse resistant. **Ceiling:** Ceiling should be durable and cleanable. Do not locate equipment, valves or other items above the room which may require access. Do not provide ceiling access panels.
Plumbing	None required.
HVAC	Provide system per paragraph 3-7.2.
Fire Protection	Provide system per paragraph 3-7.1.
Power	Provide outlets per paragraph 3-7.3.
Lighting	Provide system per paragraph 3-7.3. Dimmable by occupant.
Communication	**CCTV:** None required. **CATV/Internal Video:** None required. **PA/Audio:** Coordinate with installation needs, processes, and equipment. **Telephone:** None required. **Data:** Required. **Security:** Coordinate with installation needs, processes, and equipment.
Acoustics	Meet Clinic/Health Unit criteria from UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	None
Furnishings Fixtures and Equipment (FF&E)	Comfortable armchair or lounge chair and a side table may be included.
User-provided Equipment	None
Special Requirements	Confirm with installation if impact/abuse resistant wall assembly or padding on walls is appropriate. Consider ligature-resistant door hardware and detailing.

Figure 4-5 Interview/Meeting Room

Description/Usage	Private office for interviewing personnel seeking counseling or training. Discussions could contain private health or financial information.
Minimum Ceiling Height	8′-0" (244 cm)
Finishes	**Walls:** Provide a low-maintenance, durable finish on full-height partitions extending to the underside of structure with sound insulation. **Floors:** Flooring should be sound absorptive, durable, and easy to replace in sections. **Ceiling:** Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-7.2.
Fire Protection	Provide system per paragraph 3-7.1.
Power	Provide outlets per paragraph 3-7.3.
Lighting	Provide system per paragraph 3-7.3.
Communication	**CCTV:** None required. **CATV/Internal Video:** None required. **PA/Audio:** Coordinate with installation needs, processes, and equipment. **Telephone:** None required. **Data:** Required. **Security:** Coordinate with installation needs, processes, and equipment.
Acoustics	Meet Clinic/Health Unit criteria from UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	None
Furnishings Fixtures and Equipment (FF&E)	Workstation and interviewee chair. Consider space for interviewee table, side table, and personal effects.
User-provided Equipment	Coordinate with installation.
Special Requirements	Staff/interviewee safety with view door light or side-lite and exit path.

Figure 4-6 Teaching Kitchen

Description/Usage	**A multi-use space that includes teaching and demonstration kitchen with one set of residential kitchen appliances (minimum) with space for class/audience. Other uses as break room, life-skills educational classroom, and general instruction classroom.**
Minimum Ceiling Height	9’-0" (274 cm)
Finishes	**Walls:** Provide abuse resistance, durable finish and cleanable. **Floors:** Flooring should be durable, easy to clean, and abuse resistant. **Ceiling:** Ceiling should be durable and cleanable.
Plumbing	Provide system per paragraph 3-7.4. Provide a floor drain and turn-down vent pipe at island sink. Provide 140 °F (60 °C) hot water for any sinks utilized for dish washing.
HVAC	Provide system per paragraph 3-7.2. Return air from this space must not recirculate to other spaces. Coordinate with installation needs, processes, and equipment regarding the need for an exhaust hood.
Fire Protection	Provide system per paragraph 3-7.1.
Power	Provide outlets per paragraph 3-7.3.
Lighting	Provide system per paragraph 3-7.3.
Communication	**CCTV:** None required. **CATV/Internal Vide:** None required. **PA/Audio:** Coordinate with installation needs, processes, and equipment. **Telephone:** None required. **Data:** Required. **Security:** Coordinate with installation needs, processes, and equipment.
Acoustics	Meet classroom criteria from UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	Provide residential appliances in demonstration countertop island (minimum one set) and storage casework.
Furnishings Fixtures & Equipment (FF&E)	Equip for educational instruction and cooking-lab use.
User-provided Equipment	Coordinate with installation.
Special Requirements	None

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APPENDIX A BEST PRACTICES

A-1 INTRODUCTION.

The architectural design and construction industry has produced strategies for coordination, lean project design, or integrated project delivery. This appendix identifies good design practices for MFSC. The designer is expected to interpret this guidance and configure the design for the needs of the project.

The Best Practices Appendix is considered to be guidance and not requirements. Its main purpose is to communicate proven facility solutions, systems, and lessons learned, but may not be the only solution to meet the requirement.

A-1.1 Productivity.

The WBDG Design Objective (https://www.wbdg.org/design-objectives/productive) provides five fundamental principles of productive building designs. Refer to WBDG online resources for additional information.

A-1.1.1 Promote Health and Well-Being.

Indoor environments strongly affect human health. An effective environment should be designed to support and enhance the health and well-being of its occupants. Sustainable design principles also help achieve this objective.

Fresh air, good lighting, and natural lighting has been proven to improve human performance and health; ventilation systems or operable windows must be considered as a best practice. Operable windows do pose climate control and security challenges, but provide occupants with the control of and responsibility for their immediate environment. While this may be viewed as a maintenance risk, it may enhance the facility's value with occupants, eliciting greater care and respect.

A-1.1.2 Provide Comfortable Environments.

Provide the highest achievable levels of visual, acoustic, ergonomic, and thermal comforts for occupants within the program limitations.

A-1.1.3 Design for the Changing Workplace.

Design spaces to be flexible, cost-effective, and promote an atmosphere that increases morale, productivity, and collaboration.

A-1.1.4 Technological Tools.

Effective use of technological tools for modeling, planning, and design enables higher performance operations, efficiency, or occupants to perform activities or their duties with greater success.

A-1.1.5 Energy and Sustainability.

The mission of the DoD and other Federal agencies includes the protection and preservation of America's natural resources. Designs optimized for conservation of energy and other resources are required by DoD Guides and Manuals, including but not limited to UFC 1-200-02. The Federal government and DoD provide numerous references and design guidelines for their selected methods. Consider further improvements to performance through practices and procedures early in design and integrated design decision making.

Facility programing, client, and installation coordination can also benefit from early communication and integrated design practices. The design team may consider appropriately combining these with their own best practice standards, such as ASHRAE 90.1 (or IECC in the current edition, which includes various approaches), and the AIA's *An Architect's Guide to Integrating Energy Modeling in the Design Process*. Consideration may be given to ASHRAE 209 as an optional standard to define common language and consistent energy modeling procedures. This lexicon may assist project teams to deliver a proper building energy simulation and analysis. Note that not all energy modeling procedures are recommended for all projects. Minor projects should follow a limited selection, perhaps three to five of the procedures, each at a different project milestone or phase to deliver a high-performance building.

A-1.1.6 Adaptability with Modular Furniture and Fit-outs.

Building adaptability is the capacity of a building to be used for multiple uses and in multiple ways over the life of the building. For example, designing a building with a modular and integrated approach to infrastructure delivery and interior systems (furniture, ceiling systems, and access floors) allows the building to support multiple uses and multiple futures (https://www.wbdg.org/design-objectives/sustainable).

Modular furniture can be digitally planned, manufactured to a custom fit, and re-configured to accommodate different programs and service populations of an MFSC.

APPENDIX B GLOSSARY

B-1 ACRONYMS AND ABBREVIATIONS.

°C	degree(s) Celsius
°F	degree(s) Fahrenheit
A&FRC	Airman and Family Readiness Centers
ABA	Architectural Barriers Act
AD	active duty
A/E	Architect/Engineering
AFAS	Air Force Aid Society
AFCEC	Air Force Civil Engineer Center
AFCEC/CF	AFCEC Facility Engineering Directorate
AFCFS	Air Force Corporate Facility Standards
AFI	Air Force Instruction
AFPC/DPFF	Air Force Personnel Center, Airman and Family Readiness
AIA	American Institute of Architects
AR	Army Regulation
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
AT/FP	Antiterrorism and Force Protection
AWI	Architectural Woodwork Institute
BEC	Base Education Center
BIA	Bilateral Infrastructure Agreement
CATV	community access television
CCP	Community Counseling Program
CCR	Criteria Change Request
CCTV	closed circuit television

cm	centimeter
CONUS	Continental United States
CYP	Children and Youth Program(s)
DAFMAN	Department of the Air Force Manual
DAFI	Department of the Air Force Instruction
DG	Design Guide
DoDI	Department of Defense Instruction
EFA	Emergency Family Assistance
EFMP	Exceptional Family Member Program
ER	Engineer Regulation
FF&E	Furnishings, Fixtures, & Equipment
FMEAP	Family Member Employment Assistance Program
FRS	Family Readiness System
FSC	Family Service Center
HNFA	Host Nation Funded Agreement
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HQ USMC	Headquarters, U.S. Marine Corps
HVAC	heating, ventilating, and air conditioning
I&R	Information and Referral
IECC	International Energy Conservation Code
IFS	Installation Facility Standard
IMC	International Mechanical Code
in	inch
IR&R	Information, Referral and Relocation Programs
ITA	International Trade Administration
LED	light emitting diode

LRV	light reflectivity value
MCFTB	Marine Corps Family Team Building
MFSC	Military Family Service Center
mm	millimeter
MWR	Morale, Welfare, and Recreation
NFPA	National Fire Protection Association
NMCRS	Navy and Marine Corps Relief Society
NPSP	New Parent Support (Program)
NRC	noise reduction coefficient
OCONUS	Outside the Continental United States
OPNAVINST	Office of the Chief of Naval Operations Instruction
PA	public address
PES	Preventative Education Section
PFMP	Personal Financial Management Program
PFR	Personal Financial Readiness
QoL	quality of life
RAP	Relocation Assistance Program
RC	Reserve Component
SAP	Substance Abuse Program
SAPRO	Sexual Assault and Prevention Response Office
SBP	(Casualty and) Survivor Benefit Plan
SECO	Spouse Education and Career Opportunities
SMP	Single Marine Program
SOFA	Status of Forces Agreements
STC	sound transmission coefficient
TAP	Transition Assistance Program

TRP	Transition Readiness Program
UFC	Unified Facilities Criteria
UL	Underwriters Laboratories
USMC	United States Marine Corps
UV	ultraviolet

B-2 DEFINITION OF TERMS.

Fleet Concentration Area: Navy term to describe an area where the active duty population is greater than 62,500 within a 50-mile radius.

APPENDIX C REFERENCES

C-1 GOVERNMENT.

FEDERAL LAW

42 U.S.C. 4151-4157, Architectural Barriers Act (ABA)
https://www.govinfo.gov/app/details/USCODE-2010-title42/USCODE-2010-title42-chap51-sec4151

DEPARTMENT OF COMMERCE

U.S. Department of Commerce, International Trade Association, "Electric Current Worldwide"
https://legacy.trade.gov/mas/ian/ECW/index.html

DEPARTMENT OF DEFENSE (DOD)

https://www.esd.whs.mil/

DoDI 1015.10, *Military Morale, Welfare, and Recreation (MWR) Programs* (enclosure 8)

DoDI 1342.22, *Military Family Readiness*

DoDI 6400.01, *Family Advocacy Program (FAP)*

AIR FORCE

https://www.e-publishing.af.mil/

AFI 38-101, *Manpower and Organization*

DAFI 36-3009, *Airman and Family Readiness Centers*

DAFMAN 32-1084, *Standard Facility Requirements*

ARMY

https://armypubs.army.mil/ProductMaps/PubForm/AR.aspx

AR 608-1, Army Community Service

CORPS OF ENGINEERS

DG 1110-3-122, *Design Guide for Interiors*
https://wbdg.org/FFC/ARMYCOE/COEDG/dg_1110_3_122.pdf

ER 1110-345-100, *Design Policy for Military Construction*
https://www.publications.usace.army.mil/USACE-Publications/Engineer-Regulations/

NAVY

OPNAVINST 11010.20H, *Navy Facilities Projects*
https://www.wbdg.org/FFC/DOD/UFC/OPNAVINST_11010.20H.pdf

OPNAVINST 11010.45A, *Site Approval Request Process*
https://www.wbdg.org/ffc/dod/ufc/navfacinst_11010.45a.pdf

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 1-200-01, *DoD Building Code*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

UFC 3-101-01, *Architecture*

UFC 3-120-01, *Design: Sign Standards*

UFC 3-120-10, *Interior Design*

UFC 3-201-02, *Landscape Architecture*

UFC 3-301-01, *Structural Engineering*

UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*

UFC 3-410-02, *Direct Digital Control for HVAC and Other Building Control Systems*

UFC 3-420-01, *Plumbing Systems*

UFC 3-501-01, *Electrical Engineering*

UFC 3-520-01, *Interior Electrical Systems*

UFC 3-530-01, *Interior and Exterior Lighting Systems*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems*

UFC 4-022-01, *Security Engineering: Entry Control Facilities / Access Control Points*

UFC 4-023-10, *Safe Havens*

UFC 4-026-01, *Design to Resist Forced Entry*

UFC 4-740-06, *Youth Centers*

FC 4-740-14N, Navy and Marine Corps Child Development Centers

UFC 4-740-15, *Continuous Child Care Facilities*

C-2 NON-GOVERNMENT.

AMERICAN INSTITUTE OF ARCHITECTS

https://www.aia.org

An Architect's Guide to Integrating Energy Modeling in the Design Process

AMERICAN SOCIETY OF HEATING AND REFRIGERATION ENGINEERS

https://www.ashrae.org/

ANSI/ASHRAE/IES Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

ASHRAE 209, *Energy Simulation Aided Design for Buildings Except Low Rise Residential Buildings*

ARCHITECTURAL WOODWORK INSTITUTE

https://www.awinet.org/

Architectural Woodwork Quality Standards Illustrated

FEDERAL HIGHWAY ADMINISTRATION

Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways
https://mutcd.fhwa.dot.gov/

NATIONAL FIRE PROTECTION ASSOCIATION

https://www.nfpa.org/Codes-and-Standards/All-Codes-and-Standards/List-of-Codes-and-Standards

NFPA 70, *National Electrical Code*

MISCELLANEOUS

https://codes.iccsafe.org/content/imc2021p1

International Mechanical Code (IMC)

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APPENDIX D SUPPLEMENTAL RESOURCES

DEPARTMENT OF DEFENSE (DOD)

Chief of Naval Operations Instruction, *Facilities Projects Manual*
https://www.wbdg.org/

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 3-201-01, *Civil Engineering*

UFC 3-401-01, *Mechanical Engineering*

UFC 3-601-02, *Fire Protection Systems Inspection, Testing, and Maintenance*

UFC 4-730-10
8 May 2019
Change 1, 11 June 2021

UNIFIED FACILITIES CRITERIA (UFC)

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND

AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**
1	11 June 2021	3-8 Deleted paragraph Barrier Free Design Requirements; Accessibility is in paragraph 1-4. Revised Tables 4-1, 4-5, 4-6, 4-11 and 4-13 “Plumbing” to clarify when an oil water separator is required.

This UFC supersedes UFC 4-730-10, *Fire Stations*, dated 15 June 2006, and FC 4-730-10N, *Navy and Marine Corps Fire Stations*, dated 1 December 2013.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA) and, in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies must contact the preparing Service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale must be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

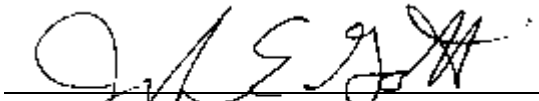
- Whole Building Design Guide web site http://dod.wbdg.org/.

Refer to UFC 1-200-01, *DoD Building Code (General Building Requirements)*, for implementation of new issuances on projects.

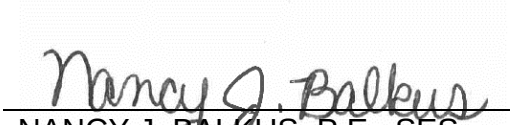
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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Document: UFC 4-730-10, *Fire Stations*

Superseding: UFC 4-730-10, *Fire Stations*, dated 15 June 2006, and FC 4-730-10N, *Navy and Marine Corps Fire Stations*, dated 1 December 2013.

Description: This UFC provides criteria for planning and design of fire stations. This UFC includes guidance for Air Force, Army, Marine Corps, and Navy fire stations.

Reasons for Document: This is a new joint-Service document. This new document represents another step in the joint-Services' effort to bring uniformity to the planning, design, and construction of military facilities. This UFC was developed to provide design requirements to accomplish the following:

- Assist planners in understanding facility requirements to ensure accurate space program budgets.
- Provide architects, engineers, and construction surveillance personnel with essential, minimum requirements for the design and construction of fire stations.
- Clarify the operational intent of the facility design.

Impact: The following will result from the publication of this UFC:

- This UFC creates a single source for common DOD fire station criteria and an accurate reference to individual Service-specific documents.
- This UFC facilitates updates and revisions and promotes agreement and uniformity of design and construction among the Services.

Unification Issues: The following is non-unified content**:**

- The Marine Corps separates their program into two organizations, one for structural and one for aircraft rescue firefighting (ARFF).
- The Navy and Marine Corps mandate direct vent apparatus exhaust systems when required by intended apparatus operations.
- For Army only, the function associated with personal protective equipment (PPE) gear storage as described in Table 4-2 is permitted to occur within and open to the apparatus bay.
- For Army only, the functional program space for the decontamination room detailed in Table 4-11 has the option to be programmed as "fire extinguisher inspection, maintenance and storage (non-flight line)."

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This UFC provides requirements for evaluating, planning, programming, and designing fire stations. The information in this UFC applies to the design of all new construction projects, including additions, alterations, and renovation projects in the continental Unites States (CONUS) and outside the continental United States (OCONUS). This UFC is not intended as a substitution for thorough review during design by individual program managers and operations staff in the appropriate Service.

Fire stations support military firefighters' mission to provide fire protection to installation flightlines and facilities and fire prevention education and training. This UFC does not apply to deployment, contingency, or field operating facilities. When the fire station function is part of a consolidated operations facility (fire/police/safety), the criteria in this UFC is applicable only to fire station functions and must be applied carefully in order to integrate with other facility functions. Identify common support/administrative spaces that can be shared to improve efficiency.

1-1.1 Types of Stations.

Functionally, there are three types of fire stations:

- Structural stations provide fire protection to facilities
- Aircraft rescue firefighting (ARFF) stations provide fire protection to flightlines and aircraft
- Combination structural/ARFF stations

To support the firefighters' mission, it is crucial that the design of all fire stations accommodate the equipment, numerous unique functional requirements, and safety of the firefighting personnel. Generally, the differences between structural and ARFF stations are limited to the apparatus bay size criteria (see paragraph 2-3.1 for more on these differences) and the facility location determinants (see paragraph 2-1).

The Marine Corps program includes two separate organizations: one for structural and one for ARFF. Unlike the other Services, the Marine Corps rarely combines the stations and requires separate offices for fire chiefs and other personnel on their installations.

1-1.2 Classes of Stations.

Irrespective of type, there are two classes of fire stations:

- Headquarters (or main) stations generally house the fire chief and most of the general administrative functions.

- Satellite stations are located throughout the installation to provide response time coverage.

The differences between headquarters and satellite stations relate only to the additional administrative functions housed in the headquarters station. Both headquarters and satellite stations may be structural, ARFF, or combination stations.

1-1.3 Users of Stations.

Not all of these personnel will be located in every fire station but generally all of the following individuals will be present in at least one fire station per installation:

- Fire chief
- Deputy fire chief
- Assistant chief/shift supervisor
- Firefighters
- Inspectors
- Training officers
- Fire prevention officers
- Hazardous materials (HAZMAT)/health and safety officer
- Logistics officer
- Administrative assistant
- Reserve firefighters

1-2 APPLICABILITY.

This UFC applies to all Service elements and contractors involved in the planning, design, and construction of fire stations worldwide.

1-3 USERS OF THIS UFC.

This UFC is intended as a source of basic architectural and engineering information for all individuals involved in the planning, design, and construction of fire stations.

Specific users of the UFC include the following:

1-3.1 Architects and Engineers.

Architects and engineers (A/E) who will provide design services under the direction of the individual Service design agencies.

1-3.2 Planning Personnel.

Planning personnel will use this UFC for programming new or replacement facilities, pre-design planning, or assessing the extent of improvements required in an existing fire station to achieve the standard established herein.

1-3.3 Additional Users.

Additional users may include entities for operational or other purposes. The respective users must refer to this UFC from their own policy documents as appropriate and may include:

- Headquarters staff and field operating agencies
- Major command (MAJCOM) staff/regions
- Base, installation, and garrison commanders
- Installation facilities management
- Installation technical proponents

1-4 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as accessibility, antiterrorism, security, high-performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein. Air National Guard facility requirements are defined in ANGH 32-1084, *Facility Space Standards*. For projects that fall under the area of responsibility of the U.S. Army Centers of Standardization (COS) program, the requirements of the COS for fire stations in Huntsville, Alabama, supersede any conflicting requirements herein. Designers must contact and coordinate with the COS accordingly.

1-5 BEST PRACTICES.

Appendix A is considered to be guidance and not requirements. Its main purpose is to communicate proven facility solutions, systems, and lessons learned, but may not be the only solution to meet the requirement.

1-6 REFERENCES.

Appendix D contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the reference publication applies.

1-7 GLOSSARY.

Appendix C contains acronyms and abbreviations.

CHAPTER 2 PLANNING AND LAYOUT

2-1 LOCATION DETERMINANTS.

Several factors determine the most appropriate and cost-effective location for a fire station.

2-1.1 Access/Response Time.

The most critical determinant for the location of a fire station is response time. Refer to DODI 6055.06, *DoD Fire and Emergency Services Program*, or DOD component policy to determine required response times. In addition to response time, accommodate access to the station by delivery vehicles, staff, and visitors.

Direct access and response time may conflict with tightening antiterrorism (AT) criteria. Provide a facility site that is prominent and easily visible from the target areas (structures or flightlines).

2-1.2 Size.

Provide site space to accommodate firefighting vehicle turning radii, personnel parking, visitor parking, storage requirements, and reserve vehicles (if applicable). Provide site space to accommodate a dumpster pad and enclosure in accordance with the installation appearance plan (IAP).

2-1.3 Elevation.

Due to the critical response capabilities required by fire and emergency response units, select a site such that parking areas and driveways are located at least 3 ft (0.9 m) above the base flood elevation (BFE).

2-2 SIZE DETERMINANTS.

Several factors determine the size of the facility, as described below.

2-2.1 General.

Generally, the size of the station depends on the class of station, the number of companies housed, the number and types of vehicles housed, and any additional spaces required. The class of station will partially drive the number of spaces required. However, depending on what is currently available on the installation, some spaces normally reserved for headquarters stations may be provided in satellite stations. The installation representatives, in conjunction with the program manager, must decide which spaces must be provided.

Gross Square Feet (GSF) Deviation: The facility constructed gross area must not exceed 100 percent of the space allocation set forth in this UFC to accommodate site,

construction, or environmental factors. The number of apparatus bays and dorm rooms are used to determine the overall size of the fire station facility.

2-2.2 Needs Validation Assessment.

Conduct a needs validation assessment to determine the class and required capacity of personnel and vehicles of the new or renovated station.

2-2.3 Types of Spaces.

For a complete list of spaces, see Table 2-1. Fire station functional spaces fall into three main categories:

2-2.3.1 Maintenance and Apparatus.

This includes the apparatus room/bays that house the firefighting vehicles and supporting maintenance spaces. The maintenance spaces include both vehicle maintenance equipment maintenance/storage for fire extinguishers, self-contained breathing apparatus (SCBA), protective clothing, hoses, and firefighting agents.

2-2.3.2 Administration and Training.

This includes the appropriate offices, training spaces, dispatch areas, and administrative areas.

2-2.3.3 Residential and Living.

This includes on-duty firefighters' bedrooms, toilets/showers, kitchen/dining, recreation, and "living room" areas.

2-2.3.4 Other Spaces.

Other spaces that don't readily fit into the three categories include the following:

- Vending space shared by both staff and firefighters.
- Air Force Reserve Command/Air National Guard annex may provide a separate space for administration, equipment storage/maintenance, training, and testing.
- Host nation employee dayroom as mandated by Master Labor Contracts (MLC) or Status of Forces Agreements (SOFA).
- Transition zones (yellow) to allow movement of personnel between the facility's hot (red) and cold (green) zones. Hot zones are spaces in the facility exposed to carcinogens and green zones are living/working spaces intended for extended occupancy.

Table 2-1 Fire Station Program Spaces

Space	Notes
Maintenance and Apparatus	
Apparatus room/bays	Made up of bays; either single- or double-length bays. Sized according to truck modules: See para. 2-3.1.1.
Personal protective equipment (PPE) gear storage	One per station.
Hose storage	One per station.
SCBA compressor room	At least one per department. May be required in multiple stations due to extent of geographic separation as dictated by installation mission requirements.
SCBA maintenance	One per department.
Protective clothing laundry	One per station.
Equipment wash/disinfection	One per station.
Work room/equipment maintenance	One per station.
Vehicle maintenance equipment storage	One per station. Tools and minor parts.
EMT storage (basic first aid supplies)	One per station.
Medical storage cabinet/locker (drugs and needles)	One per station. Lockable. This may be combined with or a sub-space of the EMT storage room.
HAZMAT/CBRNE equipment storage	HAZMAT: One per station. CBRNE (chemical, biological, radiological, nuclear, explosive): As dictated by installation mission requirements. Not all stations require these spaces and store these materials off-site.
Agent storage	At least one per department. May be required in multiple stations due to extent of geographic separation as dictated by installation mission requirements.
Spare PPE gear storage	At least one per department.
Decontamination room	One per station. For Army only, this room can be programmed as "fire extinguisher inspection, maintenance and storage (non-flight line)."
Flightline fire extinguisher maintenance and storage	One per department.
Vehicle maintenance bay	Addition to apparatus room/bays, as dictated by installation mission requirements.
Vehicle maintenance office	As dictated by installation mission requirements if vehicle maintenance bay is provided.
Reserve and active duty mobility/deployment gear storage	As dictated by installation mission requirements.
Administration and Training	
Station officer office	One per station.

Watch desk	One per station only if no dispatch in station and then made part of station officer office. (Receives calls from dispatch.)
Fire chief office	One per department.
Chief's conference room	One per department. May be a part of fire chief's office.
Deputy chief office	The requirement for a deputy chief is driven by the size of the department.
Administrative assistant	Provided only in conjunction with chief and deputy chief.
Lobby area	Generally provided only in conjunction with chief and deputy chief.
Assistant chief/shift supervisor	One per station. Additional staffing as dictated by installation mission requirements.
Assistant chief of fire prevention	One per department as dictated by installation mission requirements.
Inspector(s) office(s)	Several workstations per department may be located in several stations.
EMS office	Space for EMS to complete confidential paperwork as dictated by installation mission requirements.
HAZMAT/health and safety office	One per department.
Logistics office	As dictated by installation mission requirements.
Department training room	At least one per department (in HQ station). May be provided in other stations as dictated by installation mission requirements.
Training officer office	One per department.
Testing/individual study area	One per station. Separate room.
General administration storage	One per station.
Fire-only dispatch	One per department; provided only if no requirement for consolidated or joint dispatch. Dispatch receives emergency calls from the public.
Consolidated or joint dispatch	Provided in lieu of fire-only dispatch. Combines fire, security, and medical dispatch functions.
Dispatch supervisor	Provided in conjunction with dispatch centers staffed by 3 or more on-duty dispatchers.
Dispatch bathroom	Dedicated facilities. Provide off the dispatch floor for immediate access by personnel.
Dispatch kitchenette	Dedicated facilities. Provide off the dispatch floor for immediate access by personnel.
Telecommunications room	One per station. Provide presence/size of dispatch and/or watch room as dictated by installation mission requirements.
Dispatch equipment room	One per station. Provide presence/size of dispatch and/or watch room as dictated by installation mission requirements.
Generator space	One per station. May need to be located inside as a security concern.
Residential and Living	

Day room	One per station. Includes kitchen, dining, and lounge areas.
Training room	The station training area may be incorporated as part of the dining portion of the day room as dictated by installation mission requirements.
Dorm rooms	Per station. Quantity depends on number of crews.
Bathrooms/shower/changing	Male and female facilities per station. Individual unisex showering/changing rooms can be provided as dictated by installation mission requirements.
Fitness room	One per station.
Laundry room	One per station.
Recreation room	Addition to day room for noisier activities such as games as dictated by installation mission requirements.
Covered outdoor patio	One per station is counted toward overall building square footage included in the validated DD1391.
Unisex public toilet	For headquarters stations only. Toilet facilities accessible from dayroom or main lobby for use by guests/visitors. For Army only: Required in all facilities.
Other Spaces	
Vending	For use by firefighters and staff.
Reserve firefighter gear	Air Force only. As dictated by installation mission requirements.
Reserve offices	Air Force only. Offices (two) for fire chief and assistant chief and training officer as dictated by installation mission requirements.
Host nation dayroom	Provide as mandated by Master Labor Contracts (MLC) or Status of Force Agreements (SOFA).
Transition zones (yellow)	Allow movement of personnel between the facility's hot (red) and cold (green) zones. Hot zones are spaces in the facility exposed to carcinogens and green zones are living/working spaces intended for extended occupancy.

2-3 SPACE PROGRAM.

The space program for fire stations is developed through the use of an interactive worksheet. It is completed by first entering the appropriate Service branch and then selecting the following: type of station, class of station, number of companies to be housed/dorm room count, number and class of vehicles to be housed, and additional required spaces. The selections vary depending on the Service branch selected. As selections are made, the program areas are calculated and summed for both the building and the site. The worksheet must be filled out in collaboration with the appropriate fire department representative(s).

This interactive worksheet is available as a downloadable Microsoft® Excel file from the Whole Building Design Guide Web site: http://www.wbdg.org/references/pa_dod_sps.php.

2-3.1 Critical Space Drivers.

To understand how the numbers in the interactive worksheet are calculated, several critical space drivers must be understood.

2-3.1.1 Apparatus Bays.

The apparatus bays are sized based on the class of truck to be housed. See Table 2-2 for a list of common truck types. These types have been classified as follows to standardize the size criteria:

- **Large.** These typically include structural aerial (ladder) trucks or large tanker trucks with lengths greater than 38 ft (11.58 m). The standardized footprint (floor space occupied by the truck, not considering the space around it) is 10 ft by 50 ft (3.05 m by 15.24 m).
- **Medium.** This class covers a wide range of vehicles, from structural pumper trucks and smaller tanker trucks to rescue and HAZMAT trucks. Medium trucks have lengths between 30 and 38 ft (9.14 and 11.58 m). The standardized footprint is 10 ft by 38 ft (3.05 m by 11.58 m).
- **Large ARFF (Wide).** All ARFF trucks are distinguished by their generally greater width and may include heavy rescue or very large tankers. Large ARFF trucks have lengths greater than 38 ft (11.58 m). The standardized footprint is 12 ft by 50 ft (3.66 m by 15.24 m).
- **Medium ARFF (Wide).** Medium ARFF trucks are also distinguished by their generally greater width. They can vary in length from about 23 ft (7.01 m) up to 38 ft (11.58 m) but the standardized footprint is 12 ft by 38 ft (3.66 m by 11.58 m).
- **Small.** These typically include ambulances, small rescue or HAZMAT trucks, small brush units, and command vehicles. Small trucks have lengths less than 30 ft (9.14 m). A separate vehicle bay size class is not designated for these trucks. Depending on the actual size of the small class truck, it may be housed in its own bay or in a bay with another truck. For example, two 20-ft (6.10-m) -long vehicles may be housed in a large bay (either ARFF or not). The interactive worksheet makes a recommendation for the area of additional apparatus bays, as appropriate, for the quantity of small vehicles indicated. However, this area must be carefully reviewed by the planning team to ensure it provides the correct space, accounting for the actual length of the small vehicles anticipated and the space that may be available in other bays.

In addition to the truck footprint, the space program takes into account the space around the parked truck. This space varies, depending on whether the truck is parked next to a wall or another truck. See Figures B-1 through B-4 for illustrations of these variations. The space program uses the middle-sized bay for each truck class to calculate an "average" size bay for the given vehicle. Also see Table 4-1 for more information on the apparatus bays.

Table 2-2 Common Types of Vehicles and Their Size Classes

Type of Vehicle	Size Class of Vehicle (See Para. 2-3.1.1)
Structural	
Pumpers	Medium
Telesquirts	Medium
Aerial/ladders	Large
Tankers	Medium or large
ARFF	
Large water tankers	ARFF medium
ARFF foam (vary from 1500 gal [5700 L] up to 6500 gal (24,600 L)	ARFF medium or ARFF large
Ambulance	
Ambulances	Small
Rescue	
Small/light rescue	Small
Medium rescue	Medium
Heavy rescue	ARFF medium
HAZMAT	
HAZMAT support/small	Small
HAZMAT squad	Medium
HAZMAT squad	Large
Brush	
Small brush	Small
Large brush	Medium
Equipment Trailers	
Various equipment trailers pulled by command or other vehicles	Small

2-3.1.2 Dorm Room Counts.

The interactive worksheet uses two methods to calculate the number of dorm rooms needed (dorm room count). First, the user enters the number of structural companies and the number of ARFF companies, as appropriate. (If it is a structural station, ARFF

companies are not permitted and vice versa.) Based on the branch of Service selected, the worksheet will calculate the number of dorm rooms from the number of companies. Second, the user adds or subtracts dorm rooms to accommodate ambulance companies, rescue companies, or cross-staffing of companies. The initial number of rooms plus or minus the modified number of rooms is the final dorm room count.

Dorm room counts must be coordinated with the fire chief. See Table 2-3 for sample on-duty staffing by vehicle type. Cross-staffed (x-staffed) vehicles are staffed on an as-needed basis by personnel assigned to another vehicle or vehicles. X-staffed vehicles have no dedicated staff of their own. The sample vehicle staffing numbers shown in Table 2-3 do not represent staffing authorizations.

Table 2-3 Sample Staffing by Vehicle Type

Type of Vehicle	Army	Navy	Air Force	Marine Corps
Structural				
Pumpers	4	4	4	4
Telesquirts	4 or x-staffed	4 or 6	4	4
Aerial/ladders	4 or x-staffed	4 or 6	4	4
Tankers	x-staffed	1 or x-staffed	n/a	1 or x-staffed
ARFF				
Large water tankers	x-staffed	1 or x-staffed	1	1 or x-staffed
ARFF foam	3	3	3	4
Ambulance				
Ambulances	2 or x-staffed	2	n/a	2
Rescue				
Small/light rescue	x-staffed	3 or x-staffed	3	3 or x-staffed
Medium rescue	x-staffed	3 or x-staffed	3	3 or x-staffed
Heavy rescue	x-staffed	3 or x-staffed	3	3 or x-staffed
HAZMAT				
HAZMAT support/small	x-staffed	x-staffed	x-staffed	x-staffed
HAZMAT squad	x-staffed	x-staffed	x-staffed	x-staffed
Brush				
Small brush	x-staffed	x-staffed	x-staffed	x-staffed
Large brush	x-staffed	x-staffed	x-staffed	x-staffed

2-3.2 Total Area.

The space program developed through the use of the interactive worksheet serves as a guideline for the fire station planning team and generally represents the maximum space allowed. The final space program for a new fire station will need to be carefully determined by installation representatives and the appropriate Service program office, guided by the criteria in this UFC. The space assessment and its related basic facility requirement (BFR) calculation serves as the basis for the validated DD1391, which defines the total authorized space allowances for each project.

2-4 LIFE-CYCLE COST PRIORITIZATION.

Prioritize a lower total life-cycle cost over initial capital investment. Design these facilities with the objective of achieving the lowest life-cycle cost over a 40-year period. To do so, the project's design program must define the scope and performance requirements to develop and validate a long-term operational budget. The budget must be within reasonable funding expectations while supporting an appropriate and high-quality program and meeting the performance requirements identified in this UFC.

2-5 LAYOUT AND ADJACENCIES.

As with location determinants, the key internal adjacencies are driven by response time. The location of the residential and living areas must accommodate quick and clear access to the apparatus room/bays for response in the event of an alarm. The apparatus bays require the ability to drive through with overhead doors on either end of each bay. The appropriate layout and adjacencies are illustrated through a bubble diagram.

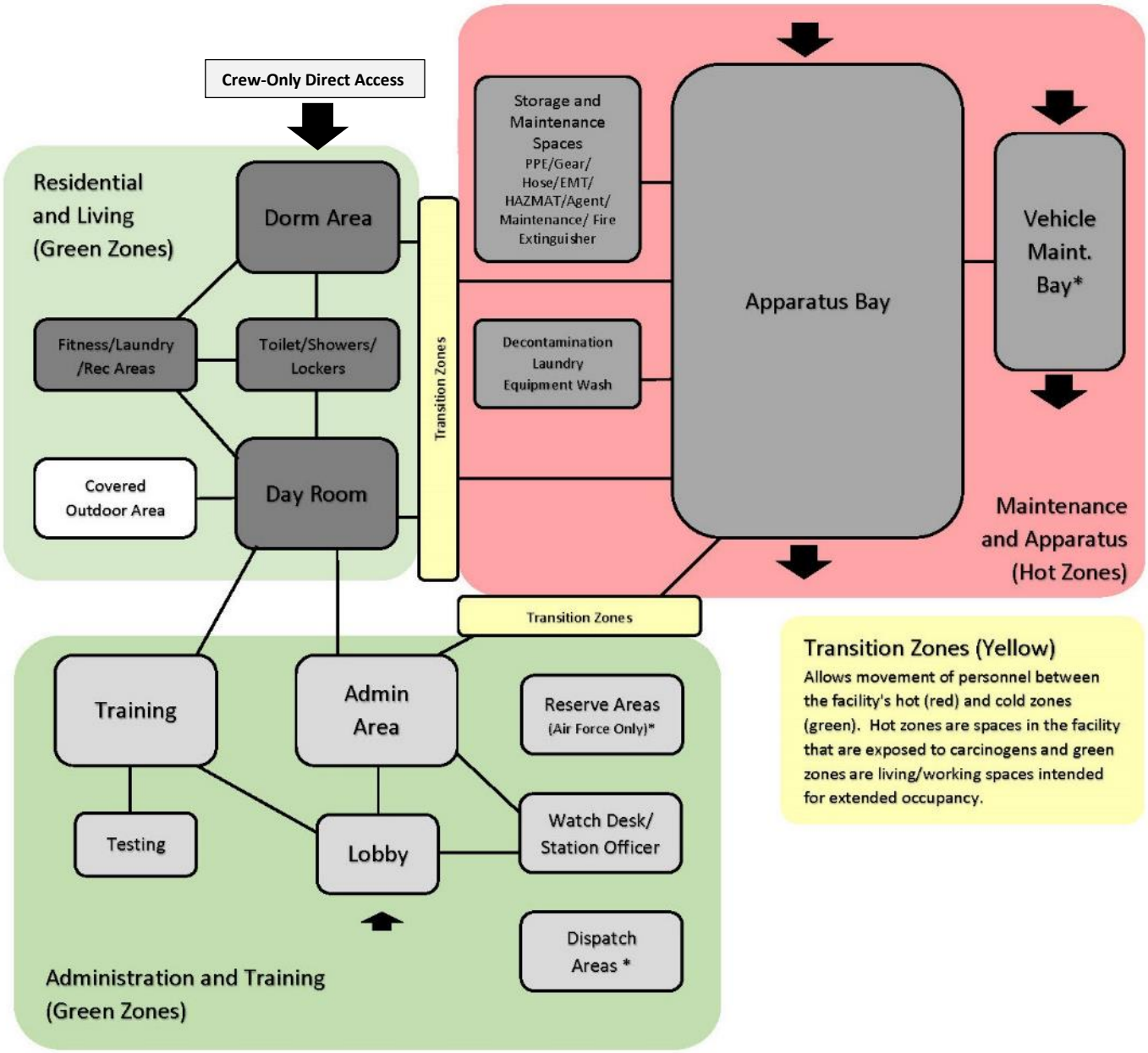
In HQ/main stations, coordinate the relationship between the administrative areas and the living areas with the users and program manager. There may be a desire to separate these areas to provide a sense of functional identity for each. One-story fire stations are preferred. However, if necessary, some required adjacencies may be accommodated vertically. If a two-story solution is proposed, the dispatch and administrative areas may be placed on the first floor to best account for Architectural Barriers Act (ABA) compliance requirements. The sequence for transitioning from a hot zone to a cold zone must allow space for personnel to take five steps along a walk-off surface over a minimum 6-ft (1.8-m) -long path after removing gear and washing off any visible contaminants.

2-5.1 Functional Relationship Bubble Diagram.

The bubble diagram in Figure 2-1 indicates the acceptable relative adjacencies of the functional spaces. Some of these key adjacencies may be accommodated through a hallway rather than a direct entrance/exit from one space to another. This is particularly true with the apparatus room/bays and the day room since many facility spaces need an adjacency with these two spaces. Note that the apparatus bay support area indicated in the diagram includes the following spaces, some of which may not be included in every station, depending upon installation mission requirements:

- SCBA maintenance
- SCBA compressor room
- Work room/equipment maintenance
- Equipment wash/disinfection
- Protective clothing laundry
- EMT storage
- HAZMAT/CBRNE equipment storage
- Spare PPE gear storage
- Decontamination room
- Flightline fire extinguisher maintenance

Figure 2-1 Basic Facility Functional Relationship Diagram



* If required by Installation mission requirements.

2-5.2 Space Assessment.

See the functional data sheets in Chapter 4 for additional information on the space types and their relationships to each other.

2-6 ALTERATIONS TO EXISTING FACILITIES.

2-6.1 Regulatory Authorities.

Refer to the following appropriate authorities for each Service:

- Army. The standard may be modified to accommodate the existing structure. However, all proposed modifications to the standard must be sent to the Army Corps of Engineers, Engineering & Support Center, HSV (CEHNC), for review and HQDA (CFSC; CYS) for approval prior to the initiation of concept design.
- Navy. Funding thresholds and authorities are in the most current version of OPNAVINST 11010.20, Navy Facilities Projects. The site approval request (SAR) process is in CNICINST 11010.3, Site Approval Request Process, and NAVFACINST 11010.45A, Site Approval Request Process. Prior to altering an existing fire station or converting an existing facility to a fire station, contact the local Asset Management Business Line of the Public Works Department (PWD) or Regional Facilities Engineering Command (FEC) for approval of changes to real property via site approval, certification of the work and property classification, assistance with project development, and the identification of signing authorities and fund source. This certification or assistance also applies to any alterations, conversion, construction, repair, or equipment installation effort for minor/specific work orders, special projects, or MILCON projects. Contact the Capital Improvements Business Line (CIBL) for assistance with the latest design and building codes.
- Air Force. Consult AFCEC for all architectural and functional requirements; technical issues relating to fire, life safety, certification; and publication coordination. Consult HQ USAF/A4C for functional policies.
- Marine Corps. Consult with Marine Corps Installations Command (GF) Facilities and (G3) Fire and Emergency Services.

2-6.2 Other Considerations.

It is unlikely that a non-fire station facility would ever be converted to a fire station. However, should this need arise, evaluate the site and structure of the existing facility and its limitations with regard to the required functions of a fire station.

Consideration must be given to the adaptability of the existing facility to the intent of the fire station program. For instance, can the building accommodate the apparatus room/bays? Does it have site space for the vehicle turning radii? Does it meet the

higher structural requirements for an essential facility (Risk Category IV) and an inhabited building or billeting? If not, can it be economically upgraded? Whether planning a conversion, alteration, addition, or new construction, all the criteria in this UFC must be met by the resulting facility.

2-6.3 Sustainable Design.

The location of a facility can have a significant impact on achieving sustainable design rating points. (See paragraph 3-9 for more information on sustainable design and sustainable rating systems.) Evaluate issues such as brownfield redevelopment, potential building orientation, access to public transportation, and reuse of existing paving and hardscape when selecting a site.

2-7 ACCESSIBILITY.

In accordance with UFC 1-200-01, follow the Architectural Barriers Act (ABA) Accessibility Standards for DOD facilities.

2-8 SUSTAINABLE DESIGN.

Design fire stations per the requirements of UFC 1-200-02, *High Performance and Sustainable Building Requirements*.

2-9 HAZARDOUS MATERIALS.

2-9.1 Background Information.

DOD operates facilities that routinely utilize, or have utilized in the past, hazardous materials and chemicals that contain lead, cadmium, chromium, and other heavy metals. Operations and activities that can create an unsafe condition with regards to worker protection include (but are not limited to) manual demolition, scraping, grinding, heat-gun applications, power tooling with dust collection, application of corrosion-control materials, spray paint with lead/chromium (VI)/cadmium-based paints, burning, power tooling without dust collection, rivet busting, cleanup activities with dry abrasives, movement/removal of enclosures, abrasive blasting, welding, cutting, and burning on steel structures. When these operations occur, there are hazards associated with the generation of dust, debris, and fumes. The hazards and the controls required are dependent on the materials used.

2-9.2 Facility Design Requirements.

For facilities that will operate, or will continue to operate, utilizing hazardous materials and/or chemicals, comply with the Occupational Safety and Health Act (OSHA), American Conference of Governmental Industrial Hygienists (ACGIH) *Guide to Occupational Exposure Values* and *TLVs and BEIs*, DODI 6055.01, *DoD Safety and Occupational Health Program*, and DODI 6055.06. The requirements found in the OSHA regulations and DODIs may affect facility design requirements, which may

include (but are not limited to), separate toilets and washing/bathing areas for workers exposed to the hazard, change rooms, decontamination areas, break rooms, clothes-washing facilities, areas for controlled disposal of contaminated waste and work clothes, both local and general high-efficiency particulate air (HEPA) ventilation systems and filters, eyewash stations, and deluge showers. Facility areas utilizing these hazardous materials and/or chemicals must be designated as regulated areas whenever exposure can be expected to be in excess of the permissible exposure limit(s) (PEL) and must be demarcated from the rest of the workplace in a manner that establishes and alerts building occupants of the boundaries of the regulated area. Design facilities in a manner to allow OSHA-required air sampling and monitoring for the specific hazardous material in use. Design facilities to control these hazards below the standards set in the stated regulations.

Additionally, DODI 6055.01, Appendix 4, lists additional requirements for facilities that involve operations generating airborne dust, mist, debris, or aerosols containing lead, chromium (VI), or cadmium. These requirements include (but are not limited to) containment processes and methods to monitor effectiveness of housekeeping procedures, decontamination procedures, and engineering controls tailored to each facility.

2-10 WEATHER RESILIENCY.

Current guidance for critical public safety facilities recommends facilities in identified weather threat areas include features to ensure emergency responders can survive through the trans-event period and immediately deliver emergency response services in the post-event period. Refer to FEMA's *Operational Lessons Learned in Disaster Response* for specific guidance.

CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL.

References within this UFC to applicable criteria and codes are intended to assist the designer in compiling the required documents. These references are not intended to identify all that may apply. It is the responsibility of the designer of record to identify and comply with all required statutes.

Use UFC 1-200-01 for applicability of model building codes and referenced government criteria. UFC 1-200-01 identifies, through references, key unified facility criteria and requirements, including accessibility, antiterrorism, security, sustainability, safety, acoustics, discipline-specific, and building systems. See paragraph 3-6 for appropriate governing codes for building services.

3-1.1 Authorized Building Program.

A DD1391 funding document is developed for all new construction projects that establishes the project requirements and authorized building size. The designer can use the functional diagram in Figure 2-1 to create the logical flow and individual space allocations for approved functions within the facility; however, the design may not exceed the square footage allowances of the DD1391 or add functions in the facility if the functions are not authorized in the validated DD1391.

3-2 STRUCTURE.

Classify the entire facility as Risk Category IV in accordance with UFC 3-301-01, *Structural Engineering*. Calculate wind loadings for the apparatus bay as a "partially enclosed building."

If the facility includes 11 or more beds, classify it as billeting in accordance with UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*. Ensure that anticipated utilization of the apparatus bay allows for its classification as low occupancy, design the vehicle doors for conventional loads, and provide structural isolation from any inhabited portions of the building in accordance with UFC 4-010-01.

3-2.1 Substructure.

Design the floor slab in the apparatus bay for appropriate wheel loads based on the heaviest type and size of vehicle anticipated to be parked therein.

3-2.2 Superstructure.

Where the length of the apparatus bay is sized to accommodate one vehicle parked in each stall, provide clear spans with no intermediate columns. With the approval of the fire chief, where the length of the apparatus bay is sized to accommodate two or more vehicles parked end-to-end in each stall, a single row of interior columns perpendicular to the stalls is permitted, provided these columns do not obstruct the vehicle lanes.

3-2.3 Fall Protection.

Provide an active fall protection system, approved by the fire chief and designed by a licensed professional engineer in accordance with 29 CFR 1926.502, *Fall protection systems criteria and practices*, and ANSI/ASSE Z359, *Fall Protection Code*, in each stall of the apparatus bay where work or maintenance on top of a parked vehicle is anticipated. Design the structure for the associated anchorage locations and loadings.

3-3 ARCHITECTURE.

Refer to UFC 3-101-01, *Architecture*, and comply with stated and cross-referenced requirements for architecture, with the following additions and exceptions for this facility type.

3-3.1 Stories.

Single-story structures are preferred for fire stations. Site constraints may drive the need for multi-story structures. If a multi-story structure is required, ensure the appropriate adjacencies are maintained so the required response times may be achieved. See paragraph 2-4 for more information on the required adjacencies.

3-3.2 Exterior.

Design the exterior to comply with current command and installation planning and design guidance. Also design for the local geographical and cultural environment. The fire station must present a cohesive architectural image. Create an attractive, functional theme that applies to the entire facility design, from the overall exterior architectural statement to the specific interior design elements. Reinforce continuity of space by space planning, building form, elevation, materials, and details.

3-3.2.1 Entrances.

Clearly identify the main fire station entrance to discourage visitors from entering the facility through an open apparatus bay door. In cold climates, provide a canopy (or a recess) at required egress doors to ensure doors can completely open without obstruction from snow and ice.

Provide separate entrances to the dorm area and the day room.

3-3.2.2 Exterior Finishes.

Provide durable and low-maintenance exterior finishes. Coordinate the exterior finishes with the Service-specific design standards noted in paragraph 3-4.2.

3-3.2.3 Apparatus Bay Fire-Rated Construction

Separate the lodging/rooming and administrative portions of the building from the apparatus bay and maintenance areas with a 1-hour fire barrier. Design this fire barrier to also prevent the passage of exhaust emissions.

3-3.2.4 Building Signage.

Building signage must provide clear directional and informational assistance. Mechanical, electrical, and/or utility room doors must have identifying signage to match other building signage. Design signage to comply with command and installation appearance plans (IAP).

3-4 INTERIOR DESIGN.

Construction and finishes (walls, floor, and ceiling) must support the cohesive image and theme of the facility as noted in paragraph 3-3.2. The living areas of the facility, such as the day room and the dorm rooms, must reflect a residential, non-institutional character.

Durability is extremely important when specifying materials for interior construction and finishes. Fire stations are occupied 24 hours a day, seven days a week, and heavy equipment is regularly handled throughout the facility. These conditions will lead to greater interior damage being incurred compared to many other facility types.

Provide a clear boundary between contaminated spaces (such as apparatus bay, protective clothing laundry, decontamination spaces, hose storage, and similar spaces where equipment and clothing are exposed on the emergency scene) and uncontaminated spaces (such as offices, classrooms, dayroom, dining, sleeping rooms). Personnel travel through/across the boundary is allowed, though provision at the boundary to permit at least hand-washing should be provided.

3-4.1 Interior Construction.

Provide blocking for all wall- or ceiling-mounted equipment and furnishings. Counters, casework, and cabinets must be of high-quality, durable construction. Specify Architectural Woodwork Institute (AWI) Premium or Custom for finishes per *AWI Standards*. Countertops must be solid surface/solid composite plastics. Specify 0.75-in. (20-mm) minimum thickness for plywood, plywood backing, and solid wood panels. Particleboard may not be used.

Finishes must be able to withstand frequent cleaning and must coordinate with the other finish materials. All interior glass must be tempered safety glass and mirrors must be constructed with break-resistant materials.

3-4.2 Finishes.

Finishes must take into account the intended uses and be highly durable. They must meet the requirements listed in NFPA 101, *Life Safety Code*, and UFC 3-120-10, *Interior Design*. Coordinate the interior (and exterior) design with Service-specific

standards or agencies. Comply with the following requirements throughout the entire facility:

- In moist climates, do not cover the inside of exterior walls with impervious materials such as mirrors or vinyl wall coverings. This is due to concern over mold development in the walls.
- Procure a high-quality, easy-to-maintain, durable carpet that provides a long-lasting appearance.
- For more information on finishes in specific areas, see the functional data sheets in Chapter 4.

3-4.3 Interior Signage.

Develop a comprehensive signage package that addresses both way-finding and definition of all spaces within the facility. Signage must reflect and complement the interior environment through colors, images, and materials used. Signage must be in accordance with UFC 3-120-01, *Design: Sign Standards*, and with command and installation appearance plans (IAP).

3-4.4 Window Treatments.

All windows and other glazed openings to the exterior of the building must be provided with horizontal blinds or solar shading systems as part of the construction project.

3-5 ACOUSTICS.

3-5.1 Sound Transmission Coefficient Ratings

The functional data sheets in Chapter 4 provide minimum sound transmission coefficient (STC) ratings for the appropriate spaces. Typical STC ratings range from 35 to 55 STC, depending on the space and its intended use. The design team must achieve the minimum required STC values by treating wall surfaces, wall openings, and the structure with sound-attenuating materials.

3-5.2 Outdoor Indoor Transmission Class

Refer to UFC 3-101-01 and comply with stated and cross-referenced requirements for building envelope requirements. UFC 3-101-01 provides minimum building façade sound isolation ratings utilizing the composite Outdoor Indoor Transmission Class (OITC) values necessary for determining the acoustic building envelope requirements. Typical OITC ratings range from OITC 25 to OITC 50, dependent upon interior background noise levels set as noise criteria (NC) ratings. Unless otherwise stated, design the building envelope and interior spaces to achieve the more stringent acoustic criteria where applicable.

3-5.3 Air Installations Compatible Use Zones

Per DODI 4165.57, *Air Installations Compatible Use Zones (AICUZ)*, when a fire station is located near the flightline, comply with the AICUZ noise reductions for the facility location. If an AICUZ map is not available for the location, an acoustical engineer must conduct an acoustical analysis to determine the exact type and extent of the additional acoustical treatments needed to address aircraft noise.

3-6 SERVICES.

3-6.1 Plumbing.

Design all building systems—such as domestic hot and cold water, sanitary and storm drainage, propane, fuel oil, or natural gas systems—to meet the requirements of local installation standards, criteria in UFC 1-200-01, and cross-referenced requirements therein.

Provide combination water fountain and water bottle-filling station wherever electric water coolers are required. Provide double check-valve backflow preventers on all water lines serving beverage machines, coffee brewers, and ice makers.

3-6.2 Heating, Ventilating, and Air Conditioning (HVAC).

Refer to UFC 1-200-01 and comply with stated and cross-referenced requirements for HVAC systems. Unless otherwise stated, design spaces to comply with comfort cooling and heating requirements of UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*.

HVAC systems will maintain a negative pressure relationship between yellow/red zones and green zones at all times. Yellow zones are the transition zones between red zones (exposed to carcinogens) and green zones (living/working spaces).

3-6.3 Fire Protection and Life Safety.

Refer to UFC 1-200-01 and comply with stated and cross-referenced requirements for fire protection, life safety, and mass notification systems.

3-6.3.1 Fire Protection System Requirements.

Protect the entire fire station throughout with an automatic fire suppression and voice evacuation fire alarm system regardless of building size and type of construction. Comply with the facility safety section of NFPA 1500, *Standard on Fire Department Occupational Safety, Health, and Wellness Program*, except as modified in this UFC.

3-6.3.1.1 Carbon Monoxide Detection.

Provide carbon monoxide (CO) detection as required per UFC 3-600-01, *Fire Protection Engineering for Facilities*. Monitor, power, and provide notification for the CO detection from the fire alarm system, also as required per UFC 3-600-01.

3-6.3.1.2 Area Smoke Detection.

Provide smoke detection in sleeping rooms and sleeping room access hallways. Do not provide smoke detection in the apparatus bay or other areas where exhaust fumes may be present. Enable the general building evacuation signal upon activation of any smoke detector.

3-6.3.2 Retractable Partitions.

Where one or more retractable partitions are provided, fire suppression and fire alarm devices will be provided to protect the space in accordance with UFC 3-600-01 with the partitions in the open or closed position.

Means of egress inclusive of the number of exit access doors and door swing must be in accordance with NFPA 101 requirements with the partitions in the open or closed position.

3-6.4 Electrical.

Refer to UFC 1-200-01 and comply with stated and cross-referenced requirements for electrical systems. Also comply with the following fire station-specific requirements.

3-6.4.1 Lighting.

See Chapter 4 for light level and control requirements that are exceptions to or in addition to the requirements referenced above. Refer to UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*, for lighting levels not specified in Chapter 4 or in the requirements referenced above.

3-6.4.2 Emergency Power.

Provide 100 percent emergency generator back-up power for all stations. For satellite stations, provide emergency back-up power, at a minimum, for the following spaces/systems:

- Apparatus bay lighting and doors
- Watch desk/dispatch and all associated equipment
- IT room systems related to the dispatch and communication functions
- HVAC related to IT room support

- Lighting

Refer to the functional data sheets in Chapter 4 for uninterruptible power supply (UPS) requirements for applicable spaces. Provide on-site fuel storage for emergency generator back-up power for a 72-hour period. If fuel contracts are secured, the requirement for on-site fuel storage can be reduced to a 24-hour period.

3-6.4.3 Telecommunication Systems.

See Chapter 4 for outlet locations.

3-6.4.4 Television Systems.

See Chapter 4 for outlet locations.

3-6.4.5 Electronic Security Systems (ESS).

Design the ESS in accordance with UFC 4-021-02, *Electronic Security Systems*. See Chapter 4 for locations and additional criteria.

3-6.4.6 Access Control Systems.

Provide card readers with keypads at entries to building.

3-6.4.7 Closed-circuit Television (CCTV).

Provide the infrastructure for a CCTV system to meet operational requirements.

CCTV cameras will be located to monitor the apparatus bays, vehicle maintenance bay, and the main entrance to the facility. CCTV monitors will be located at either the watch desk or dispatch, if provided. See Chapter 4 for additional information.

3-6.4.8 Intercommunication Systems.

See Chapter 4 for locations and additional criteria.

3-6.4.9 Firefighter Alert System.

Firefighter alert systems must be provided in accordance with NFPA 403, *Standard for Aircraft Rescue and Fire-Fighting Services at Airports*, and NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*, for emergency response facilities (ERF). See general requirements below and Chapter 4 for additional information.

General Requirements:

- The system must provide audible announcements from defined message format to follow initial audible alert.

- Consult with component's dispatch leadership for specific technology used by computer aided dispatch (CAD)/records management system (RMS) for information transfer. This may include Web services.
- The system must provide fire station and EMS alerting with ramped heart saver tones no greater than 5 seconds from initiation.
- The system must provide fire station and EMS alerting with amplitude lighting no greater than 5 seconds from initiation.
- Fire station and EMS alerting will be provided with audible announcement to pubic address (PA) system no greater than 5 seconds from initiation.
- Fire station and EMS alerting will be provided with audible announcement to radios no greater than 5 seconds from initiation.
- Fire station and EMS alerting will be provided with a digital resource display board.
- The system must provide audible announcements from defined message format to follow initial audible alert.
- The system must provide a digital light status bar.
- The system must provide rip-and-run printers for incident and route information where required by the fire chief.
- The system must allow for zoning of audible and visual alert notification.
- Provide simultaneous light and audible control inside and outside to alert on-duty staff of emergencies.
- Provide simultaneous light and audible control for the following spaces when the firefighter alert system is activated: dorm room dedicated alert lights, corridor lights from dorm rooms to the apparatus bay, and the apparatus bay lights.

3-6.4.10 Lightning Protection System.

Install lightning protection systems for new facilities and existing facilities modifications in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems*.

3-7 SITE WORK.

In addition to the criteria established in UFC 1-200-01 and the cross-references included therein, comply with the following additions or exceptions for this facility type.

Organize the site to be compatible with the site planning and style of adjacent existing structures. Locate the building to reflect local climatic conditions. For example, provide protection from prevailing winds and glare and orient operable windows to take advantage of summer breezes. Locate the building to take advantage of passive solar heating and day lighting.

3-7.1 Landscaping.

Select plants that are easy to maintain and enhance the visual quality of the facility in all seasons. Indigenous species are preferred. Accentuate main entrances to the facility with plant materials and specialty paving (precast concrete or brick pavers). Assess the growth characteristics of selected plant material when evaluating line-of-sight requirements to either flightline pavements or facilities. Comply with UFC 3-201-02, *Landscape Architecture*, and local installation landscape standards. For the Air Force, also refer to the applicable major command and installation standards.

Plan for sustainable design issues when designing the landscape. Select plants that require little to no additional water beyond normal rainfall. Avoid plants that require an irrigation system or evaluate a gray water or storm water irrigation system. Due to the proximity to the flightline for ARFF facilities, select trees and shrubs that produce little or no debris. Avoid using plants that produce fruits or nuts that may attract unwanted animals and birds to the airfield environs.

3-7.2 Firefighting Vehicle Access Drives.

Ensure that dimensions and layouts of access roadways and service entrances accommodate specific vehicle types anticipated for fire station operations. Provide apparatus ramps constructed of portland cement concrete pavement designed to support the anticipated vehicle weight.

Design the facility and site to permit drive-through apparatus bays unless restricted by the site and/or flightline. If the vehicle access drives are sloped, either for drainage or due to the site profile, ensure the slope angle is low enough to be easily navigated by the firefighting apparatus and the driver can maintain good visibility of the area around his or her vehicle. Provide signage and/or striping explicitly prohibiting unauthorized vehicles on the access drives and apparatus ramps. Do not install gates or other access control measures that would impede emergency response.

3-7.3 Parking and Other Access Drives.

Provide parking based on the total positions assigned, including eight- and 24-hour shift positions and reservists (if appropriate). Provide visitor parking separate from staff parking, with visitor parking spaces totaling approximately 25 percent of those required for staff. If possible, do not allow access drives to staff and public parking to cross the vehicle access drive out of the apparatus bay. Provide signage and/or striping to correlate with any parking or access drive restrictions or authorizations. Locate parking areas so they do not dominate the main entrance and public image of the facility. Provide a service drive adjacent to the mechanical room. Comply with UFC 3-201-01, *Civil Engineering*, and UFC 4-010-01.

3-7.4 General Site Lighting.

Refer to UFC 1-200-01 and comply with stated and cross-referenced requirements for electrical systems. If the facility is near a flightline, provide site lighting that will not interfere or be a distraction to aircraft movement at night. Comply with UFC 3-530-01. **\1\ /1/**

3-8 SUSTAINABLE DESIGN.

Requirements for sustainability apply to construction, redesign, renovation, and modernization projects. Comply with UFC 1-200-02.

CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-1 INTRODUCTION.

This chapter identifies the specific design needs for each functional area as outlined in the space program. Tables 4-1 through 4-33 provide these data in a standard functional data sheet format.

The interior construction specialties, equipment, and furnishings criteria provided in these tables are broken down as follows:

- Casework/Built-in Equipment. This includes anything physically attached or plumbed to the building, such as counters, cabinets, casework, toilet accessories, window treatments, laundry machines, and marker boards.
- Furnishings, Fixtures, and Equipment (FF&E). This includes contractor-furnished, contractor-installed loose items such as desks, tables, chairs, and bookshelves.
- User-Provided Equipment. This includes all government-furnished, government-installed items, which are typically limited to office equipment such as computers, printers, and copiers. Flat panel display; if mounted, flat panel display mount is a built-in equipment item.

Table 4-1 Apparatus Bay

Description/ Usage	The apparatus bays house the fire protection vehicles. Drive-through bays are preferable. All bays must accommodate the latest and largest structural and ARFF vehicles. Each bay of the apparatus room/bays must include the required support utilities (drops) for vehicles such as exhaust, compressed air, hot and cold water, lighting, and power. Back to back bay arrangement is not permitted.
Min. Ceiling Ht.	14 ft (4.26 m) minimum. Note: 14 ft (4.26 m) clearance is required with bay doors in open and closed positions.
Finishes	**Walls**. Concrete masonry units (CMU). Provide epoxy paints on all wall surfaces. **Floor**. Provide either a sealed concrete surface or a 1-part or 2-part water-based epoxy concrete floor paint, in a slip-resistant, semi-gloss, light color finish. Final color selection to be coordinated with user and installation. Apply a concrete etcher to thoroughly clean concrete surface and a bonding primer for proper adhesion prior to applying epoxy finish. Slope floor to trench drains. **Ceiling**. Ceiling not required; however, provide finishes for exposed structure. Coordinate mechanical, electrical, and plumbing components. None of the ceiling components can be located below minimum ceiling height.
Plumbing	Provide minimum 3-in. (75-mm) -diameter water service with 2.5-in. (62-mm) -diameter National Standard Threads ball-valve outlet to each vehicle. Provide a combination eye/face wash and drench shower. Provide foot-operated mop sink with mop hanging rack. Provide one standard hot and cold water hose bibb with mounted hose reel (100 ft [30.5 m] capacity) for every two truck bays. Provide floor trench drains parallel to the centerline of each vehicle. All apparatus room/bays drains must connect to an **1**\oil water separator or where the Installation has pretreatment or treatment methods in place in accordance with their permitted allowances, an approved sanitary sewer system. Coordinate with Installation EV staff for information on existing pretreatment or treatment methods and permitted allowances. /**1**/ If an exterior wash area is provided, size the separator for the total volume and connect the exterior drain to this separator. Provide compressed air with self-retracting reels at each vehicle bay. Provide SCBA air connection.
HVAC	Design heating for 68 °F (20 °C) dry bulb. Local installations may decide to forgo heating in areas without risk of freezing. Provide gas-fired radiant heating if natural gas or propane is available. Local base or post authorities may choose different heating systems on a case-by-case basis. Provide ventilation to cool bay to within 10 °F (6 °C) of design outdoor temperature. The Services will not air condition the apparatus bay unless through exceptions. If approved, systems used for conditioning will be determined on a case-by-case basis. Consider climatic conditions, energy costs, and sustainability impacts for exceptions and system selections. For Army projects, refer to TI-800-1 for appropriate exceptions. For Navy projects: Local base authorities within the Naval Forces Central Command region may choose to air-condition the apparatus bay; air-conditioning of the apparatus bay is not permitted for any other regions. Maintain apparatus bay air quality within the strictest established regulatory guidelines for volatile organics, nitrogen oxide, sulfur dioxide, carbon monoxide, particulates, diesel exhaust particulates established by: • NIOSH (National Institute for Occupational Safety and Health) REL (recommended exposure limit/10-hour time-weighted average), *NIOSH Pocket Guide to Chemical Hazards*

	• OSHA (Occupational Safety and Health Administration) PELS (permissible exposure limit/8-hour time-weighted average), *Annotated Permissible Exposure Limits (PELS) Tables* • ACGIH threshold limit value (average over 8-hour work shift)/short-term exposure limit (over 15-minute period), *Guide to Occupational Exposure Values* and *TLVs and BEIs* • NFPA 1500 Per the International Mechanical Code (IMC), the apparatus bay will be classified as an "enclosed parking garage." The apparatus bay ventilation system will operate continuously and comply with all other applicable requirements of IMC-2015 Sections 403, 404, 502.13, and 502.14 or current IMC equivalent. Minimum ventilation rate will be the greater of the requirements of IMC-2015 Section 404.2 or current IMC equivalent and ASHRAE 62.1, “Transportation Waiting". Exhaust and ventilation systems will be designed and operate to keep apparatus bay negatively pressurized with respect to adjacent occupiable spaces at all times. Provide carbon monoxide and nitrogen dioxide detectors. Such detectors will be listed in accordance with UL 2075 and installed in accordance with their listing and the manufacturer's instructions. Provide air contaminant detector systems with audible and visual alarms given at required levels and be easily identifiable by all occupants within the apparatus bay. Force HVAC systems to operate when contaminants are sensed and continue to operate until safe conditions are present in the apparatus bay. Provide an air-cleaning system for elimination of fire apparatus vehicle exhaust in compliance with NFPA 1500, the IMC, and ASHRAE 62.1. The apparatus bay air-cleaning system will be designed to remove, treat or eliminate particulates, VOCs, and gaseous exhaust contaminants from the apparatus bay. Air-cleaning system will automatically operate on vehicle operation and operate until apparatus bay air has been fully treated. For Navy and Marine Corps projects: If engines are operated inside the apparatus bay other than to move apparatus into and out of the bay then also provide a direct vent system that connects directly to the fire apparatus exhaust and evacuates vehicle exhaust directly to the outdoors. The direct vent system can be either an automatic-type Fire Apparatus Vehicle Exhaust Removal System (FAVERS) or a manually operated hose-type exhaust system operating whenever equipment is running in the bay. A make-up air system will supply heated air to the apparatus bay. Make-up air system will be designed and controlled to provide make-up air for all sources of exhaust installed within the apparatus bay. Make-up air should be distributed to minimize drafts and be introduced above apparatus level since diesel exhaust is heavier than air. In this way, the make-up air flow downward will assist in pushing the exhaust fumes out the apparatus bay doors when open. Provide a floor radiant heating element at each bay door to prevent the door from freezing to the pavement at the local installation's discretion.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4. Locate all outlets at 36 in. (900 mm) above finished floor (AFF). Provide one self-retracting electric drop cord for each parking area. Provide backup power sized to provide full unobstructed operation capability of the apparatus bays. Provide power to each retractable bay door.

Lighting	Provide lighting system per paragraph 3-6.4. Provide doors with a signaling system to indicate fully raised doors. A red/green indicator must be located on the driver's side. Coordinate indicator mounting height at viewable distance from driver position in planned truck for each bay.
Communication	**CCTV**. Provide interior and exterior outlets located to provide coverage of the apparatus bay and facility's main entrance. **CATV/Internal Video**. None required. **PA/Audio**. Provide speakers and horns with visual element. **Telephone**. Provide one line with internal two-way communication. **Data**. Provide data drops as required by equipment. **Security**. None required. **Firefighter Alert System**: Fire station and EMS alerting will be provided with audible announcement (to fire station PA systems and radios), ramped heart saving tones, and amplitude lighting with a digital resource display board no greater than 5 seconds from initiation.
Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	Ice machine (with fresh water dispenser). Locate in direct adjacency to apparatus bay. Install in a clean area that allows adequate space for safe handling of ice and does not present a risk for ice contamination. Provide storage cabinet for cleaning supplies near mop sink.
User-provided Equipment	CCTV cameras.
Special Requirements	Provide 14 ft by 14 ft (4.3 m by 4.3 m) apparatus bay doors, with electric eye, and/or fixtures and automatic reverse device. For ARFF bays, provide 18 ft by 18 ft (5.5 m by 5.5 m) apparatus bay doors as recommended by NFPA 403. Even if ARFF vehicles are only intended to be housed on one side of a double bay, provide the 18 ft by 18 ft (5.5 m by 5.5 m) doors on both sides to permit drive through and allow flexibility of use. Provide manual means to open doors in case of power failure. If solid door panels are used, provide insulated doors. Provide doors with radio-operated closing devices that can be activated from the vehicle. Ensure both the internal floor slope and the approach drive slope allow the fire protection vehicles to transition into and out of the apparatus bay without bottoming-out or impeding driver sightlines. Provide fall protection system per paragraph 3-2.

Table 4-2 PPE Gear Storage

Description/ Usage	The personal protective equipment (PPE) area provides storage for firefighters' protective gear. A well-ventilated locker is assigned to each member of the firefighting crew. Provide floor area in front of each locker as required for easy access during emergencies. Provide as ventilated space separate from apparatus bay. For Army only: PPE lockers are permitted to be located within and open to the apparatus bay.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls.** CMU. Provide a low-maintenance, durable finish such as industrial latex or epoxy paints on all wall surfaces. **Floor.** Provide a slip-resistant, sealed concrete surface sloped to the drain. **Ceiling.** Provide durable ACP or GWB ceiling with industrial latex or epoxy paint.
Plumbing	Provide a floor drain. If part of apparatus bay, ensure hose bibb is available within 20 feet (6.1 m).
HVAC	Provide a system per paragraph 3-6.2. Provide exhaust to maintain space negatively pressurized relative to occupiable spaces. Exhaust system must be separate from occupiable space exhaust. For Army projects only, if PPE gear storage is incorporated into the apparatus bay, size general space ventilation system to account for gaseous emissions from storage gear.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide speakers and horns with visual element. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide open 24 in. by 24 in. by 6 ft (600 mm by 600 mm by 1800 mm) high wire mesh metal locker that includes shelves and clothes hook. Lockers located along side walls.
Furnishings Fixtures & Equipment (FF&E)	Option to provide moveable gear lockers in lieu of fixed units. Provide work bench surface for personnel to conduct self-inspection of gear, take gear out of service for washing and return/place new PPE in service.
User-provided Equipment	None required.
Special Requirements	Locker layout must permit free air circulation around and throughout clothing. Layout must account for storage of additional spare equipment items. Provide extended-height door kick plates (min. 36 in. [914 mm]). Provide vision panel in door to assist in prevention of collision as personnel are frequently simultaneously moving in both directions through this doorway.

Table 4-3 Hose Storage

Description/ Usage	This area provides for storage of hoses. Hoses are rolled and stored on fixed or mobile storage racks.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU. Provide a low-maintenance, durable finish such as industrial latex or epoxy paints on all wall surfaces. **Floor**. Provide a slip-resistant, sealed concrete surface sloped to floor drain. **Ceiling**. None required.
Plumbing	Provide a floor drain. Ensure a hose bibb is available within 20 feet (6.1 m).
HVAC	Provide a system per paragraph 3-6.2. Ensure space is well ventilated.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6., and dedicated outlets required to support drying equipment (if provided).
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. Provide a speaker. **Telephone**. None required. **Data**. None required. **Security**. None required.
Casework/Built-in Equipment	Fixed racks for roll-up hose storage.
Furnishings Fixtures & Equipment (FF&E)	Optional to provide movable racks for roll-up hose storage.
User-provided Equipment	Hoses and hose drying oven when required due to climatic conditions.
Special Requirements	None required.

Table 4-4 SCBA Maintenance/Compressor Room

Description/ Usage	The self-contained breathing apparatus (SCBA) maintenance room is used for the maintenance and minor repair of SCBA equipment. It includes a work bench, task lighting, and shelving for storage of parts and equipment. The room also contains a mask pressure testing machine. Separate but directly adjacent is the dedicated SCBA compressor room, which houses the main compressor unit used to charge the SCBA tank with filtered air. Ensure direct access between these rooms. This space must include sound attenuation. A compressed air supply line is provided from this room to the SCBA maintenance room and the apparatus bay.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU. Provide a low-maintenance, durable finish such as industrial latex or epoxy paints on all wall surfaces. **Floor**. Provide a slip-resistant, sealed concrete surface. **Ceiling**. None required.
Plumbing	Provide SCBA compressor and bottle filling stations. Provide compressed air lines to apparatus bay and SCBA maintenance room. Provide a floor drain for condensate. SCBA compressor air intake air must be separated from potential sources of contamination for SCBA compressor to provide Grade-E air as defined by ANSI/CGA G-7.1. Adequate maintenance and access clearance will be provided around SCBA compressor. Provide utility sink in SCBA maintenance room.
HVAC	Provide a system per paragraph 3-6.2. Provide positive pressure ventilation to prevent contamination.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4. In the SCBA maintenance room, provide task lighting at the work/service bench at 50 fc (500 lux).
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide data drops as required by equipment. **Security.** None required.
Casework/Built-in Equipment	Provide stationary containment fill station for safety of the occupant during fill operation.
Furnishings Fixtures & Equipment (FF&E)	Provide industrial grade 24 in. (610 mm) deep minimum work bench and storage shelving. Provide spare parts bin. Provide workstation as applicable with installation requirements.
User-provided Equipment	Provide mask pressure testing machine and scales.
Special Requirements	Layout must account for storage of additional spare equipment items.

Table 4-5 Protective Clothing Laundry

Description/ Usage	Protective clothing laundry room is utilized to wash and disinfect firefighters' protective clothing/gear. The room must accommodate large commercial-grade washers and dryers and a drip-dry rack. Locate room with direct access to the exterior, equipment maintenance/wash/ disinfection room, PPE gear storage, and apparatus bay.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU. Provide a low-maintenance, durable finish such as epoxy paints on all wall surfaces. **Floor**. Provide a slip-resistant, sealed concrete surface sloped to floor drain. **Ceiling**. Provide durable, moisture-resistant ACP or GWB ceiling.
Plumbing	Provide hot and cold water supply and an open-end drain to each washer. Provide hot and cold water supply and drain for laundry/utility sink. Provide a floor drain.**1**\ /**1**/ . Refer to NFPA 1581 for more information.
HVAC	Provide a system per paragraph 3-6.2. Exhaust per UFC 3-410-01 and negatively pressurize room. Provide direct vents to the outside for each dryer.
Fire Protection	Provide system per paragraph 3-6.3. Regardless of size, enclose the laundry room with a 1-hour fire barrier.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required
Acoustics	No special provisions required.
Casework/Built-in Equipment	Large, high-capacity, industrial extractors and dryers (soft mount and programmable controls) that comply with NFPA 1851 and NFPA 1581. (NFPA 1581 requires commercial models of washers and dryers to be front-loading to prevent agitator damage to clothing). Provide one additional dryer per extractors. Extractors must be mounted on concrete foundations. Provide a stainless-steel laundry-folding table. Provide stainless-steel laundry/utility sink. Provide wall-mounted hanging racks.
Furnishings Fixtures & Equipment (FF&E)	Provide workstation and workbench per installation requirements.
User-provided Equipment	None required.
Special Requirements	None required.

Table 4-6 Equipment Maintenance/Wash/Disinfection

Description/ Usage	The maintenance area is used for the minor repair and maintenance of firefighters' equipment. Provide a work bench with lighting and storage. The wash/disinfection area is located adjacent to the maintenance area. It includes a wash-off area where incoming equipment can be washed, desalinated, and dried. When fire trucks return from a fire or other event, equipment is brought into this area for cleaning and disinfection. The equipment is taken from the truck directly to the wash and disinfection area prior to the truck's entry into the apparatus bay. Provide direct access to exterior.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU. Provide a low-maintenance, durable finish such as industrial latex or epoxy paints on all wall surfaces. **Floor**. Provide a slip-resistant, sealed concrete surface. **Ceiling**. Provide durable moisture-resistant ACP or GWB ceiling.
Plumbing	In the wash/disinfection area, provide floor mop sink with hose and spray nozzle. Provide a three-compartment stainless-steel sink and a drip dryer rack.**1**\ Connect all drains to an approved sanitary sewer or septic system. Coordinate with Installation EV staff to determine if the local pretreatment program requires the use of an oil water separator. /**1**/ Provide compressed air supply to both wash and maintenance rooms. Provide floor drain in maintenance area.
HVAC	Provide a system per paragraph 3-6.2. Provide exhaust to negatively pressurize both rooms.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4. Provide 50 fc (500 lux) task lighting at work/service bench.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide 3-compartment stainless-steel laundry/utility sink and 8 ft by 4 ft (2.4 m by 1.2 m) stainless-steel work table for wash/disinfection space.
Furnishings Fixtures & Equipment (FF&E)	Provide industrial grade 24 in. (610 mm) deep minimum work bench with storage shelving and spare parts bins. Provide hanging racks and open shelf storage units.
User-provided Equipment	None required.
Special Requirements	None required.

Table 4-7 EMT Storage and Medical Storage Cabinet

Description/ Usage	The EMT storage area is for storage of basic first aid supplies. It must be directly adjacent to the apparatus bay. The space must be fully conditioned. The medical storage cabinet is often a cabinet or subspace within the EMT storage area and is for storage of drugs, needles, and other restricted medical supplies. Access to EMT storage is restricted and controlled to prevent theft and abuse of controlled substances.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide CMU or GWB wall with a low-maintenance, durable finish such as industrial latex paint. **Floor**. Provide low-maintenance resilient sheet or tile flooring material with rubber base. **Ceiling**. Provide ACP ceiling.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** Provide electric cipher lock with remote push-button release and manual key override if narcotics/controlled substances are to be stored in this location.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide wall (or free-standing FF&E) shelving units.
Furnishings Fixtures & Equipment (FF&E)	Provide a lockable cabinet for EMT storage to store drugs and other restricted supplies. Provide lockable medical refrigerator.
User-provided Equipment	None required.
Special Requirements	Provide a keyed lock set at the access point to the space.

Table 4-8 HAZMAT/CBRNE Equipment Storage

Description/ Usage	HAZMAT/CBRNE equipment storage is a dedicated storage room housing only equipment classified for use with hazardous materials. Provide floor and open shelf storage areas.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU. Provide a low-maintenance, durable finish such as industrial latex paint. **Floor**. Provide a sealed concrete surface. A non-skid, low-maintenance traffic coating may also be acceptable. **Ceiling**. None required.
Plumbing	Provide compressed air with self-retracting hose reels at the work bench.
HVAC	Provide a system per paragraph 3-6.2. Provide exhaust to negatively pressurize room.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide heavy-duty hanging racks for HAZMAT suits.
Furnishings Fixtures & Equipment (FF&E)	Provide industrial and large-item storage shelving units.
User-provided Equipment	None required.
Special Requirements	None required.

Table 4-9 Agent Storage

Description/ Usage	Agent storage can be integral to the fire station building or detached. It must be located with access to the drive leading into the apparatus bay or access within the apparatus bay for ease of loading and unloading of firefighting agents.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU or metal stud construction. If metal stud construction, provide plywood sheathing for protection. Provide paint finish to plywood. **Floor**. Provide a sealed concrete surface. **Ceiling**. None required.
Plumbing	None required.
HVAC	Heating and cooling only as needed by the stored agent's MSDS temperature requirements. Maintain a minimum temperature of 50 °F (10 °C) or per stored agent's MSDS temperature requirements, whichever is higher.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	None required.
User-provided Equipment	None required.
Special Requirements	Provide double or overhead-type exterior doors. Provide insulated doors in locations where required by climatic conditions. Layout must account for storage of additional spare equipment items.

Table 4-10 Spare PPE Gear Storage

Description/ Usage	This space serves to store extra PPE gear for all assigned firefighters and reservists currently not on duty. The space includes gear lockers with an open shelving storage system.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU. Provide a low-maintenance, durable finish such as industrial latex or epoxy paints on all wall surfaces. **Floor**. Provide a sealed concrete surface. A non-skid, low-maintenance traffic coating may also be acceptable. **Ceiling**. None required.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2. Provide exhaust to maintain space negatively pressurized relative to occupiable spaces. Exhaust system must be separate from occupiable space exhaust.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide lockable 24 in. by 24 in. by 72 in. (600 mm by 600 mm by 1800 mm) high wire mesh metal lockers that include shelves and clothes hooks.
Furnishings Fixtures & Equipment (FF&E)	Option to provide portable gear lockers in lieu of fixed units.
User-provided Equipment	None required.
Special Requirements	Locker layout must permit free air circulation around and throughout clothing.

Table 4-11 Decontamination Room

Description/ Usage	The decontamination room provides showers and lockers for firefighters to decontaminate themselves prior to entering the living portion of the fire station. Space must be accessible/combined with the transition zones within the apparatus bay. For Army only: As required by the installation's mission, it is optional to utilize this space as "non-flightline fire extinguisher inspection, maintenance and storage." The non-flightline fire extinguisher maintenance and storage includes an indoor storage/maintenance room and possibly an outdoor storage area. The indoor storage/maintenance room accommodates a work bench with lighting to perform maintenance and service of extinguishers, safety cage, scale, recharge kit, and parts storage bins. Provide open shelving for storage of extinguishers. The outdoor storage area is covered and enclosed with a secured screen. This may be combined with the flightline fire extinguisher maintenance and storage area and made as one space with no dividing walls.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU. Provide a low-maintenance, durable finish such as industrial latex or epoxy paints on all wall surfaces. **Floor**. Provide a slip-resistant, sealed concrete surface. **Ceiling**. None required.
Plumbing	Provide a hose bibb and floor drain. Provide emergency eye wash station. Provide utility sink. Provide shower. Connect all drains to **1**\ an approved sanitary sewer or septic system. Coordinate with Installation EV staff to determine if the local pretreatment program requires the use of an oil water separator. /**1**/ For Army fire extinguisher maintenance only: Provide compressed air with self-retracting hose reels at the work bench.
HVAC	Provide a system per paragraph 3-6.2. Exhaust space per UFC 3-410-01 and to maintain negative pressure relationship to occupiable areas. Exhaust system must be separate from occupiable space exhaust.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4. For Army fire extinguisher maintenance only: Provide 50 fc (500 lux) task lighting at work/service bench.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** For Army fire extinguisher maintenance only: Provide quad outlet at work bench and in locations where required to accommodate equipment. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide bench and lockers.
Furnishings Fixtures & Equipment (FF&E)	For Army fire extinguisher maintenance only: Provide industrial-grade 24 in. (610 mm) minimum work bench, storage shelving, spare parts bin, and flammable storage locker.

User-provided Equipment	Floor scale for Army only.
Special Requirements	For Army fire extinguisher maintenance only: Provide double leaf doors to exterior. Locate access to fire extinguisher maintenance and storage away from apparatus bay exterior circulation.

Table 4-12 Fire Extinguisher (Flightline) Maintenance and Storage

Description/ Usage	The fire extinguisher maintenance and storage includes two parts: outdoor storage and indoor storage/maintenance room. The indoor storage/maintenance room accommodates a work bench with lighting to perform maintenance and service of extinguishers, safety cage, scale, recharge kit, and parts storage bins. The outdoor storage area is covered, enclosed with a secured screen, and accommodates tank recovery, spare tanks, and spare gaseous agent re-servicing tanks. This may be combined with the non-flightline fire extinguisher maintenance and storage area and made into one space with no dividing walls. For Army only: This space can be substituted for additional PPE gear storage as required by the installation.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU. Provide a low-maintenance, durable finish such as industrial latex or epoxy paints on all wall surfaces. **Floor**. Provide a slip-resistant, sealed concrete surface. **Ceiling**. None required.
Plumbing	Provide a hose bibb and floor drain. Provide an emergency eye wash station in maintenance room. Provide utility sink. Provide compressed air with self-retracting hose reels at the work bench.
HVAC	Provide a system per paragraph 3-6.2. Exhaust space per UFC 3-410-01 and to maintain negative pressure relationship to occupiable areas.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4. Provide 50 fc (500 lux) task lighting at work/service bench.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide quad outlet at work bench and in locations where required to accommodate equipment. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide cylinder for extinguishing agent recovery (if halon is used, accommodate a 1500 lb [680 kg] cylinder). Place the agent recovery tanks outside the exterior wall of this room and connect via utility lines to a discharge point inside the room. If this approach is taken, provide a remote gauge in the room that displays the tank's fill status.
Furnishings Fixtures & Equipment (FF&E)	Provide industrial grade 24 in. (610 mm) minimum work bench, storage shelving, spare parts bin, and flammable storage locker.
User-provided Equipment	Agent and nitrogen tanks, dry chemical extinguisher recharge kit and floor scale.

Special Requirements	Provide double leaf or overhead-type doors to exterior. Locate access to fire extinguisher maintenance and storage away from apparatus bay exterior circulation.

Table 4-13 Vehicle Maintenance Bay

Description/ Usage	This space is mainly used to service and repair firefighting vehicles, if required by installation mission requirements. At times, this bay may be used as an additional apparatus bay as well. The bay is sized to accommodate the largest vehicle and the equipment required to service it. Similar to the apparatus bay, the vehicle maintenance bay must be a drive-through.
Min. Ceiling Ht.	14 ft (4.26 m) minimum.
Finishes	**Walls.** CMU. Provide epoxy paints on all wall surfaces. **Floor**. Provide either a sealed concrete or 1-part or 2-part water-based epoxy concrete floor paint, in a slip-resistant, semi-gloss, light color finish. Final color selection to be coordinated with user and installation. Apply a concrete etcher to thoroughly clean concrete surface and a bonding primer for proper adhesion prior to applying epoxy finish. Slope floor to trench drains. **Ceiling**. Ceiling not required; however, provide finishes on exposed structure. Coordinate mechanical, electrical, and plumbing components. None of the ceiling components can be located below minimum ceiling height.
Plumbing	Provide minimum 3-in (75-mm) diameter water service with 2.5 in. (62-mm) diameter National Standard Threads ball valved outlet to each vehicle. Provide a combination eye/face wash and drench shower. Provide standard one hot and cold water hose bibb for every two truck bays. Provide floor trench drains parallel to the centerline of each vehicle. Connect trench drain to an **1**\ oil water separator or where the Installation has pretreatment or treatment methods in place in accordance with their permitted allowances, an approved sanitary sewer system. Coordinate with Installation EV staff for information on existing pretreatment or treatment methods and permitted allowances./**1**/ Provide compressed air with self-retracting hose reels at each vehicle bay.
HVAC	Design heating for 68 °F (20 °C) dry bulb. Local installations may decide to forgo heating in areas without risk of freezing. Provide gas-fired radiant heating if natural gas or propane is available. Local base or post authorities may choose different heating systems on a case-by-case basis. Provide ventilation to cool the vehicle maintenance bay to within 10 °F (6 °C) of design outdoor temperature. The Services will not air-condition the vehicle maintenance bay unless through exceptions. If approved, systems used for conditioning will be determined on a case-by-case basis. Consider climatic conditions, energy costs, and sustainability impacts for exceptions and system selections. For Army projects, refer to TI-800-1 for appropriate exceptions. For Navy projects: local base authorities within the Naval Forces Central Command region may choose to air-condition the vehicle maintenance bay; air-conditioning of the maintenance bay is not permitted for any other regions. Maintain vehicle maintenance bay air quality within the strictest established regulatory guidelines for volatile organics, nitrogen oxide, sulfur dioxide, carbon monoxide, particulates, diesel exhaust particulates established by: • NIOSH REL (10-hour time-weighted average), *NIOSH Pocket Guide to Chemical Hazards* • OSHA PELS (8-hour time-weighted average), *Annotated Permissible Exposure Limits (PELS) Tables*

	• ACGIH threshold limit value (average over 8-hour work shift)/short-term exposure limit (over 15-minute period), *Guide to Occupational Exposure Values* and *TLVs and BEIs* • Latest NFPA 1500 Per the IMC, the bay will be classified as an "enclosed parking garage." The bay ventilation system will operate continuously and comply with all other applicable requirements of IMC-2015 Sections 403, 404, 502.13, and 502.14 or current IMC equivalent. Exhaust and ventilation systems will be designed and operated to keep vehicle maintenance bay negatively pressurized with respect to adjacent occupiable spaces at all times. Provide an air-cleaning system for elimination of fire apparatus vehicle exhaust in compliance with NFPA 1500, the IMC, and ASHRAE 62.1. The bay air-cleaning system will be designed to remove, treat, or eliminate particulates, VOCs and gaseous exhaust contaminants from the bay. Air-cleaning system will automatically operate on vehicle operation and operate until vehicle maintenance bay air has been fully treated. For Navy and Marine Corps projects: If engines are operated inside the vehicle maintenance bay other than to move apparatus into and out of the bay, then provide a direct vent system that connects directly to the fire apparatus exhaust and evacuates vehicle exhaust directly to the outdoors. The direct vent system can be either an automatic-type FAVERS or a manually operated hose-type exhaust system operating whenever equipment is running in the bay. A make-up air system will supply heated air to the bay. Make-up air system will be designed and controlled to provide make-up air for all sources of exhaust installed within the bay. Make-up air should be distributed to minimize drafts and be introduced above apparatus level since diesel exhaust is heavier than air. In this way, the make-up air flow downward will assist in pushing the exhaust fumes out the bay doors when open. Provide a floor radiant heating element at each bay door to prevent the door from freezing to the pavement at the local installation's discretion.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4. Locate all outlets at 36 in. (900 mm) AFF. Provide self-retracting electric drop cords between vehicles. Provide backup power sized to provide full unobstructed operational capability of the apparatus bays and vehicle maintenance bay. Provide power to each retractable door.
Lighting	Provide system per paragraph 3-6.4. Provide doors with signaling system indicating fully raised doors. A red/green indicator must be located on the driver's side at 72 in. (1800 mm) AFF.
Communication	**CCTV**. Provide interior and exterior outlets and cameras located to provide coverage. **CATV/Internal Video**. None required. **PA/Audio**. Provide speakers and horns with visual element. **Telephone**. Provide one line with internal two-way communication. **Data**. Provide data drops as required by equipment. **Security**. None required.
Acoustics	No special provisions required.

Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	Provide tool storage bins and industrial work benches.
User-provided Equipment	CCTV cameras.
Special Requirements	Provide hydraulic lifts and/or overhead lift/crane per installation requirements. Provide or accommodate ladder access to ceiling equipment such as lights, HVAC, and apparatus vehicle exhaust system equipment. Vehicle doors must match the size, operator, and controls to those of the apparatus bays.

Table 4-14 Vehicle Maintenance Equipment Storage

Description/ Usage	Vehicle maintenance equipment storage is tied to the vehicle maintenance bay and is used to store spare parts and tools required for vehicle maintenance and service. It is only provided if required by installation mission requirements. It must accommodate shelving storage and floor area for storage of large items such as tires and wheels. This space must be adjacent to the vehicle maintenance office and vehicle maintenance bay.
Min. Ceiling Ht.	14 ft (4.26 m) minimum.
Finishes	**Walls**. CMU. Provide epoxy paints on all wall surfaces. **Floor**. Provide a sealed concrete surface. A non-skid, low-maintenance traffic coating may also be acceptable. **Ceiling**. Ceiling not required; however, provide finishes on exposed structure. Coordinate mechanical, electrical, and plumbing components. None of the ceiling components can be located below minimum ceiling height.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. Provide a speaker. **Telephone**. Provide one line with internal two-way communication. **Data**. None required. **Security**. None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	Provide industrial or large-item storage shelving units.
User-provided Equipment	None required.
Special Requirements	None required.

Table 4-15 Deployment Gear Storage

Description/ Usage	This storage space is utilized for storage of firefighting gear required for military deployment, if required by installation mission requirements. This gear may be used by reservists and/or active duty military personnel. It includes ventilated lockers.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU. Provide epoxy paints on all wall surfaces. **Floor**. Provide a sealed concrete surface. **Ceiling**. None required.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide lockable 24 in. by 24 in. by 72 in. (600 mm by 600 mm by 1800 mm) high wire mesh metal lockers that include shelves and clothes hooks.
Furnishings Fixtures & Equipment (FF&E)	None required.
User-provided Equipment	None required.
Special Requirements	Locker layout must permit free air circulation around and throughout clothing. Layout must account for storage of additional spare equipment items.

Table 4-16 Station Officer's Office/Watch Desk

Description/ Usage	The station officer's office provides space for the station officer and/or company officers to perform their administrative functions. For satellite stations the station officer's office may serve to control public access to the station. If a watch desk function is required (i.e., dispatch not located in the station), it is typically included in the station officer's office. The watch desk receives emergency calls from dispatch and contains the security monitors for the station. It is usually occupied 24 hours a day/7 days a week.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as eggshell latex paint. **Floor**. Provide low-maintenance resilient sheet or tile flooring material with rubber base or durable commercial carpeting with rubber base. **Ceiling**. Provide ACP ceiling system.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2. Provide independent thermostat.
Fire Protection	Provide system per paragraph 3-6.3. If sleeping accommodations are provided in this room, provide required systems for sleeping rooms per Chapter 3 and fire-rated construction as required for residential occupancies per NFPA 101.
Power	Provide outlets per paragraph 3-6.4, and as needed to support the extensive equipment required. Provide two additional quad outlets at the control center console. Provide a switch controlling operation of apparatus bay doors. Provide HVAC shutdown switch adjacent to LOC devices. If LOC devices are located elsewhere, coordinate HVAC shutdown switch location with this alternate location.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** For stations without a dispatch, monitors for the facility cameras will be located here. Provide outlets required to support required equipment. **CATV/Internal Video.** Provide outlets required to support required equipment. **PA/Audio.** Provide simultaneous light and audible control for the entire fire station. **Telephone.** Provide regular and secure multi-telephone line required to support switch board operation, telephone, and fax. **Data.** Provide regular and secure data outlets to support required equipment. **Security.** Provide pin pad/cipher electric lock with remote push-button release and manual key override. **Firefighter Alert System:** Provide light and audible control for the following elements when the firefighter alert system is activated: dorm room lights (the dedicated alert light), corridor lights from dorm rooms to apparatus bay, and the apparatus bay lights.
Acoustics	Provide partition and door construction with a minimum STC rating of 45 per paragraph 3-5.
Casework/Built-in Equipment	Provide tinted windows with blinds.
Furnishings Fixtures & Equipment (FF&E)	Provide control center console. Provide modular component workstations to accommodate computers, monitor screens, two-way radios, and audio equipment. Provide wall-mounted installation grid coordinate map. Provide map racks. Provide safes for classified technical manuals. Provide book cases and ergonomically designed seating.

User-provided equipment	If the facility does not include a dispatch, CCTV monitors, recording equipment and controls will be located here. Recording system to record all emergency radio and telephone conversations. Computers, computer monitors, radios and audio equipment.
Special Requirements	Provide vision panel to the apparatus bay. Provide a 36 in. (920 mm) free access area around the entire control console. Provide space for Emergency Information Systems computer.

Table 4-17 Fire Chief's and Deputy Fire Chief's Offices

Description/ Usage	The fire chief's and deputy fire chief's offices are two separate offices that will not exist in every station. When they are both located in a station, they are adjacent to each other and to an administrative assistant and a chief's conference room. Each office includes a typical office space and workstation. An adjacent private bedroom and private toilet are shared by both offices and must be directly accessible by both offices.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as eggshell latex paint. In toilet, provide moisture-resistant gypsum wall board with porcelain tile wainscot and semi-gloss industrial latex-based paint. **Floor**. Provide durable commercial carpeting with rubber base in office and sleeping areas. Provide porcelain tile and porcelain tile base in toilet. **Ceiling**. Provide ACP or gypsum board ceiling. Provide moisture-resistant gypsum board ceiling in the toilet. Provide eggshell latex paint in office and sleeping areas and semi-gloss industrial paint in the toilet.
Plumbing	Provide water closet, shower, floor drain, and lavatory.
HVAC	Provide a system per paragraph 3-6.2. Exhaust private toilet as required by UFC 3-410-01. Provide independent thermostat for fire chief's and deputy fire chief's offices.
Fire Protection	Provide system per paragraph 3-6.3. If sleeping accommodations will be provided in this room, provide required systems for sleeping rooms per Chapter 3 and fire-rated construction as required for residential occupancies per NFPA 101.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4. Provide task lighting at individual desks. Provide a dedicated alert luminaire that is controllable from the watch desk/dispatch and tied into the firefighting alert system with a red-tinted bulb or lens.
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet in the office area and one outlet in the bedroom area. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide data outlets to support required equipment. **Security.** None required. **Firefighter Alert System**: Provide system per paragraph 3-6.4. Fire station and EMS alerting will be provided with audible announcement to radios no greater than 5 seconds from initiation. The system must use web services submission method to the fire and emergency services (F&ES) RMS via a secure, encrypted website.
Acoustics	Provide partition and door construction with a minimum STC rating of 52 per paragraph 3-5.
Casework/Built-in Equipment	Provide window blinds. In the private bedrooms, provide black-out roller shades. Provide robe hooks and/or coat hooks.

Furnishings Fixtures & Equipment (FF&E)	Provide office desk, office chair, file cabinet, bookshelf, task lighting, and additional side chair. In the private bedroom, provide twin bed, night stand, table lamp, and a wardrobe.
User-provided Equipment	Computers and associated equipment.
Special Requirements	In large facilities where an assistant fire chief exists, the private toilet must be shared with the deputy fire chief and the fire chief must be provided with his or her own private toilet. There also may be a requirement for a chief's conference room. If required, this would be directly adjacent to or expand out of the chief's office. It provides space for a small conference table for 8 to 10 people.

Table 4-18 Offices

Description/ Usage	General administrative office spaces in the station include the following: assistant chief/shift supervisor office (for Army only: Assistant chief's office will include a private bunk room and toilet/shower room), inspectors' office(s), training officer office, vehicle maintenance office, EMS office, dispatch supervisor (if provided), administrative assistant, reservist office (if provided), assistant chief of fire prevention (if provided), HAZMAT/health & safety officer (if provided), and logistics officer (if provided). General administration storage space. Assistant chief for fire prevention's office: This typical office space at 120 net ft^2 (11.1 m^2) must contain a workstation located adjacent to and accessible from the inspector's office area or accessible from the corridor in the administrative office area. The offices are generally grouped together in the administrative component of the fire station. The administrative assistant is generally only provided if the chief and deputy chief are resident in the station, in which case this area also doubles as the general reception area for the facility and is located directly off the lobby (see Table 4-19).
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as eggshell latex paint. **Floor**. Provide low-maintenance resilient sheet or tile flooring material with rubber base or durable commercial carpeting with rubber base. **Ceiling**. Provide ACP ceiling.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide data outlets to support required equipment. **Security.** None required.
Acoustics	Provide partition and door construction with a minimum STC rating of 39 per paragraph 3-5.
Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	Provide office desk, office chair, file cabinet, bookshelf, task lighting, and an additional side chair. For a more executive-level office, provide a credenza and two additional side chairs. For the fire prevention office, provide plans review/drafting table and plans storage cabinet/rack.
User-provided Equipment	Computers and associated equipment.
Special Requirements	The vehicle maintenance office will be located near the vehicle maintenance bay and storage. It will likely have CMU walls and more durable finishes than typical offices.

Table 4-19 Lobby

Description/ Usage	The lobby is generally only provided if the department chief and deputy chief are resident in the station. It serves as the entrance to the facility and gathering/waiting space for the visiting public. The lobby must be adjacent to the administrative component of the facility. It must be recognizable from the outside and be a well-lit, inviting space. For Army only: All facilities will require a lobby.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as industrial eggshell latex paint. **Floor**. Provide porcelain tile with porcelain tile base. Provide recessed walk-off mat. **Ceiling**. Provide acoustical and decorative ACP or gypsum board ceiling such as egg-shell latex paint for gypsum board ceiling.
Plumbing	Provide an electric water cooler.
HVAC	Provide a system per paragraph 3-6.2.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4. Provide outlets for display cases.
Lighting	Provide system per paragraph 3-6.4. Provide decorative luminaires and task lighting.
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line for local and toll-free calls. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide tack boards and a glass-enclosed bulletin board or recessed display cases.
Furnishings Fixtures & Equipment (FF&E)	Provide upholstered seating, side tables, and magazine rack.
User-provided Equipment	CCTV camera.
Special Requirements	Provide airlock at main entrance when necessary. Provide overhead weather protection at fire station entrance as applicable by climate zone.

Table 4-20 Department Training Room

Description/ Usage	Department training room is a classroom space used for the continuing education and training of fire station staff and occasionally the public. At least one per department (in HQ station). May be provided in other stations as dictated by installation mission requirements. Space must be sized to fit on-duty population or Reserve component, whichever is larger. Provide seating and desks. Provide audiovisual capabilities with phone and Internet connections for each training station. A storage closet is located adjacent to the training room and used for storage of audiovisual equipment, media, additional equipment, and furnishings.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as eggshell latex paint. **Floor**. Provide low-maintenance resilient sheet or tile flooring material with rubber base, or durable commercial carpeting with rubber base. **Ceiling**. Provide ACP ceiling.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2. Provide independent thermostat.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4. Provide direct power to each work table.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide data outlets to every workstation. **Security.** None required.
Acoustics	Provide partition and door construction with a minimum STC rating of 55 per paragraph 3-5.
Casework/Built-in Equipment	Provide flat panel display mount. Provide bulletin board with tack surface and dry-erase board. Provide shelving and rack storage in training room closet.
Furnishings Fixtures & Equipment (FF&E)	Provide training tables and chairs or tablet armchairs. If a separate testing area is not provided, provide computer/study/testing carrels. Flat panel display. Provide podium or lectern.
User-provided Equipment	Computers, printer, and DVD.
Special Requirements	Provide black-out shades if windows are provided.

Table 4-21 Testing/Individual Study Area

Description/ Usage	This area consists of individual computer/study carrels for study and testing of firefighters. Each of these stations must be private to eliminate potential for cheating during testing and to facilitate quiet study.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as eggshell latex paint. **Floor**. Provide low-maintenance resilient sheet or tile flooring material with rubber base or durable commercial carpeting with rubber base. **Ceiling**. Provide ACP ceiling.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4. Provide direct power to each computer/study carrel and printer.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** Provide video camera with monitor located in training officer office. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker **Telephone.** None required. **Data.** Provide data outlets to all workstations and equipment. **Security.** None required.
Acoustics	Provide partition and door construction with a minimum STC rating of 55 per paragraph 3-5.
Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	Provide computer/study carrels, office chairs, and task lights. Provide lockable storage for personal technology devices.
User-provided Equipment	Computers and printer.
Special Requirements	None required.

Table 4-22 Dispatch

Description/ Usage	The dispatch room functions to receive and dispatch emergency-related calls. The space can be programmed for either a fire-only dispatch operation or a consolidated dispatch operation. Fire-only dispatch rooms are solely responsible for receiving and dispatching fire-related emergency calls. A consolidated dispatch room handles fire, security, and medical response service calls. Not every station includes a dispatch. The dispatch room includes workstations sized to accommodate the necessary equipment for each individual dispatcher. Coordinate with installation to determine if consolidated dispatch is to be operated by cross-trained staff vs independent staff assigned per service call type. In larger dispatch rooms (three or more dispatchers), a separate, adjacent room for the dispatch supervisor is required. The finishes and mechanical/electrical requirements for this room are the same as for offices (see Table 4-18). Provide low-profile access flooring as required by installation mission requirements. Dispatch rooms also include a dedicated toilet and kitchenette directly adjacent to and accessible from the dispatch floor for staff use. For Air Force only: When E-911 is programmed, provide additional space for Emergency Information Systems computer, Next-Gen 911, and DOD Public Safety Answering Point (PSAP) Pilot Program initiative.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as industrial eggshell latex paint. **Floor**. Provide low-profile access flooring with a low-maintenance resilient sheet or tile flooring material with rubber base or durable commercial carpeting with rubber base. **Ceiling**. Provide ACP ceiling.
Plumbing	Provide an ADA-accessible toilet with a lavatory. Provide a kitchenette with a kitchen sink and disposal.
HVAC	Provide a system per paragraph 3-6.2. Provide primary HVAC from independent dedicated HVAC system. The back-up HVAC system for the dispatch must be the main building HVAC system. Power primary and backup HVAC systems with generator backup power. Exhaust the toilet as required by UFC 3-410-01.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4 and as needed to support all equipment, including charging equipment for handhelds. Provide a switch controlling open-only operation of apparatus bay doors. Provide HVAC shutdown switch. The generator must provide back-up power for all dispatch room systems. In addition, provide uninterruptible power supply (UPS) for the dispatch equipment.

Lighting	Provide 50 fc (500 lux) task lighting at control desk. Firefighter alert system: Provide light and audible control for the following elements when the firefighter alert system is activated: dorm room lights (the dedicated alert light), corridor lights from dorm rooms to apparatus bay, and the apparatus bay lights.
Communication	**CCTV**. Monitors for the facility cameras will be located here. Provide outlets required to support equipment. **CATV/Internal Video**. Provide outlets required to support equipment. **PA/Audio**. Provide a speaker and a microphone. **Telephone**. Provide regular and secure multi-telephone line required to support switchboard operation, telephone, and fax. **Data**. Provide regular and secure data outlets to support required equipment. **Security**. Provide pin pad/cipher electric lock with remote push-button release and manual key override. Provide remote door-locking capability within the room. **Firefighter Alert System**: The system must provide audible announcements from defined message format to follow initial audible alert.
Acoustics	Provide partition and door construction with a minimum STC rating of 49 per paragraph 3-5.
Casework/Built-in Equipment	At kitchenette, provide wall and base cabinets with 24-in (610-mm) deep solid surface counter. Provide wall personnel lockers and coat hooks per installation requirements.
Furnishings Fixtures & Equipment (FF&E)	Provide control center console. Provide modular component workstations to accommodate computers, monitor screens, two-way radios and audio equipment. Provide map racks. Provide book cases, and ergonomically designed seating. Provide refrigerator, coffee maker, and microwave. Provide a secure drawer or safe for storage of classified documents and classified technical manuals. Security must meet SECRET criteria.
User-provided Equipment	Computers, monitor screens, two-way radios, and audio equipment. Recording system to record all emergency radio and telephone conversations. Wall-mounted installation grid coordinate map.
Special Requirements	Comply with the requirements for "Communication Centers" in NFPA 1221 as well as the requirements in UFC 4-021-02, Chapter 7. Note that some equipment requires free access area around the entire control console. Design this space appropriate to the equipment being provided. Note any special requirements for the E-911 system, if appropriate. If required for selected equipment, provide a conduit to the roof for a roof-mounted antenna. Provide an adjacent dedicated IT room. Provide low-profile access flooring as required by installation mission requirements. Provide vision panel to the apparatus bay. Provide space for Emergency Information Systems computer. Provide tinted windows with blinds. Operators must be able to see exterior conditions. Also provide visible access to the flightline, if applicable.

Table 4-23 Telecommunications Room

Description/ Usage	This room is the termination point for all data and communication utilities in the facility. This room also houses the equipment racks for the facility's computer networks, telephone, and communication feeds.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as eggshell latex paint. Provide 0.75-in. (19 mm) fire-rated plywood on all walls as required. **Floor**. Provide sealed concrete or static dissipative tile flooring with rubber base. **Ceiling**. Provide ACP ceiling.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2. Provide dedicated HVAC system.
Fire Protection	Provide system per paragraph 3-6.3. Provide smoke detection.
Power	Provide outlets per paragraph 3-6.4 and as needed to support the extensive equipment required. The generator must provide back-up power for all dispatch and alarm systems. In addition, provide UPS for these systems and the computer file server.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** Provide telephone line as required to support equipment. **Data.** Provide data lines as required to support equipment. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide racks to accommodate equipment.
Furnishings Fixtures & Equipment (FF&E)	None required.
User-provided Equipment	None required.
Special Requirements	Provide a cipher lock at the door. Locate telecommunications room in a central location of the station.

Table 4-24 Day/Training Room (Including Kitchen)

Description/ Usage	The day room is configured and furnished like a very large residential kitchen/dining room/living room. It must be flexible to accommodate a number of different activities. The dining area must accommodate dining, informal meetings, and group training for the number of on-duty companies. Provide controllable natural light and seating to accommodate all company members, both in the dining setting and comfortable seating for television watching, reading, and relaxation in the living room area. Directly adjacent to the dining area is a kitchen sized to provide preparation space for the entire overnight population of the station. In HQ/main stations this may include additional 8-hour/10-hour management/admin/prevention personnel. The kitchen must resemble a residential kitchen as much as possible. Provide separate dry and cold food storage for two shifts. Provide additional cold and dry food storage for a swing shift and/or other facility occupants. If day room is provided, refer to the contractual agreement and points of contact for size, space, and operational criteria.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as industrial eggshell latex paint. **Floor**. Provide low-maintenance resilient sheet or tile flooring material with rubber base, or durable commercial carpeting with rubber base. In kitchen, provide porcelain tile. **Ceiling**. Provide ACP or GWB with eggshell latex paint.
Plumbing	Provide hot and cold water supply in kitchen. Provide cold water connections for the coffee and ice makers. Provide hot water connections for dishwashers. Provide two-basin deep kitchen sink with garbage disposal and sink sprayer. Provide drain connection for the dishwashers. Provide a floor drain. Natural gas service must have an accessible shut-off switch.
HVAC	Provide a system per paragraph 3-6.2. Provide exhaust hood over kitchen stoves appropriate to the grade of equipment provided.
Fire Protection	Provide system per paragraph 3-6.3. Protect hood and duct systems for cooking equipment per UFC 3-600-01.
Power	Provide outlets per paragraph 3-6.4 to accommodate all kitchen equipment.
Lighting	Provide system per paragraph 3-6.4. Provide 50 fc (500 lux) task lighting at the day/training area. Provide residential-style luminaires with dimming control switches.
Communication	**CCTV**. None required. **CATV/Internal Video**. Provide at least one outlet in the living room area. **PA/Audio**. Provide a speaker. **Telephone**. Provide one line with internal two-way communication. **Data**. Provide at least one outlet in the dining/training area. Provide outlets in the living room area. **Security**. None required. **Firefighter Alert System**: Fire station and EMS alerting will be provided with audible announcement (to fire station PA systems and radios), ramped heart

	saving tones, and amplitude lighting with a digital resource display board no greater than 5 seconds from initiation.
Acoustics	Provide partition and door construction with a minimum STC rating of 45 per paragraph 3-5.
Casework/Built-in Equipment	Kitchen area: Provide large-capacity dishwashers, stove/range, exhaust hood, and free-standing ice-maker. Provide light commercial-grade equipment. Provide base and wall cabinets with deep, solid-surface work counter. Provide a minimum of two separate dry storage closets or pantries (one for each of two shifts). Provide additional pantry/closet for HQ/main stations with admin/management/prevention personnel. Dining/training area: Provide bulletin board with tack surface. Provide flat panel display mount and wall-mounted dry-erase board.
Furnishings Fixtures & Equipment (FF&E)	Kitchen area: Provide a minimum of two separate refrigerators with freezers (one for each of two shifts), microwave oven, commercial-grade coffee maker, and toaster oven. Provide light commercial-grade equipment. Provide additional refrigerator unit for HQ/main station with admin/management/prevention personnel. Dining/training area: Provide dining table with chairs. Living room area: Provide recliner armchairs, side tables, and entertainment center.
User-provided Equipment	Flat panel display, DVD player.
Special Requirements	None required.

Table 4-25 Dorm Rooms

Description/ Usage	Dorm rooms are the private quarters of the firefighters and are used for studying, relaxing, entertainment, and sleeping during 24-hour shifts. The room is shared between two firefighters of different crews/shifts so that the room is never occupied simultaneously. Individual wardrobes are provided for each firefighter. A bed, nightstand, and desk are shared. A two-bed arrangement, giving each firefighter an individual bed and nightstand, has become a desirable option in recent years. Wall-beds, also known as Murphy beds, are also becoming a common alternative. These combine the personality of an individual bed with added space savings. The room must be a comfortable, inviting space that promotes relaxation. Acoustical privacy between rooms and acoustical protection from outside-to-inside sound transmission is important. Provide direct access to a private corridor and means of natural light in every room (design for AT issues, especially in OCONUS locations, with regard to natural light provisions).
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as eggshell latex paint. **Floor**. Provide durable commercial carpeting with rubber base. **Ceiling**. Provide painted gypsum ceiling with eggshell latex paint.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2. Provide independent thermostat for each room.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet. **PA/Audio.** Provide a dedicated alert speaker with a soft-start audio output controllable from the watch desk/dispatch and tied into the firefighting alert system. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide one outlet. **Security.** None required. **Firefighter Alert System**: The system must provide a digital light status bar. Provide a dedicated alert luminaire that is controllable from the watch desk/dispatch and tied into the firefighting alert system with a red-tinted bulb or lens.
Acoustics	Provide partition and door construction with a minimum STC rating of 55 per paragraph 3-5.
Casework/Built-in Equipment	Provide black-out roller shades. Provide adjustable-arm flat panel display mounts. Provide robe and/or coat hooks.
Furnishings Fixtures & Equipment (FF&E)	Provide extra-long twin bed, night table, two wardrobes, desk and desk chair, desk light, and alarm clock. As an alternative to a shared bed, provide two beds or two retractable wall beds (retractable beds are built-in casework).
User-provided Equipment	Flat panel display.
Special Requirements	Provide operable windows.

Table 4-26 Bathrooms/Showers/Changing

Description/ Usage	The bathroom/shower/changing room includes private water closets, lavatory, and shower stalls with private changing area for the personal use of the firefighters. Also provide lockers for temporary storage of personal items within this room. These lockers are not for storage of PPE gear.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as industrial semi-gloss latex or epoxy paint. Provide full-height porcelain tile with cementitious backerboard. **Floor**. Provide slip-resistant porcelain tile. **Ceiling**. Provide painted moisture-resistant gypsum board ceiling.
Plumbing	Provide shower stalls, lavatories, and water closets. See Special Requirements below for male/female distribution. Provide a floor drain.
HVAC	Provide a system per paragraph 3-6.2. Exhaust per UFC 3-410-01.
Fire Protection	Provide system per paragraph 3-6.3. Provide corrosion-resistant sprinklers and escutcheons such as stainless-steel or Teflon-coated throughout room.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide 24-in. (610 mm) -deep minimum solid-surface materials for countertops. Provide solid plastic (HDPE) or color-through phenolic shower and toilet partitions. Provide a mirror over the vanity. Provide 24-in- (610-mm) -deep lockers. Provide a mix of full- and half-sized Z-shaped lockers with integral benches (usually part of the locker system) at least 16 in. (406 mm) wide. Provide solid plastic (HDPE) or color-through phenolic lockers.
Furnishings Fixtures & Equipment (FF&E)	None required.
User-provided Equipment	None required.

Special Requirements	Divide facilities as follows for smaller stations: • One-company station: Provide 1 water closet, 1 shower, and 1 lavatory for females, and provide 2 water closets, 2 showers, and 2 lavatories for males unless required otherwise by UFC 1-200-01 and UFC 3-420-01. • Two-company station: Provide 1 water closet, 1 shower, and 1 lavatory for females, and provide 4 water closets, 4 showers, and 3 lavatories for males unless required otherwise by UFC 1-200-01 and UFC 3-420-01. For larger stations, consult with user, UFC 1-200-01, and UFC 3-420-01 for final fixture count but plan for concentrated usage of the toilets after a call and the disparity between male and female fixture counts. Note: Use of individual unisex shower/changing rooms as dictated by installation mission requirements is acceptable. Provide a janitor's closet associated with or in proximity to this room. This closet includes a floor mop sink with hot and cold water and a hose connection, a floor drain, and storage for pails, mops, vacuums, and related cleaning supplies and equipment. Provide a lockable door with a vision panel that can be opened from the inside without a key. Provide lockable cabinets for cleaning supplies. Exhaust per UFC 3-410-01. Provide extended-height door kick panel (minimum 24 in. [610 mm]).

Table 4-27 Fitness Room

Description/ Usage	The fitness room promotes health and physical fitness of fire department personnel. The fitness room must accommodate the latest in fitness machines as well as more traditional equipment. The room must be sized to provide open floor workout space and free circulation between equipment while in use. The room must be arranged to accommodate all on-duty personnel. Fitness training is often conducted by the entire crew at one time.
Min. Ceiling Ht.	10 ft (3 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as industrial eggshell latex paint. **Floor**. Provide 0.079 in. (2 mm) virgin rubber top surface with a 0.30 in. (7.5 mm) recycled rubber base. Use tile only for easy replacement. Tile must be manufactured in a mold and never cut from rolls so placing weights on the seams during installation is not necessary. Impact and athletic flooring system cannot be accommodated by interlocking flooring tiles or movable furnishings such as mats. **Ceiling**. Provide acoustical ACP or gypsum board ceiling with a finish such as industrial eggshell latex paint for gypsum board ceiling.
Plumbing	Provide electric water cooler.
HVAC	Provide a system per paragraph 3-6.2.
Fire Protection	Provide system per paragraph 3-6.3. Where a sauna is present, provide high-temperature-rated corrosion-resistant sprinklers and escutcheons such as stainless-steel or Teflon-coated throughout sauna area. Fire alarm notification appliances are not required within the sauna. Provide an audible and visual fire alarm notification appliance on the wall directly opposite the entry door into the sauna, with a minimum sound power of 95 dB at 10 ft (3 m) and 110 cd. At a minimum, provide a 100 in^2 (0.6 m^2) vision panel within the entry door into the sauna.
Power	Provide outlets per paragraph 3-6.4. Provide wall or floor outlets to accommodate fitness machines. Ceiling fans may be provided.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** Provide for camera for view of room from the watch desk/stations officer's office. **CATV/Internal Video.** Provide at least one outlet for a wall-mounted unit. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** None required. **Security.** None required.
Acoustics	Provide partition and door construction with a minimum STC rating of 52 per paragraph 3-5.
Casework/Built-in Equipment	Provide full-wall-height mirrors on at least one wall. Flat panel display mount. Provide cabinet with counter top with an associated electrical outlet.
Furnishings Fixtures & Equipment (FF&E)	Provide fitness machines, treadmill, stationary bicycle, elliptical machine, weights, and mats.
User-provided equipment	Flat panel display.

Special Requirements	Provide exterior access or locate in close proximity to exterior access. Provide for natural light to the extent feasible (with shade/privacy screen).

Table 4-28 Laundry Room

Description/ Usage	The laundry room contains washers, dryers, and a folding table for use by the firefighters. This laundry room is only used for personal clothing of the firefighters and occasionally for laundry from the common areas of the fire station, not for firefighting gear.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as industrial semi-gloss latex paint. **Floor**. Provide a resilient sheet or tile flooring material with rubber base. **Ceiling**. Provide durable, moisture-resistant ACP or GWB ceiling. Provide semi-gloss latex paint for gypsum board ceiling.
Plumbing	Provide hot and cold water supply and an open end drain to each washer. Provide a floor drain. Provide a deep laundry sink.
HVAC	Provide a system per paragraph 3-6.2. Provide dryer venting per UFC 3-410-01.
Fire Protection	Provide system per paragraph 3-6.3. Regardless of size, enclose the laundry room with a 1-hour fire barrier. Exception: Where the building is fully sprinklered in accordance with UFC 3-600-01, a smoke partition and associated opening protection may be provided in lieu of the 1-hour fire barrier.
Power	Provide outlets per paragraph 3-6.4. Provide an additional outlet at the folding table.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide a built-in laundry-folding table and wall-mounted drying rack.
Furnishings Fixtures & Equipment (FF&E)	Provide large, heavy-duty, residential washers and dryers: • Less than 3 companies. One washer and two dryers. • 4 companies. Two washers and four dryers. • More than 4 companies. Three washers and six dryers. • Always provide two dryers to every one washer.
User-provided Equipment	None required.
Special Requirements	This laundry room is to be utilized only for washing staff's personal linens and clothing.

Table 4-29 Recreation Room

Description/ Usage	If required by the installation mission, this room provides space for the firefighters to engage in noisier recreational activities, such as table games (e.g., pool or table tennis) or video games and is in addition to the day room. Provide acoustical separation from the day room and dorm rooms. For Army only: This space can be substituted for additional day/training room as required by the installation.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as industrial eggshell latex paint. **Floor**. Provide low-maintenance resilient sheet or tile flooring material with rubber base, or durable commercial carpeting with rubber base. **Ceiling**. Provide acoustical ACP or gypsum board ceiling such as industrial eggshell latex paint for gypsum board ceiling.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2. Provide independent thermostat.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4. Provide power required to accommodate any game equipment.
Lighting	Provide system per paragraph 3-6.4. Provide residential-style luminaires with dimming control switches.
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide at least one outlet. Coordinate height of outlet for a wall-mounted flat panel display. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** None required. **Security.** None required.
Acoustics	Provide partition and door construction with a minimum STC rating of 55 per paragraph 3-5.
Casework/Built-in Equipment	Flat panel display mount.
Furnishings Fixtures & Equipment (FF&E)	Provide pool table/table-tennis table, lounge chairs, side tables, bar stools, book cases, and storage cabinets.
User-provided Equipment	Flat panel display.
Special Requirements	None required.

Table 4-30 Vending

Description/ Usage	The vending area accommodates two or more vending machines for snacks and drinks. The vending area must be conveniently located for the use of firefighters and fire station staff. Do not place vending machines in the day room or lobby. Recommended locations include the recreation room (if provided) or an alcove off a main hallway.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide a low-maintenance, durable finish such as eggshell latex paint. **Floor**. Provide low-maintenance resilient sheet or tile flooring material with rubber base. **Ceiling**. Provide ACP or painted gypsum ceiling.
Plumbing	None required.
HVAC	Provide a system per paragraph 3-6.2.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4. Provide outlets and power required by vending machines.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	None required.
Furnishings Fixtures & Equipment (FF&E)	None required.
User-provided Equipment	Vending machines.
Special Requirements	None required.

Table 4-31 Outdoor Patio/BBQ

Description/ Usage	This is an outdoor patio space. The patio counts toward overall building square footage. Its character must resemble a residential patio or deck. Firefighters will relax, play games, and barbeque in this space during their 24-hour shift when weather permits. Patio must be adjacent to or in close proximity to the apparatus bay for easy access in the event of a call and be directly accessible from the kitchen/dining area.
Min. Ceiling Ht.	Provide shade structures.
Finishes	**Walls**. None required. **Floor**. Concrete, brick, or stone paver accents. **Ceiling**. None required.
Plumbing	Provide hose bibb. If natural gas is available, provide gas connection for an external grill at the local installation's discretion. Locate gas connection 10 ft (3 m) away from structure and not adjacent to any combustible materials. Natural gas service must have accessible shut-off.
HVAC	None required.
Fire Protection	Provide system per paragraph 3-6.3. Refer to NFPA 13 for fire-suppression requirements under attached canopies or awnings, where provided. Refer to UFC 4-021-01 for mass notification system requirements.
Power	Provide exterior outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4. Provide 5 fc (50 lux) at the grill.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide exterior-grade counter-top/food preparation workstation collocated with grill as required per installation.
Furnishings Fixtures & Equipment (FF&E)	Provide garden furniture: tables, chairs, lounge chairs, garden umbrella, and exterior surface walk-off mat at entrance to day room.
User-provided Equipment	Grill.
Special Requirements	None required.

Table 4-32 Unisex Toilet "Public Use"

Description/ Usage	For headquarters stations only. Toilet facilities accessible from dayroom or main Lobby for use by guests/visitors. For Army only: All facilities will require a unisex toilet "public use".
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. Provide porcelain tile on cementitious backer board for wet walls. Provide a low-maintenance, durable finish such as eggshell latex paint. **Floor**. Provide slip-resistant porcelain tile with tile base. **Ceiling**. Moisture-resistant gypsum board.
Plumbing	Provide lavatory, water-closet, and floor drain.
HVAC	Provide a system per paragraph 3-6.2. Exhaust per UFC 3-410-01.
Fire Protection	Provide system per paragraph 3-6.3. Provide corrosion resistant sprinklers and escutcheons.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide sink set into counter/cabinet. Provide coat hooks. Provide wall-mounted/fold-down baby changing station.
Furnishings Fixtures & Equipment (FF&E)	None required.
User-provided Equipment	None required.
Special Requirements	None required.

Table 4-33 Transition Zone

Description/ Usage	This space allows movement of personnel between the facility's hot (red) and cold zones (green). Hot zones are spaces in the facility exposed to carcinogens and green zones are living/working spaces intended for extended occupancy. Also, locate the following areas between hot and green zones: equipment maintenance/wash/disinfection, protective clothing laundry, PPE gear storage, spare PPE gear storage, and deployment gear storage. The sequence for transitioning from a hot zone to a cold zone must allow space for personnel to take 5 steps along a walk-off surface over a minimum 6-ft (1.8 m) -long path after removal of gear and washing off any visible contaminants. Transition zones must be in close proximity to hand wash sink/eyewash, PPE storage/laundry, and boot scrub station.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls**. CMU. Provide a low-maintenance, durable finish such as industrial latex or epoxy paints on all wall surfaces. **Floor**. Provide a sealed concrete surface and walk-off mat with scraper surface finish. A non-skid, low-maintenance traffic coating may also be acceptable. **Ceiling**. Provide ACP or painted gypsum board ceiling.
Plumbing	Provide a hand-washing sink.
HVAC	Provide a system per paragraph 3-6.2. Exhaust space to maintain negative pressure relationship to occupiable/"green" zones.
Fire Protection	Provide system per paragraph 3-6.3.
Power	Provide outlets per paragraph 3-6.4.
Lighting	Provide system per paragraph 3-6.4.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/Built-in Equipment	Provide accessories, paper towel dispenser/waste receptacle, soap dispenser, hand sanitizer, and mirror.
Furnishings Fixtures & Equipment (FF&E)	Boot scrub station.
User-provided Equipment	None required.
Special Requirements	Provide recessed walk-off mat. Signage: "No fire gear beyond this point."

APPENDIX A BEST PRACTICES

The Best Practices Appendix is considered to be guidance and not requirements. Its main purpose is to communicate proven facility solutions, systems, and lessons learned, but may not be the only solution to meet the requirement.

A-1 STRUCTURE.

Single-story structures are preferred for fire stations. Where feasible, design the structural system to accommodate potential future expansion, such as additional stalls for the apparatus bay.

A-1.1 Substructure.

Coordinate the design assumptions for the floor slab in the apparatus bay with those for exterior pavements; for example, use wheel loads that correspond to the default fire truck configurations in the Pavement-Transportation Computer Assisted Structural Engineering (PCASE) software program.

A-1.2 Superstructure.

Coordinate clearance and support requirements for the large overhead doors in the apparatus bay. Where feasible, use pre-engineered systems and components for building framing. For example, a pre-engineered metal building system may be an economical solution at the apparatus bay.

A-1.3 Fall Protection.

Coordinate the anchorage locations and loadings with the fall protection system specifications and the minimum design requirements of 29 CFR 1926.502.

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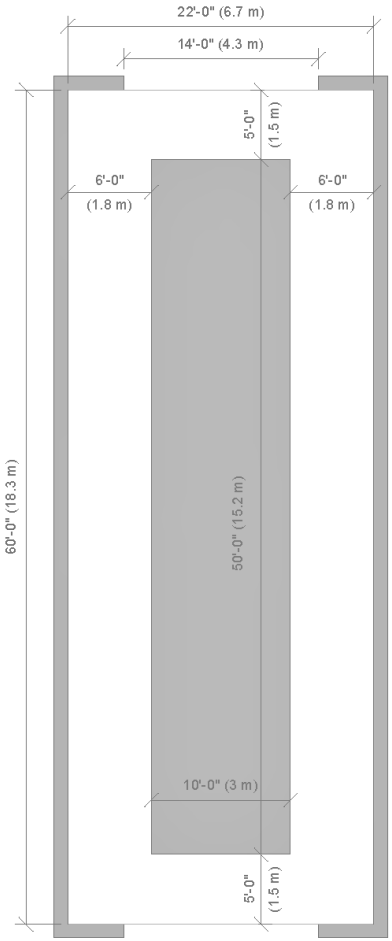
APPENDIX B FIGURES

B-1 APPARATUS BAYS.

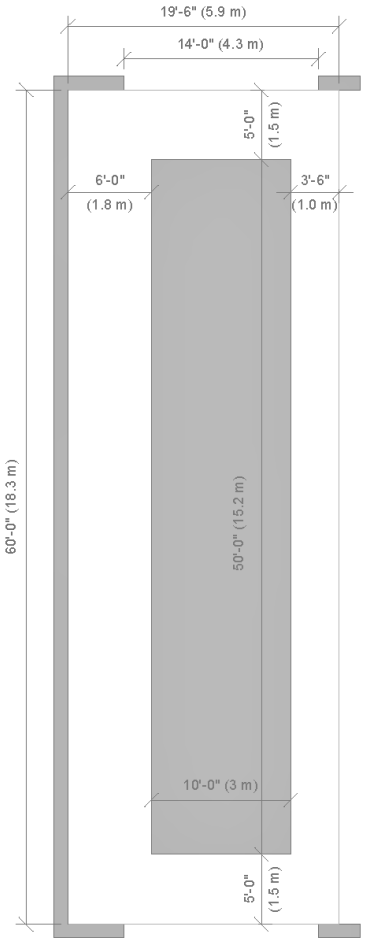
The key driver behind the size and configuration of the apparatus bays are the truck sizes and the required area around the vehicle footprint. Paragraph 2-3.1.1 gives the standard truck sizes and their relative footprints. The diagrams in Figures B-1 through B-4 illustrate the required space around each vehicle size class.

Each diagram has three possible configurations: a truck parked between two walls, a truck parked between a wall and another truck, and a truck parked between two other trucks. This is due to the different set-off distances for a wall versus another vehicle.

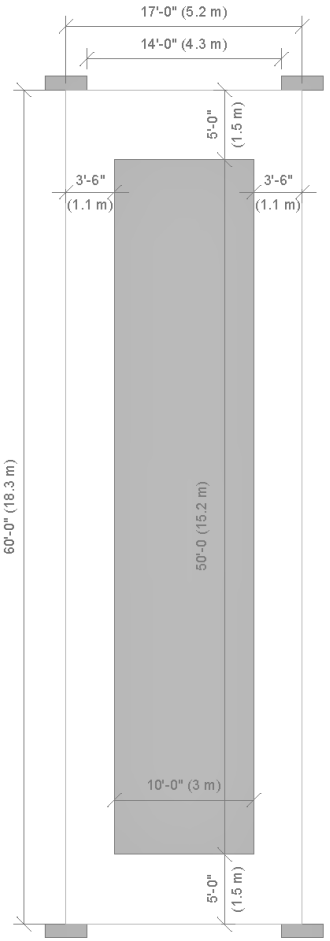
Figure B-1 Large Vehicle Class



LARGE TRUCK
SINGLE BAY
1320 SF
(122.6 SQUARE METERS)

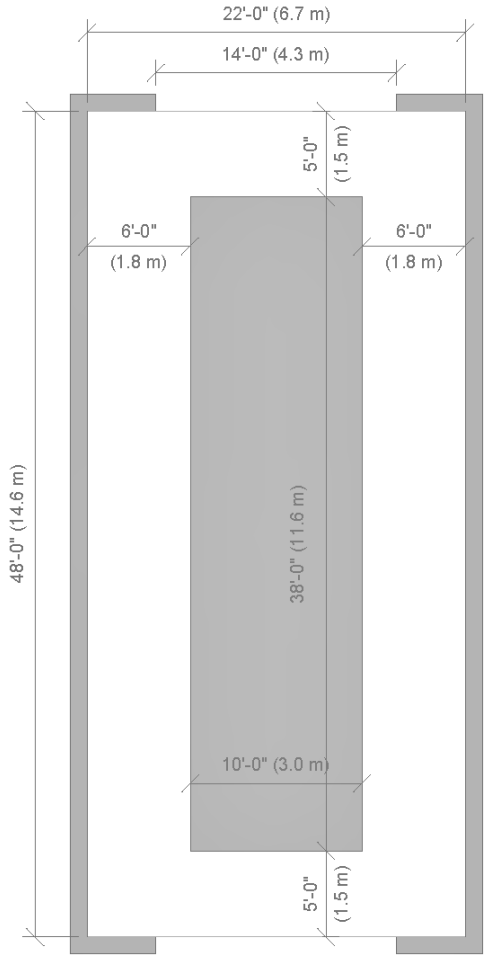


LARGE TRUCK
DOUBLE BAY
1170 SF
(108.7 SQUARE METERS)

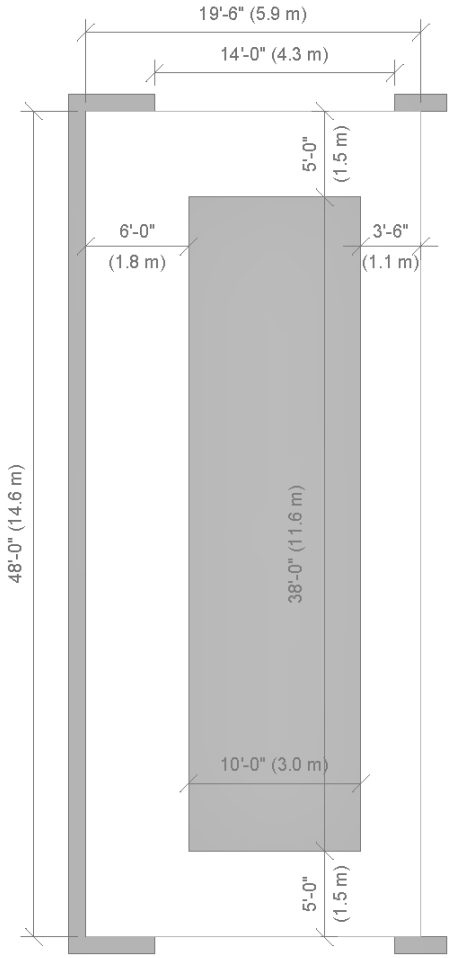


LARGE TRUCK
THREE OR MORE BAY
1020 SF
(94.7 SQUARE METERS)

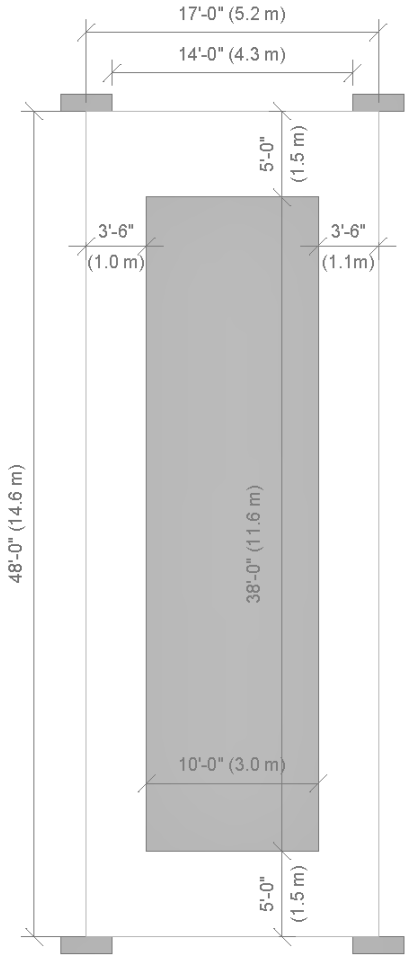
Figure B-2 Medium Vehicle Class



MEIDUM TRUCK
SINGLE BAY
1056 SF
(98.1 SQUARE METERS)

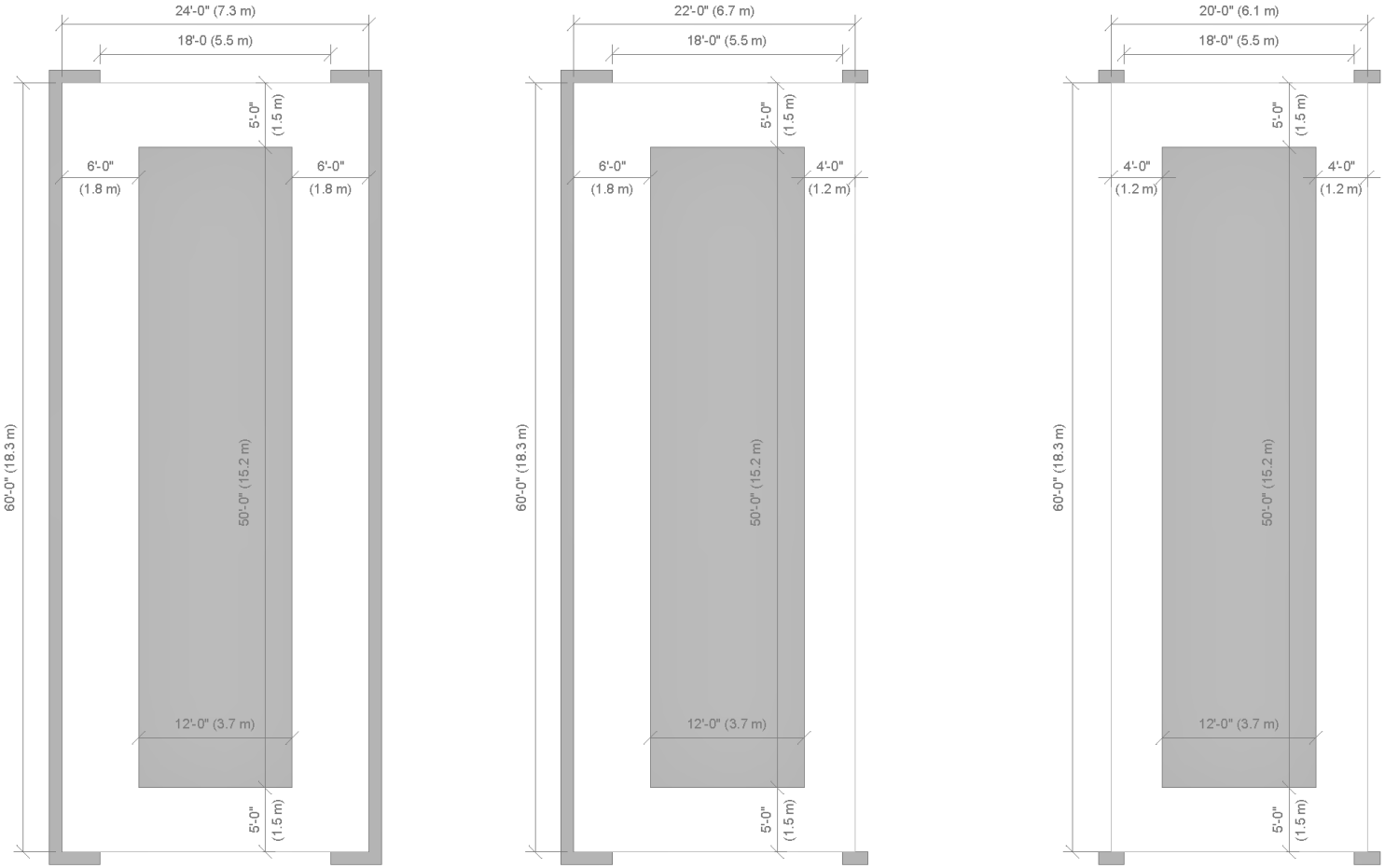


MEDIUM TRUCK
DOUBLE BAY
936 SF
(86.9 SQUARE METERS)



MEDIUM TRUCK
THREE OR MORE BAY
816 SF
(75.8 SQUARE METERS)

Figure B-3 Large ARFF (Wide) Vehicle Class

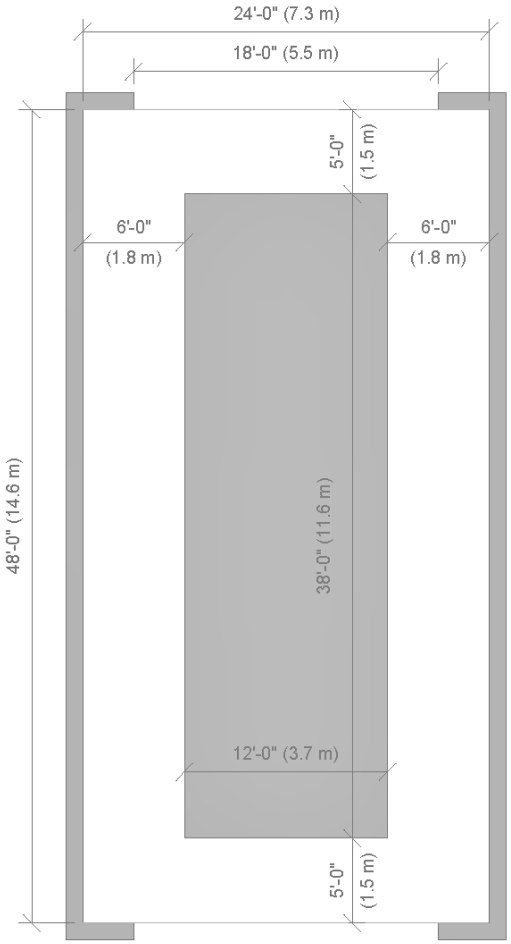


ARFF LARGE TRUCK
SINGLE BAY
1440 SF
(133.7 SQUARE METERS)

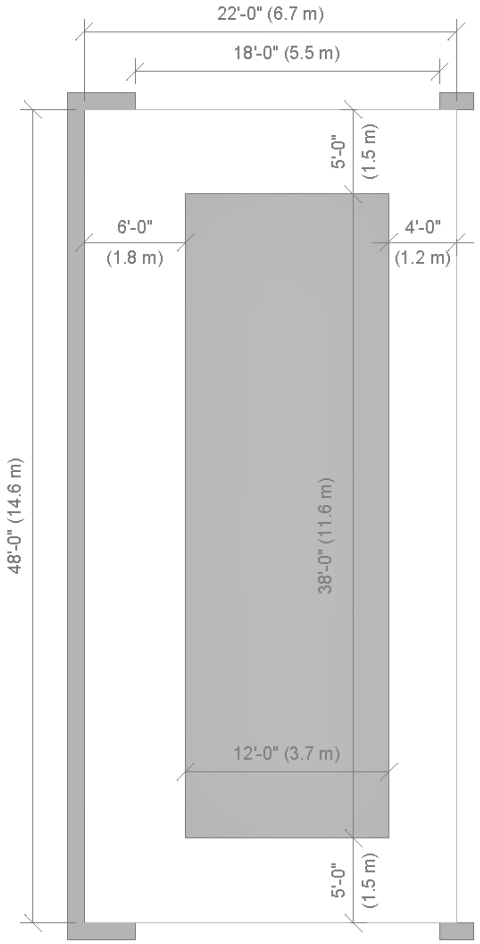
ARFF LARGE TRUCK
DOUBLE BAY
1320 SF
(122.6 SQUARE METERS)

ARFF LARGE TRUCK
THREE OR MORE BAY
1200 SF
(111.5 SQUARE METERS)

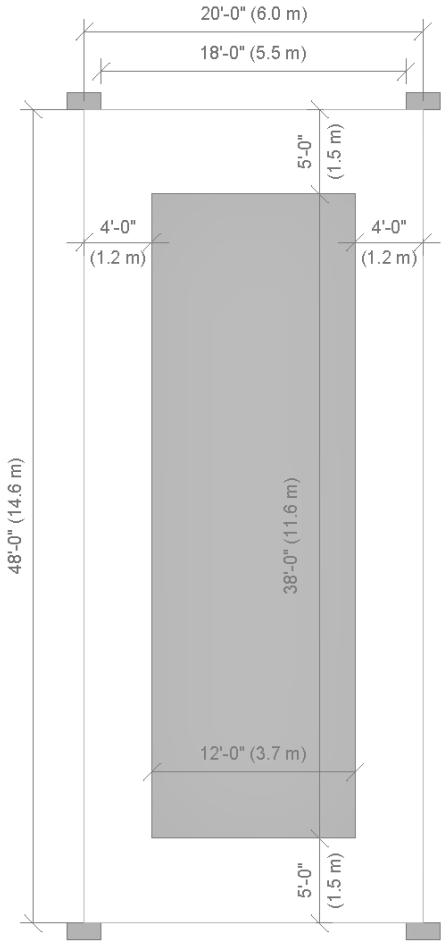
Figure B-4 Medium ARFF (Wide) Vehicle Class



ARFF MEIDUM TRUCK
SINGLE BAY
1152 SF
(107.0 SQUARE METERS)



ARFF MEDIUM TRUCK
DOUBLE BAY
1056 SF
(98.1 SQUARE METERS)



ARFF MEDIUM TRUCK
THREE OR MORE BAY
960 SF
(89.2 SQUARE METERS)

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APPENDIX C GLOSSARY

C-1 ACRONYMS AND ABBREVIATIONS.

°C	Degree Celsius
°F	Degree Fahrenheit
ABA	Architectural Barriers Act
ACGIH	American Conference of Governmental Industrial Hygienists
ACP	Acoustical Ceiling Panel
AFF	Above Finished Floor
ANGH	Air National Guard Handbook
ANSI/ASSE	American National Standards Institute / American Society of Safety Engineers
ANSI/CGA	American National Standards Institute / Compressed Gas Association
AR	Army Regulation
ARFF	Aircraft Rescue Firefighting
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASN(EIE)	Assistant Secretary of the Navy (Engineering, Installations & Environment)
AWI	Architectural Woodwork Institute
CAD	Computer Aided Dispatch
CATV	Cable Television
CBRNE	Chemical Biological Radiological, Nuclear, Explosive
CCTV	Closed-circuit Television
cd	Candela
CFR	Code of Federal Regulations
CMU	Concrete Masonry Units

CNIC	Commander, Navy Installations Command
dB	Decibel
DoD	Department of Defense
DODI	Department of Defense Instruction
DVD	Digital Video Disc
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
FAVERS	Fire Apparatus Vehicle Exhaust Removal System
fc	Foot Candle
ft	Foot
ft2	Square Foot
gal	Gallon
GWB	Gypsum Wall Board
HAZMAT	Hazardous Materials
HDPE	High-Density Polyethylene
HQ USAF/A4C	Logistics, Engineering and Force Protection, Civil Engineers
HQ	Headquarters
Ht	Height
HVAC	Heating, Ventilating, and Air Conditioning
IMC	International Mechanical Code
in.	Inch
IT	Information Technology
kg	Kilogram
L	Liter
lb	Pound

m	Meter
m^2	Square Meter
mm	Millimeter
MSDS	Material Safety Data Sheet
NAVFACINST	Naval Facilities Command Instruction
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
OCONUS	Outside Continental United States
OPNAVINST	Chief of Naval Operations Instruction
OSHA	Occupational Safety and Health Administration
PA	Public Address
PPE	Personal Protective Equipment
RMS	Record Management System
RMS	Records Management System
SCBA	Self-contained Breathing Apparatus
SF	Square Foot
STC	Sound Transmission Coefficient
UFC	Unified Facilities Criteria
UL	Underwriters Laboratories
UPS	Uninterruptible Power Supply
VOC	Volatile Organic Compound

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UFC 4-740-02
3 February 2019
Change 1, 30 May 2019

UNIFIED FACILITIES CRITERIA (UFC)

FITNESS CENTERS



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NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location
1	30 May 2019	Updated Service-specific criteria in para. 2-3; updated references in paras. 3-5.1.2 and 3-6.4.1; updated functional data sheet link in para. 4-3; updated requirements and references in Tables 2-1, 4-20, 4-22, 4-25, 4-29, 4-30, 5-1, 5-2, 5-8, 5-9, 6-1, 6-14, and 6-17; added new Table 5-10 for building support/vertical circulation; updated App. B; designated former App. A as App. D, App. B as App. A, and App. D as Chap. 6; and updated references in App. D

This UFC supersedes FC 4-740-02F, *Air Force Fitness Centers*, dated 26 September 2006, and FC 4-740-02N, *Navy and Marine Corps Fitness Centers*, dated 1 April 2014.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and DOD field activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DOD projects and work for other customers, where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA) and, in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies must contact the preparing Service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale must be sent to the respective Service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Refer to UFC 1-200-01, *DoD Building Code (General Building Requirements)*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Document: UFC 4-740-02, *Fitness Centers*

Superseding: FC 4-740-02F, *Air Force Fitness Centers*, dated 26 September 2006, and FC 4-740-02N, *Navy and Marine Corps Fitness Centers*, dated 1 April 2014.

Description: This UFC provides criteria for planning and design of fitness centers for the combined DOD United States Armed Forces.

Reasons for Document: This is a new Joint Service document. This document represents another step in the Joint Services' effort to bring uniformity to the planning, design, and construction of military facilities. The UFC was developed to provide design requirements to accomplish the following:

- Assist planners in understanding facility requirements to ensure accurate space program budgets
- Provide architects, engineers, and construction surveillance personnel with essential, minimum requirements for the design and construction of fitness centers
- Clarify the operational intent of the facility design

Impact: The following will result from the publication of this UFC:

- This UFC creates a single source for common DOD fitness center criteria and an accurate reference to individual Service-specific documents
- This UFC facilitates updates and revisions and promotes agreement and uniformity of design and construction between the Services

Unification Issues: The following is non-unified content:

- For Navy and Marine Corps only, exceptions in supporting specific functional program areas occur as noted in Table 2-1, "Functional Program Areas" and the functional data sheets in Chapter 4.
- The Army has different ceiling fan requirements.
- Chapter 6, "Austere Fitness Centers," applies only to the Navy.

Note: The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by DOD.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This UFC provides requirements for evaluating, planning, programming, and designing fitness centers. This UFC is not intended as a substitute for thorough review by individual program managers and operations staff in the appropriate Service.

1-2 APPLICABILITY.

The information in this UFC applies to the design of all new construction projects, including additions, alterations, and renovation projects within the United States and its territories and possessions and outside of the United States and its territories and possessions. It also applies to the procurement of design-build services for these projects.

1-3 USERS OF FACILITY.

The facility users are as follows:

- Active-duty military, retired military personnel, and their family members; and
- DOD civilians and others, as authorized.

1-4 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DOD Building Code (General Building Requirements)*. UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as accessibility, antiterrorism, security, high-performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-5 REFERENCES.

Appendix D contains a list of references used in this document. The publication date of the code or standard is not included in this document. In general, the latest available issuance of the reference is used.

1-6 GLOSSARY.

Appendix C contains acronyms and abbreviations.

1-7 AUSTERE FITNESS CENTERS (FOR NAVY ONLY).

Chapter 6 of this UFC contains requirements for fitness centers that are specifically designated as "austere." Austere construction is intended for facilities in locations determined by Commander, Navy Installations Command (CNIC), and approved by the Office of the Chief of Naval Operations (OPNAV) to be eligible for austere construction. The austere standards are intended to be applied flexibly and in varying degrees to all facilities at locations designated as austere. Flexibility is allowed to ensure the criteria are appropriate for individual austere locations.

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CHAPTER 2 PLANNING AND LAYOUT

2-1 LOCATION DETERMINANTS.

Determine the most appropriate and cost-effective location for a fitness center based on the following factors. Ensure the availability and capacity of required utilities and the compatibility of the mass/scale of the facility relative to adjacent structures.

2-1.1 Access.

Locate the fitness center to be visible and easily accessible to other facilities utilized by the target audience, such as barracks/dormitories, MWR/NEX/MCCS/Services facilities, and dining facilities. To accommodate patron access, evaluate the relationships to existing vehicular and pedestrian circulation patterns, bike trails, and bus stops. Provide adequate parking as close to the facility as possible within antiterrorism (AT) requirements.

2-1.2 Cost.

Design these facilities with the objective of achieving the lowest lifecycle cost over a 40-year period. The project's design program must adequately define the scope and performance requirements and match those needs against a budget. Conversely, the budget must adequately support an appropriate and high-quality program following performance requirements outlined in this UFC.

2-1.3 Expansion.

Evaluate possible future additions when selecting the site to ensure cost-effective expansion possibilities. Future projects may include additional fitness center spaces, adjacent aquatics/swimming pool, adjacent outdoor sports fields and courts, and new/emerging program requirements.

2-2 FACILITY SIZE.

The space program must be developed in coordination with the installation’s mission requirements. The fitness center’s size will be driven by the program and the installation's population.

2-3 SPACE PROGRAM.

\1 The final space program for a new fitness center will need to be carefully determined by installation representatives, using the criteria in this UFC. The space assessment and its related basic facility requirement (BFR) calculation serves as the basis for the validated DD Form 1391, which defines the total authorized space allowances for each project.

For the Navy and Marine Corps, the space program is developed through the use of an interactive spreadsheet and serves as a baseline for the fitness center planning team. This spreadsheet is available as a downloadable Microsoft® Excel file from the Whole

Building Design Guide (WBDG) website: http://www.wbdg.org/references/pa_dod_sps.php. (See Appendix B for a sample space program spreadsheet for a Navy facility.)

For the Air Force, the space program is developed through the use of an interactive spreadsheet and serves as a baseline for the fitness center planning team. This spreadsheet is available as a downloadable Microsoft® Excel file from the WBDG website: http://www.wbdg.org/references/pa_dod_sps.php.

For the Army, the space program is developed through consultation with the Physical Fitness Facility Center of Standardization to determine space requirements on the MILCON Requirements, Standardization, and Integration (MRSI) website: https://mrsi.erdc.dren.mil/cos/hnc/pff/. **/1/**

2-3.1 Space Tabulation.

The tabulation of areas for the majority of spaces within a fitness center follows UFC 3-101-01, *Architecture*, paragraph 2-2, "Building Area Calculations." Functional balconies within fitness centers used for fitness must be programmed as full scope in the area calculation. For indoor elevated jogging tracks, the Navy, Marine Corps, and Air Force programs these at full square footage.

Space requirements for the optional multipurpose field and supporting facilities are in Chapter 5.

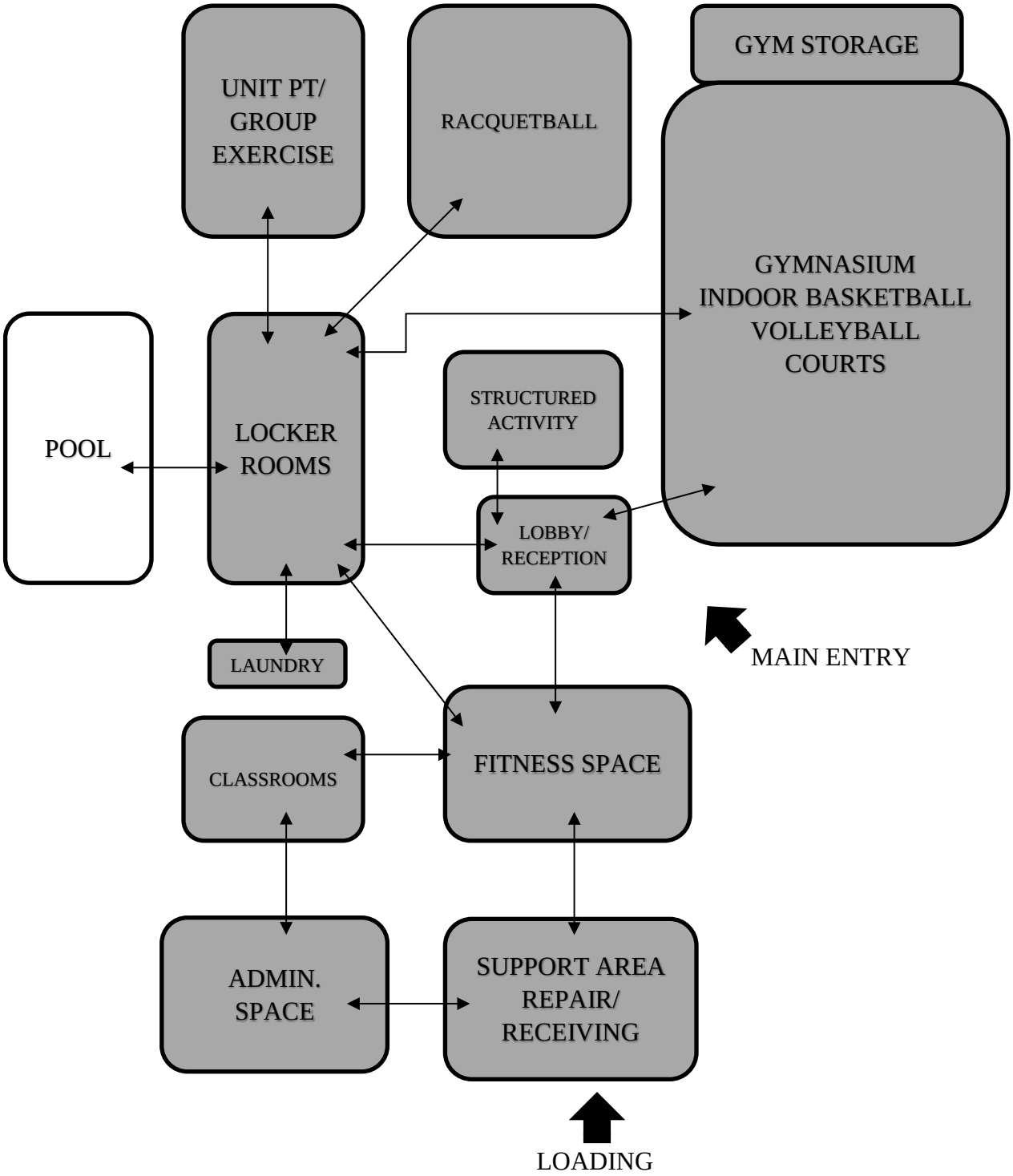
2-4 LAYOUT AND ADJACENCIES.

The appropriate adjacencies are illustrated in Figure 2-1. These diagrams do not convey a building shape. Actual building shape will vary with available site, topography, vehicular access, site restrictions, utility access, and final installation program requirements. Required adjacencies may be accommodated vertically. This figure illustrates a facility with the gymnasium near the front entrance. This configuration allows the gymnasium to be used for events while the rest of the facility is closed off. However, also evaluate the massing of the facility when determining the location of the gymnasium.

2-4.1 Basic Facility.

The diagram in Figure 2-1 indicates acceptable relative adjacencies of the major functional spaces for a basic facility.

Figure 2-1 Basic Facility Functional Relationship Diagram



2-5 SPACE ASSESSMENT.

See Chapter 4 for additional information on the space types and their relationships to each other.

2-6 SCOPE OF FACILITY.

The fitness center comprises the fitness program spaces, the administrative area, and building support. Within the fitness programs there are core functional program areas and optional functional program areas. All functional program areas are described in Table 2-1 and paragraph 2-7. All of these spaces are described in greater detail in Chapters 2 and 4. Additionally, due to the numerous possible variations of fitness center programs, an interactive space programming tool has been developed to help users calculate a baseline space program for a new fitness center. This tool is described in paragraph 2-3.

A fitness center may be combined with a natatorium or outdoor athletic fields; however, the natatorium and fields have different category codes and may be programmed separately or as part of a fitness center complex. Chapter 5 includes requirements for multipurpose fields and softball fields. Requirements for natatoriums and other types of athletic fields are not included in this UFC.

2-7 PROGRAM AREAS.

2-7.1 Fitness Program, Administrative Areas, and Building Support.

Table 2-1 lists the core and optional areas for the fitness program, administrative areas, and building support. These are the traditional functions of a fitness center. They provide facilities and support services to meet the general fitness, skill development, training, and sports needs of all authorized users. This table identifies functional areas; when programming a facility, evaluate other areas such as circulation/corridors, exterior wall cavities, and mechanical/electrical/communication rooms to determine gross areas of the building. See UFC 3-101-01 for methods to calculate gross building area. Service-specific spaces are identified with an asterisk (*).

2-8 ANTITERRORISM/FORCE PROTECTION.

Refer to UFC 4-020-01, *DOD Security Engineering Facilities Planning Manual*, and UFC 4-010-01, *DOD Minimum Antiterrorism Standards for Buildings*, to develop requirements.

Table 2-1 Functional Program Areas

Functional Program Area	Description/ Requirements
Lobby/Reception	
Entry lobby and waiting/display	Entry space in front of control counter and/or vestibule. Combined with a waiting area with seating and display space. Space includes a public telephone.
Control counter/equipment issue/storage	Sign-in and small gear issue. Provides visual control via line of sight (LOS) to, at minimum, the entry, free weights, and locker room entrance. Visual control over other key areas must be accommodated via LOS or CCTV. Provides area to hold gear for issue (e.g., towels, balls, and racquets).
Retail/vending/food and beverage sales	Food and beverage sales may be combined with gear issue (refrigerator); may be self-serve (vending). Option for a retail area for clothes, sports equipment. Option for an expanded, separate juice counter in lobby space. May be contract space.
Public restrooms	Restrooms used primarily by visitors, spectators, and persons not using the locker and shower rooms. Sizing is tied to gym capacity.
Janitor's closet	Space used by custodial staff, with mop sink and storage space.
Administrative	
Director's office	Private office.
Program managers' offices	Private office. Installation to determine quantity of offices and workstations within each office.
Administrative support	Workstations.
Classroom/training room	Space used for conducting training and large meetings. Classroom sized for 25 persons (750 ft^2 [69.68 m^2]) for small facilities, 50 persons (1500 ft^2 [139.35 m^2]) for medium and large, and 75 persons (2250 ft^2 [209.03 m^2]) for extra-large and jumbo facilities.
Copy/work/break room	Copier, layout space, storage, small staff break area.
Gymnasium	
Basketball/volleyball court(s)	NCAA-size court(s).
Spectator seating	Minimum of 200 seats; more as required and with additional courts.
Storage/support	Storage area with access to both the gym and to the outside if adjacent intramural fields are present.
Unit PT/Group Exercise	
Group exercise room	One large subdividable room with partitions (for classes and/or unit/command fitness training).

Storage/support	Storage area with access to unit PT/group exercise room.
Fitness Spaces	
Stretching/warm-up/cool-down	Usually one open space; may use floor finishes to separate subspaces; may use alcoves; may use balconies/mezzanines.
Free/plate-loaded weights	
Selectorized (machine) weights	
Cardiovascular (cardio) equipment	
Fitness program manager's office	Private office adjacent to fitness assessment room and fitness spaces. May include fitness testing equipment.
Fitness assessment room	Private office with desk, computer, and chairs for staff to meet with customer adjacent to fitness spaces. Includes fitness testing equipment.
Indoor track	Optional. Determine permissibility by center size and climate.
Structured Activities	
Structured activity space	Can be used as needed, e.g., for rock climbing wall, indoor cycling, volleyball, martial arts/boxing, other structured activity, or rolled into other functional areas, as needed.
Racquetball courts	Designed and specified to meet USA Racquetball Association (USRA) *Standard Specifications for Racquetball Court Construction*.
Spectator area/officiating	Optional.
Functional fitness	Space that supports Service-developed programs. Functional fitness implies performing exercise in an optimal way, to achieve certain goals that allow improved performance of regular activities outside the gym. Typical equipment in the functional fitness area includes A-frames used for various exercises with bands, individual weight stations, and various kettlebells and other equipment.
Auxiliary gymnasium	Optional. This space is used for sports competitions such as basketball, volleyball, wrestling, and indoor soccer. The auxiliary gymnasium can also support instructional functions, informal, intramural, group exercise/fitness functions, and community events. Preferably, the auxiliary gymnasium will be adjacent to the main gymnasium and, if not adjacent, must be nearby.
High Intensity Tactical Training (HITT) Center*	Marine Corps-only space. This is typically one large, open-space room that is non-partitionable and used for implementation of the HITT program. Activities/classes such as aerobics, martial arts, and yoga must not be used in this space.

Indoor Cycling	Classroom to accommodate indoor cycling classes, which includes an instructor on a bike and participants on bikes. These bikes are different from stationary bikes utilized in the cardio area. This space may be included as part of the programmed space allotted for structured activities.
Locker Rooms	Separate male/female facilities. Each locker room is divided into the three indicated sub-areas.
Men's Locker Room	Programmed per installation population.
Locker/dressing area	Programmed per installation population.
Toilet area	Programmed per installation population.
Shower/drying area	Programmed per installation population.
Women's Locker Room	Programmed per installation population.
Locker/dressing area	Programmed per installation population.
Toilet area	Programmed per installation population.
Shower/drying area	Programmed per installation population.
\1\ Steam room	Optional. This space is not supported by the Navy. **/1/**
Sauna	Optional. When used, provide separate male/female facilities.
Convertible locker space	Optional. This is locker/changing space that can be used for additional male or female space to accommodate tournaments and/or changing demographics. It is a separate room between the male and female locker rooms, with double-locked doors into each.
Support Areas	
Laundry	For towels and uniforms.
Receiving and equipment repair/storage	Receiving, storage, and repair. Area to hold (if necessary), assemble, and repair equipment and store overflow from the equipment issue (e.g., seasonal items).
Additional programmatic storage	Optional storage for additional optional program equipment. May be combined with receiving/equipment repair.
Other Program Areas	
Massage room	Optional room for massage.
\1\ Hot tub	Optional. This space is not supported by the Navy. **/1/**

Unisex changing room/unisex locker room	Single-person locker room with shower, lavatory, and toilet; family member accompanies child. Adjacent to locker area and provides direct access to the pool.
Parent/child area	**\1** Optional **/1/** age-appropriate spaces based on Service guidance. Navy option: Provides a separate room for parents to watch their children while exercising. Includes adult fitness equipment on one side and a separate child play area on the other. The two sides are divided by a 30-in. (750-mm) -high clear wall with a central entry/exit point. Marine Corps option: Provides an unstaffed child care room with play area for the children and a seating/lounge area for the adults. Adult supervision is required in this area. Does not include fitness equipment.
Mother's room	Private space for nursing mothers. One per facility.
Related Program/Facility Areas	
Pool	Note that pools and natatoriums are a different category code. If a pool/natatorium is desired, it will affect the adjacencies and traffic flow within the building. See Figure 2-1 for these adjacencies.
Physical therapy/rehabilitation training	Optional. Note that these functions are a different category code. This space is only supported in special circumstances.
Multipurpose field	See Chapter 5 for details. Fields may be programmed with or separate from a fitness center on a case-by-case basis; also refer to UFC 4-750-02N.
Outdoor track	See Chapter 5 for details. Tracks may be programmed with or separate from a fitness center on a case-by-case basis; also refer to UFC 4-750-02N for other criteria.
Softball field	See Chapter 5 for details. Fields may be programmed with or separate from a fitness center on a case-by-case basis.

CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL.

This chapter provides general criteria only and consists mainly of references to the technical design criteria documents and general considerations. Chapter 4 provides the specific design requirements for each fitness center space.

3-1.1 Authorized Building Program.

A DD Form 1391 funding document is developed for all new construction projects, which establishes the project requirements and authorized building size. The designer must use the functional space program descriptions and functional diagrams in this UFC; however, the design may not exceed the square footage allowances or add functions not authorized by the validated DD Form 1391.

3-1.2 Accessibility.

Comply with stated and cross-referenced requirements for accessibility. Facilities programmed for wheelchair competition activities shall be designed to provide access for a 40-inch (1016-mm) -wide wheelchair at the main entrance, gymnasium, and restrooms.

3-2 STRUCTURE.

3-2.1 Substructure.

For the gymnasium, provide a level concrete slab on grade over properly graded crushed stone subbase, with a minimum 10-mil (0.25-mm) polyethylene sheet vapor barrier located directly between the slab and the subbase. For rooms with floor padding, provide a recessed slab to compensate for the mat thickness or a transition area outside of the mat area.

3-2.2 Superstructure.

Provide clear spans for the activity area and gymnasium. Where specialized elements such as basketball backstops, divider curtains and drapes, lighting and sound equipment, decorative banners, acoustical treatments, score boards, or running tracks will be suspended above the floor, design the roof structure for the appropriate support locations and loadings.

3-3 ARCHITECTURE.

Comply with stated and cross-referenced requirements for architecture. Fitness areas are to be as open as possible, with maximum utilization of natural light and views. Larger spaces will be provided to allow flexibility in addressing future fitness trends. Also comply with the following fitness center-specific requirements.

3-4 EXTERIOR DESIGN.

The building's image, theme, and fixtures must be consistent with the programs offered. The building design must reflect the local geographical and cultural environment and comply with the appropriate Service and installation architectural standards. The building and site must provide a visually attractive, safe, and welcoming appearance. Group high bay spaces together. The high bay areas must not dominate or overwhelm surrounding structures.

3-4.1 Entrances/Exits.

3-4.1.1 Main Entry.

Design the facility to require access at one main entry point sized in accordance with egress requirements of NFPA 101, *Life Safety Code*. To determine the occupant load of the gymnasium, use "Assembly Use - Without Fixed Seating" from NFPA 101. If the main entrance is not sized to accommodate the occupant load of a special event (e.g., change of command, award ceremonies), a separate gymnasium special event entrance with a paved path to the parking area is required.

3-4.1.2 Covered Entry and Alarm.

The main facility entrance to the lobby serves as a welcome and transition point. Provide a covered entry. In cold climates, provide a canopy (or a recess) at required egress doors to ensure doors can open completely without obstruction from snow and ice. All other exterior doors must have a local, key-controlled alarm that sounds at the door and the control desk when the door is opened. Indicate this alarm with signage on the door.

3-4.1.3 Equipment Deliveries.

If applicable, provide a separate entrance for equipment deliveries. See paragraph 3-8 for more information on site work.

3-4.2 Doors and Windows.

Provide doors and windows to allow natural light into and views in and out of the facility. Mitigate glare and direct sunlight in activity spaces such as the gymnasium and fitness spaces.

3-4.3 Exterior Finishes.

The exterior color, texture, and design must be consistent with the programs offered, building type, and the local environment in accordance with installation design standards. The design must communicate a sense of activity and energy while complying with installation design guides/standards.

3-4.4 Exterior Signage.

Equip the main entrance with an attractive, clearly visible sign that provides the program hours of operation. Ensure that signage complies with installation requirements. Sign placement and type are site-specific. The facility must include both a building-mounted sign and site monument sign (roadway-visible) that must be strategically located, adequately lit, and sized to permit proper viewing by individuals approaching the facility.

3-4.5 Exterior Walls and Mold.

Follow UFC 3-101-01 during design to help prevent the development of mold in exterior walls.

3-5 INTERIOR DESIGN.

Construction and finishes (walls, floors, and ceilings) must support the image and theme of the facility and be consistent with the programs offered and any installation interior standards. The interior design must offer the same interest, excitement, and professionalism found in comparable commercial facilities. As with the exterior, design the fitness center interior to reflect a high energy, non-institutional character that communicates a sense of activity.

Provide premium high-end finishes that are durable, hygienic, long-lasting, easily maintainable, and consistent with the programs offered and theme of the facility. The following key public spaces offer the greatest opportunity to establish a creative and interesting interior design approach:

- Entry lobby and waiting/display
- Control counter
- Unit physical training (PT)/group exercise
- Fitness spaces
- Structured activities
- Locker rooms and public toilets

3-5.1 Interior Construction.

3-5.1.1 Glass and Mirrors.

Interior construction must be extremely durable. Hollow-core wood doors are not allowed. All interior glass must be tempered safety glass and mirrors must be made of break-resistant materials.

3-5.1.2 Counters, Casework, and Cabinets.

Counters, casework, and cabinets must be of high-quality and durable construction. Specify Architectural Woodwork Institute (AWI) premium or custom for construction and finishes per **\1** *North American Architectural Woodwork Standards* (NAAWS). ***/1/***

Casework and cabinet doors and drawer faces must be provided as veneer panel core. Doors, drawers, and casework faces must be plastic laminate at a minimum. Countertops must be solid surface/solid composite plastics only. Specify 0.75 inch (20 mm) minimum thickness for plywood, plywood backing, and solid wood panels. Particleboard must not be used.

3-5.1.3 Functions

Identify the functions requiring counters/casework in each space within the fitness center and design these to accommodate these functions. Consult with the facility manager and program managers for specific program requirements.

3-5.2 Finishes.

Finishes must take into account the intended uses, be appropriately durable, and be low maintenance. Finishes must have good acoustical noise-reducing characteristics. They must meet the requirements listed in NFPA 101.

Vinyl composition tile (VCT) is not allowed. For information on finishes in specific areas, see Chapter 4. Also, coordinate the interior design with UFC 3-120-10, *Interior Design*, and installation design standards.

3-5.3 Building Signage.

Develop a comprehensive signage package (both interior and exterior) that addresses way-finding and definition of all spaces within the facility. Signage must reflect and complement the environment through the colors, images, and materials used. Building signage must provide clear directional and informational assistance to all functional areas. Mechanical, electrical, and/or utility room doors must have identifying signage to match other building signage. Provide signage in accordance with UFC 3-120-01, *Design: Sign Standards*.

3-5.4 Acoustics.

In general, since much of the facility comprises high-activity, high-noise functions, the design must seek to separate or acoustically protect the smaller, quieter functions rather than the noisier functions. For the purposes of this UFC, the following spaces are considered to be "noisy":

- Mechanical and laundry rooms
- Selectorized weight area(s)
- Free/plate-loaded weight area(s)
- Cardiovascular equipment area(s)
- Gymnasium
- Unit PT/group exercise room
- Racquetball courts and some other structured activity spaces

At a minimum, provide the required sound transmission coefficient (STC) ratings identified in Chapter 4 for individual spaces. Where not indicated in Chapter 4 for a particular room, use the interior acoustic requirements for typical spaces noise isolation class (NIC) ratings in UFC 3-101-01.

3-5.5 Window Treatments.

All windows and other glazed openings to the exterior of the building must be provided with horizontal blinds or solar shading systems as built-in equipment.

3-6 SERVICES.

3-6.1 Plumbing.

Design all building systems, such as domestic hot and cold water, sanitary and storm drainage, propane, fuel oil, or natural gas systems to meet the requirements of local installation standards and established criteria.

In multi-story facilities, locate toilets on each floor appropriately sized for participant load. Maintain a minimum of 60 percent of fixture counts in main locker rooms. Locate floor drains outside the normal travel paths. In toilet areas, locate floor drains under the partitions, where possible. Provide the number of electric water coolers (EWC) as required by UFC 3-420-01, *Plumbing Systems*, for peak occupancy loads, located as specified in Chapter 4 of this UFC. If all of the Chapter 4 requirements cannot be met by the number of EWCs required by UFC 3-420-01, additional units will be required. A location up to 100 feet (30.5 m) away from the entrance is considered acceptable when the requirement states “near.” EWCs throughout the facility must be combination water fountain and bottle-filling units. Never locate EWCs above wood flooring. EWCs must be provided on all levels.

3-6.2 Heating, Ventilating, and Air Conditioning (HVAC).

Comply with stated and cross-referenced requirements for HVAC and UFC 3-410-02, *Direct Digital Control for HVAC and Other Building Control Systems*. Unless otherwise stated, design spaces to comply with comfort cooling and heating requirements of UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*. Do not locate moisture-containing or -producing HVAC equipment above areas with wood floors, either on the roof or within the overhead space, due to the risk of a leak causing water damage.

If Chapter 4 requirements include providing ceiling fans, provide high-volume low-speed (HVLS) fans with appropriate clearances. Provide multi-speed fans with wall-mounted controls. The number of fans and fan sizes must be selected to provide consistent air movement over the entire space. For all spaces with ceiling fans, the minimum ceiling height listed is the minimum height of the fan; the actual ceiling shall be at the required clearance height above the fan. **For Army projects:** In two-story spaces, provide HVLS fans. In a one-story space, provide one fan with a diameter of not less than 48 inches per maximum of 400 square feet (37 m^2). In a one-story space, the distance from the floor to the fan must be no less than the suggested minimum ceiling height. Use demand-controlled ventilation and/or energy recovery as required and restricted by UFC

1-200-02, *High-Performance and Sustainable Building Requirements*, and UFC 3-410-01 or when lifecycle cost-effective.

3-6.3 Fire Protection and Life Safety.

Comply with stated and cross-referenced requirements for fire protection, life safety, and mass notification systems.

3-6.3.1 Operable Partitions.

Where one or more operable partitions are provided, fire suppression and fire alarm devices must be provided to protect the space in accordance with UFC 3-600-01, *Fire Protection Engineering for Facilities*, with the partitions in the open or closed position.

Means of egress inclusive of the number of exit access doors and door swing must be in accordance with NFPA 101 requirements, with the partitions in the open or closed position.

3-6.3.2 Protection from Mechanical Damage.

Protect fire suppression, fire alarm, and life safety devices from mechanical damage where devices are located in areas subject to damage from sports equipment or related activities. Provide protective guards over exposed devices such as sprinklers, fire alarm notifications, exit signs, and manual pull stations or provide devices designed to handle impact damage. Minimize projections into activity spaces by providing flush-mounted devices. Manual pull stations with break-glass mechanisms are prohibited.

3-6.4 Electrical.

Refer to UFC 1-200-01 and comply with stated and cross-referenced requirements for electrical systems. Also comply with the following fitness center-specific requirements.

3-6.4.1 Lighting.

See Chapter 4 for light level and control requirements that are exceptions or additions to the requirements referenced above. Refer to **\1** UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*, ***/1/*** for lighting levels not specified in Chapter 4 or in the requirements referenced above.

3-6.4.2 Standby Power Connection.

Provide the facility service entrance with the capability to temporarily connect a portable generator via an external connection point. Provide a hard surface area adjacent to the building service entrance sized to accommodate the largest portable generator (with integral fuel tank) dimension and weight available based on the generator size determined during the design. Provide accessible ground rod, bonded to the building grounding system, for connection to a portable generator.

Comply with NFPA 70, *National Electrical Code*, Article 702, “Optional Standby Systems.” Connect all emergency loads to a separate emergency panel served from the

main service panel by a manual transfer switch. Document the generator size required to support design conditions. Place signage at the connection point designating proper generator size. Loads to be supported by the emergency generator include the following, as a minimum:

- Facility lighting (interior and exterior)
- Electric water heaters
- Gymnasium power
- Gymnasium HVAC system when a separate system is primarily serving the gymnasium
- Toilet and shower exhaust within locker rooms
- Public toilet exhaust

3-6.4.3 Telecommunication Systems.

See Chapter 4 for outlet locations.

3-6.4.4 Cable Television (CATV).

See Chapter 4 for outlet locations.

3-6.4.5 Electronic Security Systems (ESS).

Design the ESS in accordance with UFC 4-021-02, *Electronic Security Systems*. See Chapter 4 for locations and additional criteria. For all facilities identified to operate in the unmanned state, provide Common Access Card (CAC) -enabled entrances and provide duress alarm buttons accessible to patrons.

3-6.4.6 Closed-Circuit Television (CCTV).

Design the CCTV system in accordance with UFC 4-021-02. See Chapter 4 for locations and additional requirements.

For all facilities identified to operate in the unmanned state, provide CCTV cameras in public fitness center spaces and at access points with a connection to a local CCTV recording system.

3-6.4.7 Intercommunication and Public Address (PA) Systems.

See Chapter 4 for locations and additional criteria.

3-6.4.8 Receptacles.

See Chapter 4 for locations and additional criteria.

3-6.4.9 Emergency Medical Alert.

Provide a means of notification of a medical emergency event by using a latching dedicated blue mushroom-type switch connected directly to the transmitter device/panel used to send fire alarm signals to a fire alarm/security supervising station. Activation of the medical emergency mushroom switch will activate a separate signal via the transmitter to the fire station/security supervising station.

3-6.4.10 Lightning Protection System.

Install lightning protection systems for new facilities and existing facilities modifications in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems*.

3-7 FURNISHINGS AND EQUIPMENT.

Furnishings, fixtures, and equipment (FF&E) items are listed for specific spaces in Chapter 4. Fitness equipment includes all government-furnished, government-installed fitness equipment, including cardiovascular, strength training, and functional training items. These items are funded using the same source as FF&E but will be procured, installed, and coordinated by non-appropriated funds (NAF) via the fitness program management office.

3-8 SITE DESIGN AND ORGANIZATION.

Where possible, use outdoor spaces as transition spaces and for extended fitness uses, such as areas for runners and bicyclists and covered concrete pads for functional fitness equipment/apparatus. Provide a site design that feels safe for all authorized users. If located nearby, provide access paths to related functions such as outdoor running tracks, sports fields, open park space, or other outdoor activity areas.

3-8.1 Landscaping.

Refer to UFC 3-201-02, *Landscape Architecture*, and comply with stated and cross-referenced requirements for landscaping. Also comply with local installation landscape standards. Avoid plantings that require an irrigation system.

3-8.2 Parking and Access Drives.

Provide adequate parking for both staff and patrons with appropriate access drives.

Connect at least one of each site arrival point to an accessible building entrance using an accessible route. Provide bicycle racks near the facility entrance in a secure location. The total number of parking spaces to be constructed for a fitness center is based on a parking analysis of site conditions that considers factors such as available parking in the vicinity, access to public or government-furnished transportation, and location with respect to troop housing.

3-8.3 Service Drive.

Verify the size of required service vehicles prior to planning and designing the service access areas. Provide a back-up spur for dead-end and service drives that exceed 100 feet (30 m) in length. Provide access to the serviced areas: receiving and equipment repair area, recycling/garbage dumpster/storage (indoor or outdoor), mechanical room, and service entry, if one is designated. Provide a service vehicle apron and consolidate service access, when possible. Screen or separate the service area from public use or traffic areas with attractive walls, fences, depressions, berms, and landscaping. Comply with UFC 4-010-01. Ensure proper drainage if depressions are used. Do not cross outdoor activity areas with service access.

3-8.4 General Site Lighting.

Refer to UFC 1-200-01 and comply with stated and cross-referenced requirements for electrical systems. If the facility is near a flightline, site lighting cannot interfere with or be a distraction to aircraft movement at night.

3-9 SUSTAINABLE DESIGN.

Comply with UFC 1-200-02.

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CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-1 INTRODUCTION.

4-1.1 Design.

This chapter identifies the specific design needs for each functional area outlined in the space program. Tables 4-1 through 4-32 provide this data in a standard functional data sheet format.

4-1.2 Service-Specific Programmatic Differences.

Service-specific programmatic differences are indicated on the functional data sheets. Comply with agency requirements that apply to the project.

4-2 INTERIOR CONSTRUCTION SPECIALTIES.

The interior construction specialties, equipment, and furnishings criteria provided in these tables are broken down as follows:

4-2.1 Casework/Built-In Equipment.

This includes anything physically attached or plumbed to the building, such as counters, cabinets, casework, toilet accessories, fixed window treatments, and laundry machines.

4-2.2 Furnishings, Fixtures and Equipment (FF&E).

This includes contractor-furnished, contractor-installed loose items such as desks, tables, chairs, and bookshelves.

4-2.3 User-Provided Equipment.

This includes all government-furnished, government-installed items, which are typically limited to office equipment such as computers, printers, copiers, and flat panel displays (if mounted, the flat panel display mount will be built-in).

4-2.4 Fitness Equipment.

This includes all government-furnished, government-installed fitness equipment, including cardiovascular, strength training, and functional training items. These items are funded using the same source as FF&E but will be procured and installation-coordinated by NAF by the fitness program management office.

4-3 FUNCTIONAL DATA SHEETS.

These data sheets are available as a Microsoft® Word file for use during project execution. The file is downloadable from the Whole Building Design Guide (WBDG) website as an attachment to this UFC: **\1** http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-4-740-02 **/1/**

Table 4-1 Entry/Lobby and Waiting/Display

Description/ Usage	The lobby serves as the primary entrance to the facility for patrons, visitors, and spectators. The lobby must be open and friendly in design and serve to introduce the rest of the facility. Immediately adjacent to the lobby is the waiting/display area which provides an area for customers to relax and for the facility to display trophies and special activities and programs.
Min. Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls.** Provide a low-maintenance, durable finish with a wainscot. Provide painted gypsum wallboard or accent wall materials and color for visual interest. **Floor**. Provide a low-maintenance, durable, moisture- and slip-resistant finish suitable for this high-traffic area. Provide stained concrete, stone, terrazzo, or porcelain tile. Provide a walk-off mat/area at the entrance door that works integrally and flush with the adjacent finishes. Provide a base that matches the flooring or a vinyl or rubber base. **Ceiling**. Provide an identifying entry feature by creating custom ceiling using a combination of ceiling systems and/or a ceiling exposed to structure above.
Plumbing	Provide electric water cooler(s) near public toilets.
HVAC	Provide system per Chapter 3, "HVAC."
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Provide decorative and task lighting. Provide accent lighting at signage/wayfinding devices.
Communication	**CCTV.** Provide at least one outlet or as needed to cover the entrance and lobby. **CATV/Internal Video.** Provide a CATV outlet. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line. **Data.** Provide an outlet in the waiting/display area. **Security.** None required.
Casework/ Built-in Equipment	Provide display cases in this space.
Furnishings, Fixtures & Equip. (FF&E)	Waiting/display area must include durable, easy-to-clean, and moisture-resistant furniture; tables; magazine and brochure rack; tack surfaces; wall art; trophy case (if not built-in); and a wall clock. Provide a means to display installation and staff information. Provide a cell phone charging podium. Provide a self-use blood-pressure monitor.
User-provided Equipment	Computers and CCTV equipment.
Special Req.	Provide an airlock at the main entrance. Provide a grated snow-trap for Northern Tier bases.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-2 Control Counter/Equipment Issue/Storage

Description/ Usage	The control counter is often referred to as the front desk or reception desk. It's the focal point of information exchange within the building and is the check-in location for patrons; the check-in method may be located at the facility entrance or in the lobby to ensure all patrons check-in at entry. Do not use check-in/counting methods that restrict rapid access/egress to/from the facility, such as a turnstile. Equipment such as towels, balls, and racquetball rackets will be issued from the control desk. It must provide for direct supervision of the facility and greeting, informing, and directing patrons to their particular activity area. Additionally, the control desk serves as the focal point for safety and emergency situations. In smaller facilities, vending functions can be provided as an over-the-counter service at the control counter. Also see Table 4-3.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls**. Painted gypsum wallboard. Provide accent wall materials and color for visual interest. **Floor**. **In front of counter:** Provide a low-maintenance, durable, moisture- and slip-resistant finish suitable for this high-traffic area. Provide stained concrete, stone, terrazzo, or porcelain tile. Provide a base that matches the flooring or a vinyl or rubber base. **Behind counter**: Provide stained concrete, stone or porcelain tile, or carpet. Provide vinyl or rubber base. **Ceiling**. Acoustic ceiling panels (ACP). Use the ceiling to define and separate this area from the lobby, e.g., a dropped gypsum board soffit over the control desk and gypsum board false beams.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC."
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide power for all equipment per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Provide 30 fc (300 lx) of general ambient lighting. Provide fixed 50 fc (500 lx) task lighting at the control counter; decorative fixtures are preferred. In addition, provide accent lighting for emphasis around the counter area.
Communication	**CCTV.** All monitors must be viewable from this area. **CATV/Internal Video.** None required. **PA/Audio.** Provide PA and audio system controls at the control counter for room-by-room and "all call" communication. Provide intercom capability as directed by installation. Provide a speaker. **Telephone.** Provide one line per two points of sale (POS). Provide at least two additional general-purpose phone lines. In facilities that include a multipurpose field, provide a means for communication between the field kiosk and the control desk. **Data.** Data outlets must be provided for every piece of equipment identified as requiring data plus a 25% spare capacity for flexibility. Pieces of equipment include, but are not limited to, POS, computers, copier/printer/fax, and ID check system. **Security.** Provide a duress alarm with controls next to the POS units.

Casework/Built-in Equipment	Provide a 24-in. (610-mm) -deep counter with built-in cabinets. Provide file drawers and storage drawers with a minimum of two lockable drawers for each POS. The counter must be dual height for standing transactions, seated office functions, and ADA customer service. Note that ADA-height counter must have knee-hole space on both sides of the counter. The counter must be a durable solid surface material such as granite, concrete, or solid plastic; laminate is not permitted. Modesty panels and apron must be of durable materials. Provide a towel return drop opening in the counter top with space for a laundry cart below. The staff access to the counter must permit access to the free weight area for emergency response. Provide supports such as steel angle braces for counters with knee-hole space. Provide wall and base cabinets and an equipment counter. Storage must accommodate towels, small athletic equipment such as balls and rackets, and juice bar/vending supplies (if provided at the control counter). Provide flat panel display mount.
Furnishings, Fixtures & Equip. (FF&E)	Chairs and stools. Provide an automatic external defibrillator (AED).
User-provided Equipment	CCTV monitors, printers, scanner or swipe-card check-in device, and PA controls. POS units, desktop computer for administrative functions, and flat panel display.
Special Req.	Attendants at the control desk must have direct LOS visual control over the following: main entrance, free weight area, gymnasium entrance, locker room entrance, and climbing wall (if provided). Attendants must also have visual control (via LOS or CCTV) over the unit PT/group exercise rooms, the selectorized equipment, the cardio equipment, and structured activity areas. Air Force permits visual control of the locker room entrance via CCTV. For times when counter is not staffed: Provide a gate between the desk and surrounding area. Provide a coiling door or grille at the counter to serve as a security screen.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-3 Retail/Vending/Food and Beverage Sales

Description/ Usage	The retail/vending functions may be accommodated at the control counter. A juice bar or expanded retail functions will be provided in a separate area. Vending can also be provided at a self-service standalone space with vending machines. The vending area, if a standalone space, must be identifiable, visually screened but not totally enclosed, and visually accessible from the control desk. Space is considered optional for Navy.
Min. Ceiling Ht.	9 ft (2.74 m) minimum or matched with the lobby.
Finishes	**Walls**. Ceramic wall tile or other hard surfaces approved for food and beverage areas to a minimum of 4 ft (1.22 m) above finished floor (AFF). Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted surfaces. **Floor.** Provide hard-surface flooring matching lobby or corridor such as seamless vinyl, hard tile or other durable material. Use of VCT is not allowed in this area. **Ceiling.** ACP or painted gypsum board.
Plumbing	Two-compartment stainless steel countertop sink with hot and cold water supply and a clean-out. Provide floor drain. If an icemaker is desired, provide a water connection.
HVAC	Provide system per Chapter 3, "HVAC."
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Provide 40 fc (400 lx) of general ambient lighting. Provide 50 fc (500 lx) on food displays and at food preparation areas. Provide accent fixtures and lighting to provide special ambience.
Communication	**CCTV.** Provide quantity to allow adequate coverage. **CATV/Internal Video.** Provide an outlet at food and beverage area, if applicable. **PA/Audio.** Provide a speaker and intercom connection. **Telephone.** Provide one line per two POS. Provide at least one additional general-purpose phone line. **Data.** Provide one outlet per POS. Provide additional outlets, as needed, for associated hardware. **Security.** Provide duress alarm control next to the POS units.
Casework/ Built-in Equipment	Countertop with base and wall cabinets at the front opening. Behind the service corridor, provide base and wall cabinets. Sink-area countertop must be solid-surface. Drink rail. Dishwasher. Provide a lighted menu board (unless concessionaire operated). Option for under-cabinet microwave.
Furnishings, Fixtures & Equip. (FF&E)	Food and beverage/expanded retail: refrigerator, freezer, and other small appliances as required. In lieu of under-cabinet microwave, option for counter microwave. Provide ice maker and refrigerated display cases. Bistro-style tables and chairs.

User-provided Equipment	Provide CCTV cameras per the outlet count. Vending machines. POS unit(s).
Special Req.	Provide a means to secure the food and beverage sales/retail area. Provide a built-in safe per local policy.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-4 Laundry

Description/ Usage	The laundry accommodates cleaning and drying of towels and uniforms. Some installations contract out towel laundry; however, there is still a requirement to provide laundry for uniforms. Locate laundry adjacent to the control counter. It is preferred that the location be on an outside wall for ease of pick-up service.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted CMU or mold-resistant gypsum wallboard. Provide durable finishes, rub rails, and metal/high-impact plastic corner guards. **Floor.** Sealed concrete, porcelain tile, or seamless vinyl. **Ceiling.** None, vinyl-faced ACP, or epoxy painted mold-resistant gypsum wallboard.
Plumbing	Provide hot and cold water and drain connections in recessed washer outlet box to each of the washing machines and one laundry sink. Provide floor drains. Provide connections and floor drain to an ice machine, if provided. Coordinate ice machine floor drain location with equipment.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 76 °F (24 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Laundry Rooms, Central." Provide separate vents for each dryer and vent dryers per UFC 3-410-01.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Regardless of size, enclose laundry rooms with a 1-hour fire barrier.
Power	Provide outlets per Chapter 3, "Electrical." Provide a dedicated circuit for each washer (or washer extractor) and for each dryer (or dryer tumbler). If hard-wired (non-plug-connected), provide wall-mounted safety disconnect switch within sight of the equipment it controls.
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. Provide one speaker. **Telephone**. None required. **Data**. None required. **Security.** Provide lockable doors.
Acoustics	Provide partition construction with a minimum STC rating of 52 per Chapter 3, “Acoustics.”
Casework/ Built-in Equipment	Provide a built-in folding table and shelves for clean towel storage.
Furnishings, Fixtures & Equip. (FF&E)	Provide storage shelves (freestanding) for laundry supplies. Laundry carts, and commercial grade washers/dryers.
User-provided equipment	None required.

Special Req.	Provide easy access to rear of dryers (or tumblers) to allow maintenance and cleaning of vents (see HVAC). Provide space for storage of laundry carts. Coordinate door openings and dimensions with room layout and equipment sizes, e.g., laundry carts, washers/extractors, dryers/tumblers, and ice machines. Provide acoustical measures to control the noise/vibration of the washers/extractors and dryers/tumblers. The laundry room must not be visible from the lobby area.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-5 Public Toilets/Janitor's Closet

Description/ Usage	These toilet rooms are used primarily by visitors, spectators, and persons not using the locker and shower rooms. They must be adjacent to the lobby and gymnasium. Provide unisex or separate male, female, and gender-neutral restrooms depending on the total number of patrons to be accommodated.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls**. Epoxy or semi-gloss enamel painted mold-resistant gypsum wallboard with a ceramic tile wainscot. Prefer full-height ceramic tile walls with integral patterns, especially on wet walls. Use a dark-colored epoxy grout. **Floor**. Non-slip porcelain tile with dark-colored epoxy grout. Slope tile to drain. **Ceiling**. Semi-gloss enamel or epoxy painted mold-resistant gypsum wall board.
Plumbing	Provide wall-hung water closets, wall-hung urinals and lavatories based on the applicable UFC 3-420-01 requirements for the calculated occupancy of the gymnasium. Provide a floor drain.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 70 °F (21 °C) to 78 °F (26 °C). Exhaust per UFC 3-410-01.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. Provide a speaker. **Telephone**. None required. **Data**. None required. **Security**. Provide lockable doors.
Casework/ Built-in Equipment	Solid-surface countertop with either underhung or integral sink. Solid composite toilet and urinal partitions. Toilet accessories: Toilet paper dispensers, paper towel dispenser with integral trash receptacle, robe hooks, grab bars, sanitary napkin disposal (female water closet stalls), seat cover dispensers, and soap dispensers. Mirror. Provide electric hand dryers. Fold-down diaper-changing table/station in male, female, and gender-neutral toilets.
Furnishings, Fixtures & Equip. (FF&E)	Lockable cabinets for cleaning supplies at janitor's closet.
User-provided Equipment	None required.
Special Req.	Provide a janitor's closet associated with or in proximity of these toilets. This closet includes a floor mop sink with hot and cold water and a hose connection, a floor drain, and storage for pails, mops, vacuums, and related cleaning supplies and equipment. Include a lockable door (which can be opened from the inside). Exhaust per UFC 3-410-01.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-6 Parent/Child Area

Description/ Usage	The parent/child area is optional. This option provides parents/guardians a venue in which to exercise while maintaining direct visual control over their child. Part of the room has exercise equipment for the parent to use while the other part is designated for the children. The two areas must be divided by a 30-in. (760-mm) high, 0.5-in. (13-mm) thick, clear, shatterproof Plexiglas partition to ensure the parent can see the child at all times. Include a centrally located entry/exit in the partition**.**
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls**. Semi-gloss painted gypsum wallboard. **Floor**. Homogeneous resilient sheet flooring with scuff-resistant properties and maintenance consisting of damp mop, no wax, buff only, and resilient base. Exercise area must include permanently adhered resilient athletic flooring consisting of dual durometer layers of natural and synthetic rubbers, calendared and vulcanized together. The top layer is a non-porous, slip-resistant, textured surface; the bottom layer is a cushioned performance layer. Total thickness to be 3/8 in. (9 to 10 mm). Athletic flooring system cannot be accommodated by interlocking flooring tiles or movable furnishings such as mats. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Health club/weight rooms."
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical," in the child area. For safety of the children, the top of the electrical outlet boxes must be 54 in. (1350 mm) AFF. Provide flush-floor outlets for commercial-grade fitness equipment and outlets for wall- or ceiling-mounted flat panel display in the fitness area.
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV.** Provide outlets to ensure adequate coverage. **CATV/Internal Video.** Provide an outlet in the fitness area. **PA/Audio.** Provide a speaker. Provide an emergency call/alarm that sounds at the control counter until reset by the respondent. **Telephone.** Provide an outlet. **Data.** Provide an outlet. **Security.** Provide lockable doors.
Casework/ Built-in Equip.	Child area to include storage cabinet for children's games and toys. Flat panel display universal wall mount.
Furnishings, Fixtures & Equip. (FF&E)	**Child area**: Provide child-sized tables, chairs, and games. Provide exercise mat. **Fitness area**: Provide fitness equipment.
User-provided Equipment	Flat panel display.

Special Req.	Mar-resistant Plexiglas partition of shatterproof, 30-in. (750-mm) high, 0.5-in. (13-mm) thick, and clear to ensure the parent can see the child at all times. Include a centrally located entry/exit in the partition. Provide vision panel in the door and side lites.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customer. Adults. Children.
Min. net ft^2 (m^2)	

Table 4-7 Receiving and Equipment Repair/Storage

Description/ Usage	Provides an area to store, assemble, and repair fitness equipment. It will also be used to store overflow from the control counter/equipment issue storage, such as large or seasonal items. This area is adjacent to the fitness areas. There is an option for additional storage for optional programmatic items (such as a boxing ring). If required, this space will usually be part of/adjacent to the receiving and equipment repair area.
Min. Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls.** Durable materials such as CMU with heavy-duty epoxy paint. **Floor.** Sealed concrete. **Ceiling.** None. Paint the exposed structure.
Plumbing	Provide a utility sink with hot and cold water connections and a floor drain.
HVAC	Provide system per Chapter 3, "HVAC."
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide additional outlets at the work bench.
Lighting	Provide system per Chapter 3, "Electrical." Provide 30 fc (300 lx) of general ambient lighting. Provide 50 fc (500 lx) task lighting at the work bench.
Communication	**CCTV**. Provide one outlet. **CATV/Internal Video**. None required. **PA/Audio**. Provide a speaker. **Telephone**. Provide one line with internal two-way communication. **Data**. Provide one outlet. **Security**. Provide lockable doors, a door alarm, and exterior door bell.
Casework/ Built-in Equipment	None required.
Furnishings, Fixtures & Equip. (FF&E)	Provide adequate shelving, bins, and open-end cubicles for storage of athletic equipment for both in- and out-of-season supplies. Provide workbenches and lockable tool and parts storage cabinet.
User-provided Equipment	None required.
Special Requirements	Provide a pair of locking exterior double doors, 4 ft (1.22 m) wide by 9.5 ft (2.9 m) tall each, with flush sills, to facilitate movement of equipment. Provide an interior pair of locking double doors, 4 ft (1.22 m) wide by 9.5 ft (2.9 m) each, to facilitate movement of equipment. Do not combine this space with mechanical or electrical rooms.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-8 Administrative Offices

Description/ Usage	The administrative offices consist of a mix of private and open office space. The quantity and type of offices are facility-specific. Generally speaking, the following office spaces are provided: director's office, program managers' office(s), and support staff workstations. The offices must be free from frequent distraction, have a professional appearance, and provide a sense of workplace.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted gypsum wall board or wall covering. **Floor**. Carpet tile with resilient base. **Ceiling**. ACP.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 76 °F (24 °C).
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Ensure an adequate number of circuits to power all equipment.
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV.** Provide monitoring capability in the director's office when directed by the installation. **CATV/Internal Video:** One outlet required for director's office. **PA/Audio:** Provide a speaker. Provide controls in the director's office with room-by-room and "all call" communication. Provide intercom capability as directed by installation. **Telephone.** Provide one line per staff plus one additional line for fax and copier. **Data.** Provide one outlet per staff plus one outlet for each printer, copier, and scanner. **Security.** Provide lockable area for fitness access DVRs.
Acoustics	Provide partition construction with a minimum STC rating of 45 per Chapter 3, "Acoustics." If possible, do not locate these offices near noisy spaces as defined in Chapter 3, "Acoustics."
Casework/Built-in Equipment	Provide dry-erase boards in select offices.
Furnishings Fixtures & Equipment (FF&E)	Private offices—provide furniture for 120 ft^2 (11 m^2) or 100 ft^2 (9.3 m^2) office: desk, credenza, filing cabinet, desk chair, and two side chairs. Workstations—provide furniture for 64 ft^2 (6 m^2) workstation: desk chair and side chair for open offices. Workstation layout must provide adequate space for filing and overhead storage.
User-provided Equipment	Computers and other office equipment. Provide safe (for cash funds).
Special Requirements	For the director's office, provide an interior window with blinds to accommodate visual supervision over the fitness area and the control counter, where possible. Where possible, locate offices on exterior wall and provide windows for natural light admission. Provide shades or blinds at exterior windows for light control. Provide side lites next to the office doors for supervision and security.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-9 Classrooms/Training Rooms

Description/ Usage	This space is used for conducting training and large meetings. This space must be accessible from administrative areas and public circulation spaces. Classroom sized for 25 persons at 750 ft^2 (69.7 m^2) for small facilities, 50 persons at 1,500 ft^2 (139.4 m^2) for medium and large, and 75 persons at 2,250 ft^2 (209.0 m^2) for extra-large and jumbo facilities.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted gypsum wallboard or wall covering. **Floor.** Carpet tile is preferred. Other acceptable materials include stone, terrazzo, porcelain tile, stained concrete, or other hard tile. VCT is not allowed. **Ceiling**. ACP.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC."
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical," and additional outlets necessary to operate portable and dedicated equipment.
Lighting	Provide per Chapter 3, "Electrical," and include multiple light levels with controls for viewing multimedia presentations.
Communication	**CCTV.** Provide outlets as required for coverage. **CATV/Internal Video.** Provide one outlet. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line. **Data.** Provide a minimum of two outlets. Provide additional outlets for training purposes. **Security.** Provide lockable doors.
Acoustics	Provide partition construction with a minimum STC rating of 49 per Chapter 3, "Acoustics." If possible, do not locate this room near noisy spaces as defined in Chapter 3, "Acoustics."
Casework/ Built-in Equipment	Provide a universal flat panel display mount. Provide solid-surface countertop. Provide lockable wall and base cabinets. Bulletin board with tack surface and dry-erase board.
Furnishings Fixtures & Equipment (FF&E)	Provide tables and chairs. Provide A/V cart, podium/lectern.
User-provided Equipment	CCTV equipment, flat panel display, printer, and DVD player.
Special Requirements	Provide a lockable storage closet with built-in shelves for training materials and floor space for AV cart. Provide a vision panel, minimum 5 ft^2 (0.46 m^2), in the door. For medium-size facilities and larger, provide an acoustical operable partition with minimum STC of 45. The operable partition is to recess into an alcove when in open position. Provide two separate entrances.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-10 Copy/Work/Break Room

Description/ Usage	This space is used as a staff workroom for copying, meetings, breaks, and lunches. Provide isolated alcove or separate space for copy/workroom.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted gypsum wall board or wall covering. **Floor.** Provide hard-surface flooring matching corridor, such as seamless vinyl, hard tile, or other durable material. **Ceiling.** ACP.
Plumbing	Provide a two-compartment stainless-steel countertop sink with hot and cold water. Provide a cold-water connection for refrigerator ice maker.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 76 °F (24 °C).
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide one additional outlet at counter height for convenience. Provide additional outlets necessary to operate dedicated equipment.
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line. **Data.** Provide outlets as required for equipment. **Security.** Provide lockable doors.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Provide two separate solid-surface countertops: one for food/break functions and one for administrative functions. Provide lockable wall and base cabinets. Bulletin board with tack surface and dry-erase board.
Furnishings Fixtures & Equipment (FF&E)	Provide table, chairs, microwave, coffee machine, and refrigerator.
User-provided Equipment	Copier/fax/printer and laminating machine.
Special Requirements	Locate copy/work/break room on exterior wall and provide windows for natural light admission. Provide a vision panel in the door.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-11 Men's and Women's Lockers/Dressing

Description/ Usage	Separate men's and women's locker/dressing rooms will be used by those participating in fitness/sports activities for changing, dressing, and securing personal effects. It is open and directly adjacent to the toilet/shower facilities. As such, moisture and humidity must be addressed in the locker/dressing rooms.
Min. Ceiling Ht.	10 ft (3.05 m) minimum except where furred down at soffits.
Finishes	**Walls.** Epoxy or semi-gloss enamel painted CMU or mold-resistant gypsum wallboard. **Floor.** Non-slip porcelain tile with dark-colored epoxy grout. Slope tile to drain. **Ceiling.** High-humidity-rated, vinyl-faced ACP with a corrosion-resistant supporting grid or mold-resistant gypsum wallboard with a veneer plaster (level 5) finish and semi-gloss paint.
Plumbing	Provide and locate floor drains as required to ensure proper drainage and no standing water on the floor (this is particularly important in facilities with a pool). Provide an electric water cooler.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 70 °F (21 °C) to 78 °F (26 °C). Provide supply air from the dry side of this space (opposite the adjacent toilet/shower wet side) and exhaust from the wet area. Exhaust per UFC 3-410-01. Limit relative humidity to under 50% through the use of humidistats. Provide multi-speed ceiling fans with wall-mounted controls (not required to be HVLS fans).
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Where shower spaces are open to the locker room area, provide corrosion-resistant sprinkler and escutcheons such as stainless steel throughout the locker room.
Power	Provide outlets per Chapter 3, "Electrical." Provide counter-height outlets at the vanity area. Provide power to the hair dryers identified in the built-in equipment. Provide outlets where flat panel displays are required; provide at height of flat panel display.
Lighting	Provide system per Chapter 3, "Electrical." Lighting fixtures must have translucent, damp location, non-breakable, protective covers. Minimize shadowing at face of lockers.
Communication	**CCTV**. None required. **CATV/Internal Video**. Provide CATV outlets for wall or ceiling mounts. **PA/Audio**. Provide PA speakers as needed for full coverage. Provide speakers for the separate audio system. Provide an emergency call/alarm. **Telephone**. None required. **Data**. None required. **Security**. None required.
Acoustics	No special provisions required.

Casework/ Built-in Equipment	Provide solid plastic (HDPE) lockers and benches. Lockers must be a minimum of 15-in. wide by 24-in. deep (375 mm by 600 mm) with integral minimum 16-in. (400-mm) -wide benches (usually part of the locker system). Five percent of lockers must be accessible. Accessible benches are required to be adjacent to accessible lockers. Benches must have a minimum of 20 in. (500 mm) to maximum 24 in. (600 mm) in depth; 42 in. (1050 mm) minimum in length; seat height of 17 to 19 in. (425 to 475 mm) above the floor. Typically provide a mix of full- and half-sized Z-shaped lockers; provide 2 half-height lockers and 1 full-height locker in every 2 spaces. The location's climate determines the ratio of half- to full-sized lockers: Colder climates will require a higher percentage (or 100%) of full-sized lockers to accommodate bulkier cold weather gear. Provide shelves and hooks for coats and hats inside lockers. Steel lockers are not permitted. Mount lockers at a level above the floor to ensure operating hardware is easily reachable. Provide padlock or touch combination hardware. Provide a vanity area with a counter and mirror. Provide wall-mounted hair dryers adjacent to this area. Provide one hair dryer for every three shower heads for men and one hair dryer for every two shower heads for women. Provide a full-height wall mirror.
Furnishings, Fixtures & Equip. (FF&E)	Provide a scale and a wall clock.
User-provided Equipment	Provide blood pressure monitor and flat panel display.
Special Requirements	Provide dropped gypsum board soffits over lockers or utilize sloped-top lockers to preclude the tops of the lockers being used for storage. Design the space to block direct views from the public areas in. Consider providing natural light via frosted skylights or translucent wall building materials.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-12 Men's and Women's Showers

Description/ Usage	These separate male and female areas are directly adjacent to (and may be open to) the corresponding gender's locker/dressing and toilet areas and include private shower and adjacent drying stalls. If the facility includes a pool, the pool entry/exit must be adjacent to this area. Other adjacent functions may include sauna and/or steam room. Shower compartment construction options include constructed separation walls, field-assembled pre-manufactured shower partitions and pre-manufactured solid surface shower compartments. Shower counts are programmed per installation.
Min. Ceiling Ht.	9 ft (2.74 m) minimum
Finishes	**Walls.** Full height ceramic tile with dark-colored epoxy grout on cementitious backer units. **Floor.** Non-slip porcelain tile with dark-colored epoxy grout. Slope tile to drain. **Ceiling.** Mold-resistant gypsum wallboard with a veneer plaster (level 5) finish and epoxy paint.
Plumbing	Provide minimum 42-in. (1068-mm) -wide private shower/drying stalls for men and women. Provide a minimum of one floor drain at each shower stall and additional drains as needed to ensure proper drainage.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 70 °F (21 °C) to 78 °F (26 °C). Provide supply air from the dry side (adjacent locker/dressing area) and exhaust from the wet (toilet/shower) area. Exhaust per UFC 3-410-01. If constructed separation walls are used from floor to ceiling, locate exhaust outlets in each space.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Provide corrosion-resistant sprinklers and escutcheons such as stainless steel throughout the shower area.
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Provide recessed fixtures with sealed lenses, rated for wet applications.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. Provide an emergency call/alarm. **Telephone.** None required. **Data.** None required. **Security.** None required.
Casework/ Built-in Equipment	Solid plastic (HDPE) shower partitions secured at floor, wall, and ceiling or provide permanent walls between showers; see **Finishes** for wall finish. Provide fixed solid plastic benches at drying areas at least 16 in. (400 mm) wide. Provide hooks or towel pins on wall in drying area. Provide swim mats or tiles that are textured, anti-slip, self-draining, and raise the walking surface above standing water. If the facility includes a pool, provide a swimsuit spin-dry unit.
Furnishings, Fixtures & Equip. (FF&E)	None required.
User-provided Equipment	None required.
Special Requirements	Design the space to block direct views from the public areas into the shower room areas. Provide natural light via frosted skylights or translucent wall building materials.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-13 Men's and Women's Toilets

Description/ Usage	Separate men's and women's toilet facilities are open and directly adjacent to the corresponding gender's locker/dressing and shower areas.
Min. Ceiling Ht.	9 ft (2.74 m) minimum
Finishes	**Walls.** Full-height ceramic tile with dark-colored epoxy grout on cementitious backer units at wet walls and ceramic tile wainscots at fixture areas. Epoxy or semi-gloss painted, mold-resistant gypsum wallboard elsewhere. **Floor.** Non-slip porcelain tile with dark-colored epoxy grout. Slope tile to drain. **Ceiling.** Vinyl-faced ACP or mold-resistant gypsum wallboard with a veneer plaster (level 5) finish and semi-gloss paint.
Plumbing	Provide wall-hung water closets, wall-hung urinals and lavatories based on the applicable UFC 3-420-01 requirements for the calculated occupancy of the facility. Provide floor drains to fully drain area.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 70 °F (21 °C) to 78 °F (26 °C). Provide supply air from the dry side of this space (adjacent locker/dressing area) and exhaust from the wet area (toilet/shower). Exhaust per UFC 3-410-01. Limit relative humidity to under 50% through the use of humidistats.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Where shower spaces are open to the toilet area, provide corrosion-resistant sprinklers and escutcheons such as stainless steel throughout the toilet room.
Power	Provide outlets per Chapter 3, "Electrical," Provide GFCI outlets at lavatory at counter height.
Lighting	Provide system per Chapter 3, "Electrical." Lighting fixtures must have translucent, damp location, non-breakable protective covers with shatterproof lens. Provide lighting directly over lavatories and grooming counters and minimize reflection glare in the mirrors in the overall lighting design.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. Provide an emergency call/alarm. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Solid-surface countertop supported at both ends and with the front edge supported by galvanized angle reinforcing. Use holes in lavatory countertop for waste disposal; coordinate location of paper towel dispenser. The sink may be either undermount or integral with the counter. Solid plastic (HDPE) toilet and urinal partitions secured at floor and ceiling. **Toilet accessories**: Toilet paper dispensers, paper towel dispenser, trash receptacle, robe and towel hooks, grab bars, feminine hygiene receptacles in women's water closets, seat cover dispensers, and soap dispensers at lavatories. Provide wall-mounted shelves and full-width mirror at the lavatories. Provide a full-length mirror. Provide electric hand dryers.

Furnishings, Fixtures & Equip. (FF&E)	None required.
User-provided Equipment	None required.
Special Requirements	Design entrances to prevent direct views into this area. Provide natural light via frosted skylights or translucent wall building materials.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-14 Unisex Changing Room/Unisex Locker Room

Description/ Usage	This space provides separate, individual rooms equipped with changing area, shower, toilet, sink, diaper changing table, and lockers intended as a single-use facility for adults with or without small children. Locate near the pool (if provided) or near the parent/child area. Allow for unisex locker units to be used independently from unisex changing rooms.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** See Tables 4-11, 4-12, and 4-13 for the appropriate finishes. **Floor**. See Tables 4-11, 4-12, and 4-13 for the appropriate finishes. **Ceiling**. See Tables 4-11, 4-12, and 4-13 for the appropriate finishes.
Plumbing	Provide shower, wall-hung water closet, and lavatory. Provide a minimum of one floor drain in shower, one general floor drain, and additional drains as needed to ensure proper drainage.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 70 °F (21 °C) to 78 °F (26 °C). Exhaust per UFC 3-410-01. Limit relative humidity to 50% through use of humidistats.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Where shower spaces are open to the locker room area, provide corrosion-resistant sprinklers and escutcheons such as stainless steel throughout the locker room.
Power	Provide outlets per Chapter 3, "Electrical." Provide counter-height GFCI outlets at the lavatory.
Lighting	Provide system per Chapter 3, "Electrical." Lighting fixtures must have translucent, damp location, non-breakable protective covers. Minimize shadowing at face of lockers. Provide lighting directly over lavatory to minimize reflections and glare in the mirrors. In the shower, provide recessed fixtures with sealed lenses, rated for wet applications.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. Provide an emergency call/alarm. **Telephone.** None required. **Data.** None required. **Security.** Provide lockable doors.
Casework/ Built-in Equipment	See Tables 4-11, 4-12, and 4-13 for the appropriate casework.
Furnishings, Fixtures & Equip. (FF&E)	See Tables 4-11, 4-12, and 4-13 for the appropriate FF&E.
User-provided Equipment	None required.
Special Requirements	See Tables 4-11, 4-12, and 4-13 for the appropriate special requirements.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-15 Steam Room

Description/ Usage	**Note:** This space is not supported by the Navy. The optional steam room must have an adjacent cool-down space and direct access to the shower spaces and the locker spaces. It provides a warm, extremely humid (close to 100%) environment for therapy and relaxation. Provide separate male and female rooms as part of or adjacent to male and female toilet and shower facilities.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Full-height ceramic tile with dark-colored epoxy grout. **Floor**. Non-slip ceramic. **Ceiling**. Tile: pitched for drainage down the walls.
Plumbing	Provide a cold-water shower with a rope pull-chain. Provide floor drains. Provide access to a keyed hose bibb with hot and cold water.
HVAC	Temperature operating range: 100 °F (38 °C) to 110 °F (43 °C). Humidity 100% relative. Provide secured controls.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Provide high-temperature-rated corrosion-resistant sprinklers and escutcheons such as stainless steel throughout the steam room. Fire alarm notification appliances are not required within the steam room. Provide an audible and visual fire alarm notification appliance on the wall directly opposite the entry door into the steam room, with a minimum sound power of 95 dB at 10 ft (3 m) and 110 cd. At a minimum, provide a 100 $in.^2$ (.06 m^2) vision panel within the entry door into the steam room.
Power	None required.
Lighting	35 fc (375 lx). General ambient lighting. Lighting fixtures must have translucent, moisture-resistant, non-breakable protective covers.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker in the adjacent cool-down area. Provide an emergency call/alarm in the steam room that sounds at the control counter. **Telephone.** None required. **Data.** None required. **Security.** None required.
Casework/ Built-in Equipment	Provide ceramic tile benches in a single- or double-tiered arrangement.
Furnishings, Fixtures & Equip. (FF&E)	Provide wall-mounted clock visible from steam room.
User-provided Equipment	None required.
Special Requirements	An adjacent cool-down space can serve the steam room, sauna (if provided), and hot tub (if provided). It must have a bench with wall-mounted clothing/towel hooks. Provide a full-glass door with a door seal adequate to retain the steam within the room. Provide steam generator in an adjacent closet.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-16 Sauna

Description/ Usage	**Note:** This space is not supported by the Navy. The optional sauna must have an adjacent cool-down space and direct access to the shower and locker spaces. It provides a very hot, dry environment for therapy and relaxation. Provide separate male and female rooms as part of or adjacent to male and female toilet and shower facilities. Providing a prefabricated, packaged unit is acceptable.
Min. Ceiling Ht.	8 ft (2.44 m) minimum.
Finishes	**Walls.** CMU with either redwood or cedar panels. **Floor**. Sealed concrete with removable redwood tile "mats." **Ceiling**. Redwood or cedar panels.
Plumbing	Provide a floor drain.
HVAC	Provide a separate dry heat system with individual temperature controls and a timer to achieve 170 °F to 180 °F (77 °C to 82 °C) with 5% relative humidity. Provide secure controls. Provide passive ventilation to achieve four air changes/hour.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Provide high-temperature-rated corrosion resistant sprinklers and escutcheons such as stainless steel throughout the sauna. Fire alarm notification appliances are not required within the sauna. Provide an audible and visual fire alarm notification appliance on the wall directly opposite the entry door into the sauna, with a minimum sound power of 95 dB at 10 ft (3 m) and 110 cd. At a minimum, provide a 100 in.^{2} (0.6 m^2) vision panel within the entry door into the sauna.
Power	Provide a dedicated circuit for the heat source.
Lighting	Provide 10 fc (100 lx) of general ambient lighting. Lighting fixtures must be rated for wet applications, with ambient temperature rating of at least 180 °F (82 °C).
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. Provide an emergency call/alarm mounted within 36 in. (900 mm) of finished floor that sounds at the control counter until reset by the respondent. **Telephone.** None required. **Data.** None required. **Security.** None required.
Casework/ Built-in Equipment	Provide solid board cedar or redwood benches. One bench must meet ABA requirements. Provide a wall-mounted room temperature and humidity gauge. Provide hooks.
Furnishings, Fixtures & Equip. (FF&E)	Provide a water tub and ladle for wet sauna. Provide a wall-mounted clock in this area that is visible from the sauna room.
User-provided Equipment	None required.
Special Requirements	Provide an insulated door with a vision panel and seals to maintain temperature. Minimize exposed metal hardware. Ensure no exposed metal fasteners on the benches. Use plastic or wood interior door handle. An adjacent cool-down space can serve the sauna, steam room (if provided), and hot tub (if provided). It must have a bench with wall-mounted clothing/towel hooks.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-17 Massage Room

Description/ Usage	The optional massage room provides a private space for massage service. It is preferred to be adjacent to the locker/shower facilities.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted gypsum wall board. **Floor.** Non-slip porcelain tile with dark-colored epoxy grout or resilient flooring with resilient base or porcelain tile. **Ceiling.** ACP.
Plumbing	Provide a hand-wash sink with hot and cold water connections. Provide floor drain.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 72 °F (22 °C) to 78 °F (26 °C). Provide independent thermostat.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Provide 50 fc (500 lx) with indirect light fixtures and provide continuous dimming capability.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. Provide an emergency call/alarm that sounds at the control counter until reset by the respondent. **Telephone.** Provide one line. **Data.** None required. **Security.** Provide lockable doors.
Acoustics	Provide partition construction with a minimum STC rating of 45 per Chapter 3, "Acoustics." If possible, do not locate this room near noisy spaces as defined in Chapter 3, "Acoustics."
Casework/ Built-in Equipment	Provide clothes hooks.
Furnishings, Fixtures & Equip. (FF&E)	Provide a securable storage cabinet for supplies such as sheets, towels, and massage oil. Unless operated by a concessionaire, provide the following: height-adjustable massage table with adjustable head rest; adjustable-height wheeled stool for the therapist; massage chair in addition to or in lieu of the massage table; small table for making and verifying appointments.
User-provided Equipment	None required.
Special Requirements	None required.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-18 Hot Tub

Description/ Usage	**Note:** This space is not supported by the Navy. The optional hot tub must have direct access to the shower and locker spaces and be adjacent to the steam room, if provided. It provides a hot pool of water with powered jets of water for therapy and relaxation. May provide separate male and female rooms as part of or adjacent to male and female toilet and shower facilities or provide a single room for use by both men and women.
Min. Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls**. Water-resistant surface. **Floor**. Slip-resistant ceramic tile, no larger than 1 by 1 in. (25 by 25 mm) tiles with dark epoxy grout. **Ceiling**. Water-resistant surface.
Plumbing	Provide a floor drain.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 72 °F (22 °C) to 78 °F (26 °C). Provide minimum six air changes per hour.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Provide corrosion-resistant sprinklers and escutcheons such as stainless steel throughout the hot tub area.
Power	Provide waterproof outlets. Provide dedicated power for the water pump with a timer-operated pump switch with patron access.
Lighting	Provide waterproof fixtures.
Communication	**CCTV.** Provide outlets as required for coverage if the facility is shared by men and women. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. Provide an emergency call/alarm that sounds at the control counter. **Telephone.** None required. **Data.** None required. **Security.** Provide lockable area for when fitness access is in use.
Casework/ Built-in Equipment	Provide clothes hooks, seating bench, and handrail for entrance/exit of pool.
User-provided Equipment	CCTV equipment.
Furnishings, Fixtures & Equip. (FF&E)	Provide freestanding shelving unit for towels and a wall clock. Provide a chemical storage cabinet.
Special Requirements	Provide a whirlpool tub with a dedicated water supply, water filter, hot water heater, and water pump. Provide an emergency shut-off control for the whirlpool. Provide an adjacent dry-off/dressing area. Provide corrosion-resistant materials for hardware, AC ducts, AC registers, and door frames.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-19 Convertible Locker Space

Description/ Usage	**Note:** This space is not supported by the Navy. This optional space for large or extra-large facilities provides locker/dressing space that can be converted to male or female space, as needed, to accommodate tournaments and/or changing demographics. It is a separate room between the male and female locker rooms with double-locked doors into each. The criteria generally follow that in Table 4-11 for the locker/dressing area. This is not additional locker space and will need to be deducted from the overall calculated locker space for the facility.
Min. Ceiling Ht.	10 ft (3.05 m) minimum except where furred down.
Finishes	**Walls.** Epoxy or semi-gloss enamel painted CMU or mold-resistant gypsum wallboard. **Floor.** Non-slip porcelain tile with dark-colored epoxy grout. Slope tile to drain. **Ceiling.** High humidity-rated, vinyl-faced ACP with a corrosion-resistant supporting grid or mold-resistant gypsum wallboard with a veneer plaster (level 5) finish and semi-gloss paint.
Plumbing	Provide floor drains. Provide an electric water cooler.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 70 °F (21 °C) to 78 °F (26 °C). Exhaust per UFC 3-410-01. Control exhaust to unoccupied exhaust rate of 0.06 cfm/ft^2 (0.0183 m^3/min./m^2) when space is unoccupied. Limit relative humidity to under 50% through the use of humidistats. May provide ceiling fans with wall-mounted controls.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide counter-height outlets at the vanity area.
Lighting	Provide system per Chapter 3, "Electrical." Lighting fixtures must have translucent, damp location, non-breakable protective covers. Minimize shadowing at face of lockers.
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide an outlet. **PA/Audio.** Provide a speaker. Provide an emergency call/alarm. **Telephone.** Provide one line. **Data.** None required. **Security.** Provide lockable doors.
Casework/ Built-in Equipment	Provide solid plastic (HDPE) lockers and benches. Lockers must be a minimum of 15 in. wide by 24 in. (375 mm by 600 mm) deep with integral minimum 16-in. (400-mm) -wide benches (usually part of the locker system). These lockers are daily use only (not rented). Typically provide a mix of full- and half-sized Z-shaped lockers. The location's climate will determine the ratio of half- to full-sized lockers: colder climates will require a higher percentage (or 100%) of full-sized lockers to accommodate bulkier cold weather gear. Steel lockers are not permitted. Mount lockers at a level above the floor to ensure operating hardware is easily reachable. Provide a vanity area with a counter and mirror. Provide wall-mounted hair dryers adjacent to this area. Provide one hair dryer for every two shower heads. Provide shelves and hooks for coats and hats. Provide a full-height wall mirror.

Furnishings, Fixtures & Equip. (FF&E)	None required.
User-provided Equipment	None required.
Special Requirements	The doors in to the male and female locker/dressing area must be keyed from both sides. Provide dropped gypsum board soffits over lockers or utilize sloped top lockers to preclude the tops of the lockers being used for storage.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-20 Gymnasium/Basketball/Volleyball Courts

Description/ Usage	This space is used for team activities and sports competitions such as basketball and volleyball. Multiple court gymnasiums with divider curtains can accommodate simultaneous activities. The gymnasium can also support instructional functions, informal, intramural, and extramural sports as well as community events. Court size must meet NCAA standards. **\1** See Appendix D of this UFC for a link to the NCAA basketball court diagram. **/1/**
Min. Ceiling Ht.	28 ft (8.53 m) clear height below structure and lights.
Finishes	**Walls.** Provide durable wall system up to 12 ft (3.66 m) in height, such as CMU with heavy-duty epoxy. Above 12 ft (3.66 m), use semi-gloss enamel and acoustic panels. **Floor.** Maple athletic flooring, 25/32 in. (19.8 mm) thick. Synthetic multipurpose, resilient, athletic flooring may be allowed when requested by the installation. Flooring must meet DIN standards for the specified function per *ACSM's Health/Fitness Facility Standards and Guidelines*; however, where primary space use is basketball, minimum ball rebound must be 93%. **Ceiling.** Exposed, painted structure. Provide acoustical banners, baffles, panels, or similar treatment**.**
Plumbing	No plumbing fixtures in the gymnasium. Ensure access to nearby electric water coolers.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Gym, sports arena (play area)." Provide durable air grill covers and do not place air grills in line with basketball nets. Locate ductwork to avoid trapping balls.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety," inclusive of protection from mechanical damage. Provide protection for sprinklers, exit signs, manual pull stations, and other exposed components; minimize equipment that protrudes into activity space or safety zones near activity spaces. Install component equipment (except manual pull stations) minimum 8 ft (2.44 m) AFF for safety considerations. Provide manual pull stations with protective covers. Provide upright sprinklers with head guards.
Power	Provide outlets per Chapter 3, "Electrical." Provide power for the scoreboard, shot clocks, and a high, wall-mounted clock. Provide power requirements for other functions such as retractable backboards, divider curtain, and stage sound and lighting. Provide recessed floor outlets to power portable equipment used to officiate games. Locate power outlets along sidelines at center court.
Lighting	Provide system per Chapter 3, "Electrical." Provide lighting levels for basketball in accordance with IESNA Class III adjustable up to Class II. If the program dictates televised events, provide appropriate IESNA lighting class of play levels for that specific sport. Provide keyed light switches. Provide fixtures with wire cages or appropriate shatterproof luminaires. Do not locate fixtures directly above basketball backboards. **\1** Do not install high-pressure sodium lighting. **/1/**
Communication	**CCTV**. Provide at least one outlet in each divided space. **CATV/Internal Video**. None required unless specified by installation. **PA/Audio**. Provide speakers with proper spacing. **Telephone**. Provide one line with internal two-way communication. **Data**. Provide data outlets in recessed floor boxes routed to scoreboard, centered under the anticipated scoring table location but outside the court boundaries. **Security**. Provide lockable area for when fitness access is in use.

Acoustics	For single court modules, reverberation time must equal 1.0 second. For two-court or larger modules, reverberation time must equal 1.8 to 2.0 seconds. Provide additional acoustical control with sound baffles, banners, and acoustical materials. Provide noise attenuation measures to mitigate acoustical problems resulting from vibration transmitted through the facility structure.
Casework/ Built-in Equipment	• Provide retractable basketball nets/backboards at two per half court or six per full court. Tournament courts only require 2 goals. Breakaway rims must be installed on all goals. • Provide volleyball built-in flush floor insert sleeves in each court. Provide floor inserts for gymnastics standards. • Motor-operated, vertical-acting (roll-up), divider curtain with manual override. Ensure the motor is easily accessible for maintenance. • Provide an electronic scoreboard that is visible to officials, players, and spectators. Provide control for scoreboard and divider curtain on side of room opposite of bleachers. • Bleachers. Use manually-operated, telescoping bleachers to maximize the flexibility of the space and allow sideline space for gymnasium events. Provide for accessible seating. **\1** Minimum of 200 seats; more as required and with additional courts. **/1/** • Provide game lines on flooring for full- and half-court basketball and volleyball. • Provide 6-ft (1.83 m) -high attached safety padding with bottom edge on top of floor base on all walls that can be impacted by a player. • Provide one pair of 30-second timing clocks for the main court.
Furnishings, Fixtures & Equip. (FF&E)	Provide volleyball stanchions, net, standard protective pads, net antenna, and elevated judge's stands. Provide wrestling mat, exercise mat, protective floor coverings with portable rolling stand, seating, scoring table, and chairs. **\1** Provide an AED. **/1/**
User-provided Equipment	CCTV cameras per the outlet count.
Special Requirements	• Court size must meet NCAA standards. See Appendix D of this UFC for a link to an NCAA basketball court diagram. • Interior entrance doors into the gym must have vision panels, minimum 5 ft^2 (0.46 m^2) each and ensure visual access from the control counter to the gym entrance. Where line of sight is not possible, CCTV monitoring of gym entrance must be provided. • Provide minimum 10 ft (3.05 m) of unobstructed floor space as a safety zone between the outer edge of the playing area and any feature or obstruction. Provide minimum 12 ft (3.7 m) side to side and 18 ft (5.5 m) end to end of unobstructed floor space as a safety zone between the outer edge of the playing area and any adjacent court playing area. • Design for moisture control and prevention of condensation on floor surface. • Provide exterior double doors with removable latch post for equipment access. • Provide natural light. Skylights are not permitted above wood floors. Mitigate glare on the play and spectator areas. Any glass panels must be a minimum of 18 ft (5.49 m) AFF and 0.5-in. (13-mm) -thick, tempered, laminated safety glass. • Do not locate windows, doors, or other obstructions within 7 ft (2.13 m) of all backboard centerlines. • Ensure no glazing or lighting can create glare or distraction on the play areas and cross-court play. Do not use window treatments to mitigate glare.

For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers. Participants. Spectators.
Min. net ft^2 (m^2)	

Table 4-21 Gymnasium Equipment Storage/Support

Description/ Usage	This room accommodates the storage of equipment and supplies, e.g., roll-away basketball goals, volleyball standards, gymnasium floor protective covering, and telescopic platform for maintenance/repair, needed for program support. Coordinate with overhead storage.
Min. Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted CMU or painted gypsum wall board. **Floor.** Sealed concrete. **Ceiling.** None required.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 65 ºF (18 ºC) to 85 °F (29 °C).
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Provide fixtures with wire cages or appropriate shatterproof luminaire.
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. None required. **Telephone**. None required. **Data**. None required. **Security**. Provide lockable doors.
Casework/ Built-in Equipment	None required.
Furnishings, Fixtures & Equip. (FF&E)	Shelving and storage cabinets.
User-provided Equipment	None required.
Special Requirements	Area must be accessible from both interior and exterior though lockable double doors with kick-plates. Provide "Dutch" doors at interior for equipment issue. Provide a vision panel in the door. Provide ramp at exterior door to facilitate equipment issue/delivery, if necessary. The area must be at least 8 ft (2.44 m) wide. In addition to the gym storage room, a separate storage area accessible from the exterior may be provided for exterior sports and athletic equipment, e.g., bleachers and soccer goals.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-22 Rock Climbing

Description/ Usage	A rock-climbing wall is an optional addition, usually to the fitness equipment area or combined with other structured activities. The main uses of climbing walls are threefold: offering instructional programs for new climbers, fitness training or recreation for intermediate through advanced climbers, and climbing competitions. Locate the wall within the facility so that it is a highly visible feature or centerpiece and also serves an advertising function. Ensure direct visual control from the control counter. For renovation projects, if rock climbing area is not visible from the control counter, this space must be included in a lockable room.
Min. Ceiling Ht.	For renovations, accommodate a 20-ft (6.1-m) -minimum-height climbing wall and the specific requirements of the equipment selected. For new projects, accommodate a 25-ft (7.6-m) -minimum-height climbing wall.
Finishes	**Walls.** CMU. Basic wall features can include arêtes, dihedrals, overhanging routes, flakes, chimneys, buttresses, and roof. Design for not only the width and height of climbing walls but also the available depth to create interesting features. **Floor**. The flooring beneath the climbing wall must be seamless rubber surfacing. • Description: Cushioned seamless floor system comprised of a cushioned impact course and colored cap surface, composed of peroxide-cured EPDM and recycled select rubber bonded by a specially formulated polyurethane binder. Completed system must comply with applicable Consumer Product Safety Commission (CPSC) criteria for playground surfacing **\1** contained in *Public Playground Safety Handbook* **/1/** and the following: o Tested for shock attenuation under ASTM F1292 and Head Injury Criterion (HIC). o Tested for slip resistance under ASTM E303. o Tested for fire resistance under ASTM E84. o Complies with ABA for wheelchair access. • Thickness: Poured-in-place; final thickness of 3.75 in. (93.8 mm). • Color: As selected by architect from manufacturer's full range of standard colors. • Primer: As recommended by the manufacturer. • Line Marker: Two-component polyurethane as recommended by the manufacturer for demarcation of specific areas or other lines or lanes. • Thinner: As recommended by the manufacturer. • Acceptable Manufacturers and Products: o No Fault Industries **\1** Safety Surface **/1/** o Vitricon Vitriturf o Approved substitute • Installation: o Areas of installation: climbing wall landing surface. o Proceed only when ambient and surface temperatures are within range recommended by the manufacturer and substrate condition has been approved by the installer. **Ceiling.** None required.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Gym, sports arena (play area)."

Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Provide 50 fc (500 lx) with uniform vertical illuminance on climbing surfaces. Coordinate the location of lights with the design of the climbing wall. Lighting must not impair the wall user, e.g., down-lighting fixtures must not be installed directly above the climbing wall.
Communication	**CCTV**. If direct LOS is not possible from the control desk, provide an outlet (also see **Special Requirements**). **CATV/Internal Video**. None required. **PA/Audio**. Provide a speaker. **Telephone**. If direct LOS is not possible from the control desk, provide an emergency call/alarm that sounds at the control counter. **Data**. None required. **Security**. Provide lockable area for when fitness access is in use.
Casework/ Built-in Equip.	Manufactured climbing walls are acceptable. Select the provider based both on service and product features. Accommodate any specific power requirements. Provide a wall-mounted bulletin board in a visible, adjacent area on which appropriate information and materials are posted, e.g., safety and injury guidelines, climbing tips, target heart zone information, and instructions for measuring heart rate.
Furnishings, Fixtures & Equip. (FF&E)	None required.
User-provided Equipment	CCTV cameras per the outlet count.
Special Requirements	Climbing wall, whether custom designed or manufactured, must exhibit a natural rock appearance. Component manufactured holds that mount to the climbing wall surface must be adjustable to accommodate climbing competitions. This feature will also allow for climbing route variations and various types of holds. Provide a separate teaching station. If direct LOS from the control counter is not possible, provide a means to secure the climbing wall during periods of non-use. Safety: If a manufactured climbing wall is used, comply with the manufacturer's guidelines and safety requirements. Also refer to the following industry groups for more information on safety requirements: Climbing Wall Association; Association for Challenge Course Technology. Ensure all anchors and other safety devices are installed for safe use.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-23 Racquetball Courts

Description/ Usage	Racquetball courts generally consist of one or more enclosed courts within a larger space that allows circulation, waiting, and spectator viewing. Courts are sized and specified specifically for the game of racquetball (see **Special Requirements**).
Min. Ceiling Ht.	20 ft (6.1 m) exactly.
Finishes	**Walls.** Pre-manufactured racquetball court side and front walls must be 0.5-in (13-mm) -thick, balanced, high-density dry panel systems with minimum 50-pound density weight panels over 0.5-in. (13-mm) sound cushion layer. Unless building layout precludes the option, provide a shatterproof, tempered glass back wall/door for viewing and officiating. Minimum calculated wall reflectance must be 0.65. See **Acoustics** section of this table for additional wall information. **Floor**. Maple athletic flooring. Flooring must meet DIN standards for the specified function per *ACSM's Health/Fitness Facility Standards and Guidelines*. **Ceiling**. Pre-manufactured racquetball court ceiling, 0.5-in. (13-mm) -thick, high-density resin core panels.
Plumbing	Must be near an electric water cooler.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 66 °F (19 °C) to 72 °F (22 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Gym, sports arena (play area)." Install ducts above ceiling or within wall surfaces. Install heavy-duty dent-resistant supply and return grilles flush and located in the rear one-third of the ceiling and/or the upper one-third of the back wall.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety," inclusive of protection from mechanical damage. Provide flush-mounted institutional style sprinklers throughout the racquetball court. Do not locate sprinklers closer than 6 ft (1.83 m) to the front wall of the court. Provide flush-mounted fire alarm and life safety equipment where these devices are required to be installed within the racquetball court.
Power	None required in courts. Provide convenience outlets per Chapter 3, "Electrical," in the waiting/viewing area.
Lighting	Provide system per Chapter 3, "Electrical." Match requirements for indoor tennis courts per UFC 3-530-01. Provide lighting levels for racquetball in accordance with IESNA Class III adjustable up to Class II. Use translucent, impact-resistant, non-breakable, flush-mounted protective covers specifically designed for racquetball courts. For courts with glass walls, the lighting level must be the same on both sides of the glass wall. This reduces glare and allows players to follow the ball as it plays off the glass wall.
Communication	**CCTV.** Provide at least one outlet in the waiting/viewing area to look into the court. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker in each court (upper end of back wall preferred) and in the waiting/viewing area. **Telephone.** None required. **Data.** None required. **Security.** Provide lockable area for when fitness access is in use.
Acoustics	Racquetball separation wall assembly must provide STC 60 rating. To achieve this STC rating and control impact noise, separating wall can either include independent steel frames separated by a 1-in. (25-mm) clear space or can incorporate CMU block wall with steel frames directly attached.

Casework/ Built-in Equipment	Provide mounting sockets and netting for wallyball games on 50% of the courts or per local demand. Provide recessed storage boxes in one sidewall of each court.
Furnishings, Fixtures & Equip. (FF&E)	If a waiting/viewing area is included, provide seating for spectators.
User-provided Equipment	CCTV cameras per the outlet count.
Special Requirements	Court striping and dimensions must comply with USRA rules. Wall, floor, and ceiling materials and construction must comply with USRA *Standard Specifications for Racquetball Court Construction*. Because of the special air-conditioning requirements for racquetball courts, design exterior exposed racquetball court walls to eliminate wet walls and mildew in accordance with Chapter 3, “Exterior Walls and Mold."
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers. Participants. Spectators.
Min. net ft^2 (m^2)	

Table 4-24 Unit PT/Group Exercise Room

Description/ Usage	This is typically one large room that is partitionable and can be used for large unit physical training or for multiple smaller classes that require only minimal equipment. Activities/classes include aerobics, martial arts, and yoga.
Min. Ceiling Ht.	10 ft (3.05 m) minimum clear to lowest overhead feature. Provide a 12-ft (3.66-m) minimum clear height ceiling for facilities with large martial arts programs.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted CMU. Painted, double-layer high-impact gypsum board on studs is also acceptable. **Floor**. Maple athletic flooring. Synthetic multipurpose, resilient, athletic flooring may be allowed when requested by the installation. Flooring must meet DIN standards for the specified function per *ACSM's Health/Fitness Facility Standards and Guidelines*. **Ceiling.** Exposed structure with acoustical spray paint or ACP. If ACP, provide non-sag tiles.
Plumbing	Must be near electric water coolers.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 66 °F (19 °C) to 72 °F (22 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Health club/aerobics room." Provide at least one ceiling fan per partitionable area.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide power at flat panel display mounting locations and for sound system.
Lighting	Provide system per Chapter 3, "Electrical." Provide 30 fc (300 lx) minimum at the floor. To address safety concerns, coordinate lighting design with equipment layout and ensure that equipment users, particularly those using horizontal benches, are not exposed to glare of direct/down lighting. Provide protection for all fixtures when appropriate for specific activity. Provide multi-level switching.
Communication	**CCTV**. Provide at least one outlet in each divided space. **CATV/Internal Video**. Provide outlets for monitors coordinated with their location. **PA/Audio**. Provide speakers with proper spacing. **Telephone**. Provide one line with internal two-way communication. **Data**. Provide data outlets in the walls or in recessed floor boxes. **Security**. Provide lockable doors.
Acoustics	Reverberation time must equal 1.0 second. Provide noise attenuation measures to mitigate acoustical problems resulting from mechanical systems, plumbing systems, and vibration transmitted through the facilities structure. Provide partition construction with a minimum STC rating of 50 per Chapter 3, "Acoustics."

Casework/ Built-in Equipment	Provide one acoustical operable partition with minimum STC rating of 45. Partition must be recessed into an alcove. Provide impact-resistant/shatterproof mirrors 6 ft (1.83 m) tall on at least two walls at a minimum of 18 in. (450 mm) above the floor. If required, provide infrastructure and speakers for sound system for each divided space. Provide wall- or ceiling-mounted flat panel display mount in each divided space. Provide personal effects storage, such as cubbies, for customers in the room.
Furnishings, Fixtures & Equip. (FF&E)	Provide other fitness equipment as needed: indoor cycling equipment, stair steps, exercise balls, and small dumbbells. Provide an AED. Optional stage/platform.
User-provided Equipment	CCTV cameras per the outlet count. Flat panel display and sound system with mp3 and auxiliary input capability.
Special Requirements	Provide vision panel in the door, minimum 5 ft^2 (0.46 m^2), and consider side lites. Design the rooms to be rectangular to allow for flexibility in use. Provide a method of fastening padding on walls for use during combative sports. Provide acoustical separation from the rest of the facility. Provide natural light where appropriate based on activities in the space. Provide glare and heat-gain protection if exterior glazing is provided. Provide some visual connection to the rest of the facility. Consider providing interior windows to other exercise modules/circulation areas. If windows are provided, provide blinds. Accommodate queuing of customers in the area immediately outside the entrance. Provide secure storage room with direct adjacency to store items such as mats, stair steps, wall padding, and other fitness equipment. Storage rooms must either have double doors without astragal or designed as flow-through storage rooms.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-25 Fitness Area

Description/ Usage	This area is typically the focal point of the facility. The area is divided into four sections: stretching/warm-up/cool-down, free/plate-loaded weights, selectorized (machine) equipment, and cardiovascular equipment. The stretching/warm-up/cool-down area is open space within the larger room. It can also serve as transition areas between the other sections. The cardiovascular equipment area can be located in one or multiple areas throughout the facility. The criteria in this table will apply regardless of equipment location. Fitness area is adjacent to the equipment repair/receiving area. The free/plate-loaded weights area includes dumbbells, plate racks and plate-loaded equipment, and benches. The selectorized (machine) equipment consists of pin-selected weight equipment. The cardiovascular equipment consists of items such as treadmills, stationary bikes, and stair climbers.
Min. Ceiling Ht.	12 ft (3.66 m) minimum. 14 ft (4.27 m) is preferred.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted CMU. Provide high-impact wall guards up to 18 in. (450 mm) AFF in the free weight area. **Floor.** Use permanently adhered resilient athletic flooring consisting of dual durometer layers of natural and synthetic rubbers, calendared and vulcanized together. The top layer is a non-porous, slip-resistant, textured surface; the bottom layer is a cushioned performance layer. In the stretching/warm-up/cool-down spaces, use 1/4 in. (6 mm) thickness; in cardio, selectorized machine weights, and free weight areas use 3/8 in. (9 to 10 mm) thickness. Do not use interlocking flooring tiles or movable furnishings such as mats. Consider providing a low-profile raised floor in the selectorized and cardiovascular equipment areas to provide flexibility for routing power and data cables for fitness equipment. **Ceiling.** Exposed, painted structure. Consider providing ACP or other acoustical banners and treatments.
Plumbing	Provide a minimum of two electric water coolers.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Health club/weight rooms." Provide ceiling fans.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." **Free weight area**: Provide outlets for wall- or ceiling-mounted flat panel displays. **Selectorized equipment area**: If a fitness tracking system will be provided, coordinate equipment outlets with the specific equipment selected. Provide flush-floor outlets for commercial-grade equipment in a grid pattern sized appropriately for equipment spacing and to accommodate fitness tracking systems. Provide outlets for wall- or ceiling-mounted flat panel displays. **Cardiovascular equipment area**: Coordinate equipment outlets with the specific equipment selected. Provide flush-floor outlets for commercial-grade equipment in a grid pattern sized appropriately for equipment spacing and to accommodate fitness tracking systems. Provide dedicated circuits for all treadmills. Coordinate flat panel display outlet locations with CATV outlet locations and the equipment selected: If cardiovascular equipment incorporates monitors, ensure outlets are located appropriately and provide outlets for wall- or ceiling-mounted flat panel displays as necessary to ensure adequate viewing angles for all equipment.

Lighting	Provide system per Chapter 3, "Electrical." Provide 30 fc (300 lx) uniform lighting. To address safety concerns, coordinate lighting design with equipment layout and ensure that equipment users, particularly those using horizontal benches, are not exposed to glare of direct/down lighting.
Communication	**CCTV**. Provide outlets as needed for coverage. **CATV/Internal Video**. Provide outlets for wall- or ceiling-mounted flat panel displays throughout the fitness area. Mount at proper viewing height for cardiovascular exercise machines in that area, height as selected by fitness area designer. The quantity and location of the CATV outlets must be determined by the sports fitness center designer and the Installation fitness program manager and must be coordinated with the equipment layout. The goal must be to enhance the experience and enjoyment of working out in the fitness areas and to have a number of CATV monitors available for comfortable viewing by all users of the fitness area. Consider **\1** options for wireless transmission of audio broadcast from **/1/** video monitors. **PA/Audio**. Provide PA speakers as needed. Provide a separate audio system with speakers as needed for full coverage. Consider separate volume control and separate channels for individual activity areas. **Telephone**. None required. **Data**. Provide data outlets in recessed floor boxes in the cardiovascular and selectorized equipment areas and entertainment systems. Data to equipment for fitness tracking is optional. **Security**. None required.
Acoustics	Reverberation time must equal 1.0 to 1.3 seconds. Provide noise attenuation measures to mitigate acoustical problems resulting from mechanical systems, plumbing systems, and vibration transmitted through the facilities structure.
Casework/ Built-in Equipment	Provide 6-ft (1.83-m) -tall mirrors on at least two walls at a minimum of 18 in. (450 mm) above the floor. One of the two walls must be in the free weight area. Provide 1.5-ft by 1.5-ft by 15-in. (0.46-m by 0.46-m by 0.38-m) -deep open cubbies – quantity to be 50% of number of pieces of fitness equipment. Provide wall-mounted bulletin boards.
Furnishings, Fixtures & Equip. (FF&E)	Fitness equipment must be commercial grade. Provide a free-standing heavy punching bag and a speed bag if a boxing program is included. Exercise mats, wall clocks, and trash containers. Provide self-serve equipment cleaning supply stations throughout that include disinfectant spray bottles and disposable or reusable towels. Provide an AED.
User-provided Equipment	CCTV cameras per the outlet count. Flat panel display.

Special Requirements	If this space is provided on the second floor, ensure the elevator is specified to accommodate the fitness equipment. The foundation/floor in this space must be designed to accommodate all live and dead loads associated with the equipment. Provide storage either within the room or with a direct adjacency to store items such as mats, spare equipment, punching bags, and other sports equipment. Provide natural light through the use of windows and/or overhead skylights. Mitigate glare. Provide attractive, color-coordinated décor that projects a friendly environment. Avoid bland treatments such as a black floor and tan walls. Color selection must coordinate with equipment selected for the space. Consider providing a help desk within this space in larger facilities. If provided, locate it within the space in areas not well served by the control counter. If provided, the raised floor provides flexibility for routing power and data cables for fitness equipment. Typically, this will be a low-profile access floor. If doors are provided, include vision panels, minimum 5 ft^2 (0.46 m^2) each, and consider side lites.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-26 Fitness Assessment Room

Description/ Usage	This room provides a space for staff to meet with customers and evaluate the customer's fitness level. It is inside or directly adjacent to the fitness spaces and the program manager's office and must include typical office furnishings and fitness testing equipment.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted gypsum wall board. **Floor.** Carpet tile with resilient base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide independent thermostat.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide a minimum of one quad outlet on at least three walls. Gang outlets with data and telephone. Provide additional dedicated outlets to accommodate the fitness equipment.
Lighting	Provide system per Chapter 3, "Electrical." Provide 50 fc (500 lx) of general ambient lighting.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line. **Data.** Provide at least one outlet at the desk area and one outlet at the fitness equipment area. Provide a computer system with internet connectivity at each data outlet location. **Security.** None required.
Casework/ Built-in Equipment	None required.
Furnishings, Fixtures & Equip. (FF&E)	Office furniture: desk, credenza, filing cabinet, desk chair, and two side chairs. Partitions and dividers. Fitness testing equipment that testing can be completed on, such as a treadmill or cycle with built-in monitoring sensors/devices. Scale and height rod.
User-provided Equipment	Computers, printer, and other office equipment as needed.
Special Requirements	Provide a key locked door. Provide side lites with blinds next to the door for supervision and security. If this space is provided on the second floor, ensure the elevator is specified to accommodate the fitness equipment.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-27 Indoor Track

Description/ Usage	The indoor track provides space for running, jogging, and walking. It is usually co-located with the gymnasium (see Table 4-20), either surrounding the court safety zone or suspended above the gym area or other high-bay space. The track is required but it can be either indoor or outdoor.
Min. Ceiling Ht.	10 ft (3.05 m) minimum. If suspended in a high-bay area, the underside of the track structure must be 14 ft (4.27 m) minimum AFF.
Finishes	**Walls.** CMU with semi-gloss enamel paint. **Floor**. Resilient, cushioned running surface, such as rubber or urethane. **Ceiling**. Exposed, painted structure.
Plumbing	Provide an electric water cooler in the entrance lobby to the track.
HVAC	The HVAC criteria must match the criteria for the space in which the track is located.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide power to a wall-mounted clock and electric water cooler. If cardio fitness equipment is provided, coordinate power requirements.
Lighting	The lighting criteria must match the criteria for the space in which the track is located. When located within the gymnasium surrounding the court safety zone, provide lighting levels and controls matching the court it surrounds. When suspended above the gymnasium, provide lighting control with horizontal illuminance: 30 fc (300 lx), CV = 0.30 or less (Emax/Emin= 4:1 or less).
Communication	**CCTV.** Provide outlets for adequate coverage. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide a telephone line or other emergency call system within or adjacent to the running track area. **Data.** None required. **Security.** Provide lockable area for when fitness access is in use.
Casework/ Built-in Equipment	Provide signage to indicate running directions (directions alternate day-to-day). Provide personal effects storage, such as cubbies, for customer use. Bulletin board and digital clock.
Furnishings, Fixtures & Equip. (FF&E)	Provide freestanding storage units for towels and personal items. (This can also be incorporated into casework.) Consider providing cardio fitness equipment, such as treadmills or stair climbers, in unused corners.
User-provided Equipment	CCTV cameras per the outlet count.

Special Requirements	The metric unit equivalent for the track distance must be an accurate soft conversion because runners will time themselves based on number of laps; the reference point must be consistent. Track length is based on the inside radius. Lanes are preferred to be 45 in. (1067 mm) wide. The turns must have a minimum inside radius of 20 ft (6.1 m). Consider using banked curves. The height of banked curves on an indoor track must be 1 in. per 1 ft (25 mm per 300 mm) of track width. When using banked curves, ensure compliance with ABA requirements. Provide "lobby" areas at the entrances to a suspended track so that the doors do not open onto the track area and to provide space for stretching and warm-up. Provide an exercise mat in this area. Provide vision panels in the doors, minimum 5 ft^2 (0.46 m^2) each. Ideally, the entry lobbies are to be located near the center of a straightaway. Provide for exterior views if possible or, at a minimum, natural light admission. Mitigate glare and prevent direct sunlight on the track or the gymnasium (if suspended above). Track length and number of lanes varies as follows: **Navy.** Minimum track distance/size is 1/14 mile (115 m) and two lanes, which will fit over the smallest gymnasium option. In larger facilities, the preferred distance/size is 1/11 mile (146.3 m) in length and three lanes. In extra-large and jumbo size facilities, the Navy will include a 1/8-mile (201.2-m) four-lane track. **Marine Corps.** Minimum track distance/size for new facilities is 1/8 mile (201.2 m) and four lanes. The minimum track distance/size for add/alter facilities is 1/11 mile (146.3 m) in length and three lanes. Typically, the most space- and cost-effective location for the indoor track is suspended above the gymnasium. Service-specific size and length criteria for the track is given above but consider the following when sizing the indoor track: • Ensure the suspended track does not interfere with gymnasium play below. The track must not encroach into the clear zones of the gym. Ensure that required adjacencies are not affected by the placement of the track. • The facility can be designed to allow the track to extend beyond the gymnasium area and into other high-bay spaces, such as the fitness area. This can make for an interesting architectural feature but will have significant cost implications.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-28 Functional Fitness

Description/ Usage	Functional training is exercise performed to better enable the participant to move through normal life activities. Functional fitness implies performing exercise in an optimal way, to achieve certain goals that allow improved performance of regular activities outside the gym. This may mean more fluid, precise movements, accomplishing necessary activities with the least possible wear and destruction, and remaining pain-free in the performance of mundane tasks. Better function could have applications in pulling weeds, loading the dishwasher, waxing the car, or carrying groceries home from the store. Typical equipment in the functional fitness area includes A-frames used for various exercises with bands, individual weight stations, and various kettle bells and other equipment.
Ceiling Ht.	14 ft (4.27 m) minimum.
Finishes	**Walls**. CMU with heavy-duty epoxy or painted, double-layer (impact side) gypsum board, and provision of high-impact wall guards up to 18 in. (450 mm) AFF where weights are used. **Floor**. Use 3/8-in. (9- to 10-mm) -thick permanently adhered resilient athletic flooring consisting of dual durometer layers of natural and synthetic rubbers, calendared and vulcanized together. The top layer is a non-porous, slip-resistant, textured surface; the bottom layer is a cushioned performance layer. Provide a section of turf in coordination with installation requirements. **Ceiling**. Open structure is preferred; however, adequate acoustics must be maintained.
Plumbing	Provide a minimum of one electric water cooler.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Health club/weight rooms." Provide ceiling fans.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety," inclusive of protection from mechanical damage. Provide protection for sprinklers, exit signs, manual pull stations, and other exposed components; minimize equipment that protrudes into activity spaces. Install component equipment (except manual pull stations) minimum 8 ft (2.44 m) AFF for safety considerations. Provide manual pull stations with protective covers. Provide upright sprinklers with head guards in areas without suspended ceilings.
Power	Provide outlets per Chapter 3, "Electrical." Convenience outlets required.
Lighting	Provide system per Chapter 3, "Electrical." Lighting must be switched to allow for different levels of lighting. Provide fixtures with wire cages. **Light level:** 30 fc (300 lx) at the floor, minimum.
Communication	**Sound system**: Flush recessed speakers, 25-watt minimum output rating, capable of reproducing the entire audible range for human speech. Link speakers and provide audio interface in accessible area for sound equipment.
Acoustics	Walls must be acoustically treated to minimize the transmission of sounds from impact to other spaces.
Casework/ Built-in Equipment	None required.

Furnishings, Fixtures & Equip. (FF&E)

Description	Notes	Quantity
Double power station (3")/storage/stainless	Includes rack, bench, platform	1
Glute/ham bench (split pad)/lineal		1
Step-up box with plywood; no logo		1
Olympic lifting bar 20kg, 1-1/8 in. shaft 1800# test zinc		2
45# bumper plate		8
35# bumper plate		4
25# bumper plate		4
10# bumper plate		4
Olympic plates - grip rubber	4-10, 4-5, 4-2.5	70
Adjustable dumbbells	15-60/5# (10 Pair Total)	1
Triple-tier dumbbell rack (15 pr.)	Bottom two levels for DBs, top level for kettlebells.	1
Band attachments		1
Vertical medicine ball rack		1
Kettlebells 5-60/5, 70 to 100 lb/10	15/20/25/30/35/40	165
Olympic curl bar (26 lb.) 5 ft black		1
Olympic spring lock collars		3
Medicine ball	4/6/8/10/12/15/18/20/25/30 elite medicine balls	1
TRX straps		2
Stretch equipment: cage (e.g., True Stretch, 37 deg. angle calf stretch blocks with heel anti-slip ledge and a PT table for pre/post conditioning		
Pre-movement prep, cooldown, injury prevention, supports functional movement: stretch cage and calf stretch blocks attached semi-permanent to floor, PT table		
Power sled (plate loaded); includes harness + belt		1
	Double ladder	1
	Battling rope 50 ft	1
	Weight lifting bands	1

User-provided Equipment	None required.
Special Requirements	• A storage room must be provided. • Must be on first floor of facility due to dropping weights. • Provide vision panels in the doors, minimum 5 ft^2 (0.46 m^2), and consider side lites.

For use during project execution by the appropriate Service agency

Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 4-29 Auxiliary Gymnasium

Description/ Usage	**Note:** This space is not supported by the Navy. This space is used for sports competitions such as basketball, volleyball, wrestling, and indoor soccer. The auxiliary gymnasium can also support instructional functions, informal, intramural, group exercise/fitness functions, and community events. Preferably the auxiliary gymnasium will be adjacent to the main gymnasium. If not adjacent, must be nearby.
Ceiling Ht.	Minimum 25 ft (7.62 m) clear height to lowest overhead element.
Finishes	**Walls.** Provide durable wall system up to 12 ft (3.66 m) height, such as CMU with heavy-duty epoxy. Above 12 ft (3.66 m), use semi-gloss enamel and consider acoustic panels. **Floor**. Maple athletic flooring, 25/32 in. (19.8 mm) thick, must be installed in gymnasiums 6,500 ft^2 (603.9 m^2) or larger. Synthetic multipurpose, resilient, athletic flooring may be allowed when requested by the Installation. Flooring must meet DIN standards for the specified function per *ACSM's Health/Fitness Facility Standards and Guidelines*. **Ceiling**. Exposed, painted structure. Provide acoustical banners, **\1** baffles, panels, or similar treatment. ***/1/***
Plumbing	None required. Ensure access to nearby electric water coolers.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Gym, sports arena (play area)." Provide durable air grill covers and do not place air grills in line with basketball nets. Locate ductwork to avoid trapping balls.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety," inclusive of protection from mechanical damage. Provide protection for sprinklers, exit signs, manual pull stations, and other exposed components; minimize equipment that protrudes into activity space or safety zones near activity spaces. Install component equipment (except manual pull stations) minimum 8 ft (2.44 m) AFF for safety considerations. Provide manual pull stations with protective covers. Provide upright sprinklers with head guards.
Power	Provide outlets per Chapter 3, "Electrical." Provide power for the scoreboard, shot clocks, and a high, wall-mounted clock. Consider power requirements for additional lighting for special events.
Lighting	Provide system per Chapter 3, "Electrical." Provide lighting levels for basketball in accordance with IESNA Class III adjustable up to Class II. If the program dictates televised events, provide appropriate IESNA lighting class of play levels for that specific sport. Provide perimeter compact fluorescents multi-level switched for non-sport activities. Provide keyed light switches. Provide fixtures with wire cages or appropriate shatterproof luminaires. Do not locate fixtures directly above basketball backboards. Do not install high-pressure sodium lighting.
Communication	**CCTV**. Provide at least one outlet on each wall. **CATV/Internal Video**. None required. **PA/Audio**. None required. **Telephone**. None required. **Data**. None required. **Security**. None required.

Acoustics	Reverberation time must equal 1.0 second. Provide noise attenuation measures to mitigate acoustical problems resulting from mechanical systems, plumbing systems, and vibrations transmitted through the facility's structure.
Casework/ Built-in Equipment	• Provide six retractable basketball nets/backboards. Breakaway rims must be installed on all goals. • Provide volleyball built-in flush floor insert sleeves in each court. • Provide an electronic scoreboard. • Provide game lines on flooring for full- and half-court basketball and volleyball. • Provide 6-ft (1.83-m) -high attached safety padding with bottom edge on top of floor base on all walls that can be impacted by a player.
Furnishings, Fixtures & Equip. (FF&E)	Provide volleyball stanchions, net, standard protective pads, and net antenna. Provide wrestling mat, exercise mat, and protective floor coverings. Provide an AED.
User-provided Equipment	CCTV cameras per the outlet count.
Special Requirements	• Interior entrance doors into the auxiliary gymnasium must have vision panels, minimum 5 ft^2 (0.46 m^2) each. • Provide a minimum 10-ft (3.05-m) unobstructed floor space safety zone between the outer edge of the playing area and any feature or obstruction. • Consider moisture control and prevention of condensation on floor surface. Consider under-floor ventilation requirements, under-slab vapor barrier, estimated dew point occurrence, local water table, and local soil conditions. • Provide exterior double doors with removable latch post for equipment access. • Do not locate windows, doors, or other obstructions within 7 ft (2.14 m) of all backboard centerlines. • Ensure no glazing or lighting can create glare or distraction on the play areas.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

Table 4-30 High Intensity Tactical Training (HITT) Center

Description/ Usage	**Note: \1** This space is for Marine Corps only. **/1/** This is typically one large, open space room that is non-partitionable and is used for implementation of the HITT program. Activities/classes such as aerobics, martial arts, and yoga must not be used in this space.
Ceiling Ht.	20 ft (6.1 m) minimum.
Finishes	**Walls**. CMU with heavy-duty epoxy or painted, double-layer (impact side) gypsum board. **Floor**. Use 3/8 in. (9 to 10 mm) thick permanently adhered resilient athletic flooring consisting of dual durometer layers of natural and synthetic rubbers, calendared and vulcanized together. The top layer is a non-porous, slip-resistant, textured surface; the bottom layer is a cushioned performance layer. Synthetic artificial turf and track are to be installed in centers 2000 ft^2 (185.8 m^2) or larger. HITT logo is to be included on flooring where Olympic lift platform stations will be located. Provide high-impact wall guards up to 18 in. (450 mm) AFF. Impact and athletic flooring system cannot be accommodated by interlocking flooring tiles or movable furnishings such as mats. **Ceiling**. Exposed structure with acoustical spray paint or ACP. If ACP, provide non-sag tiles.
Plumbing	Provide a minimum of one electric water cooler.
HVAC	Provide system per Chapter 3, "HVAC". Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Health club/weight rooms." Provide ceiling fans.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety," inclusive of protection from mechanical damage. Provide protection for sprinklers, exit signs, manual pull stations, and other exposed components; minimize equipment that protrudes into activity spaces. Install component equipment (except manual pull stations) minimum 8 ft (2.44 m) AFF for safety considerations. Provide manual pull stations with protective covers. Provide upright sprinklers with head guards in areas without ceilings.
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Provide 30 fc (300 lx) minimum at the floor. To address safety concerns, coordinate lighting design with equipment layout and ensure that equipment users, particularly those using horizontal benches, are not exposed to glare of direct/down lighting. Provide protection for all fixtures and dimming capability.
Communication	**CCTV**. Provide at least one outlet on each wall. **CATV/Internal Video**. Provide at least one outlet for wall-mounted monitor(s). **PA/Audio**. None required. **Telephone**. Provide one line with internal two-way communication. **Data**. Provide at least one outlet. **\1** HDMI **/1/** cable outlet below dedicated flat panel display. **Security**. None required.
Acoustics	Reverberation time must equal 1.0 second. Provide noise-attenuation measures to mitigate acoustical problems resulting from mechanical systems, plumbing systems, and vibrations transmitted through the facilities structure. Provide partition and door construction with a minimum STC rating of 50 per Chapter 3, "Acoustics."

Casework/ Built-in Equipment	• Provide adjustable pull-up bars on at least one wall. Number of bars is determined by center size. • Provide a built-in protective box for the telephone. • Provide 9-ft (2.74-m) -high mirrors on at least two non-adjacent walls at a minimum of 18 in. (450 mm) above the floor. • Provide wall flat panel display mount in each divided space. • Provide personal effects storage, such as cubbies, for customers in the room. • Provide attached wall padding for both ends of rubberized track surface.
Furnishings, Fixtures & Equip. (FF&E)	• Fitness equipment must be commercial grade. Equipment counts will vary by size based on square footage. • Address accessibility issues in equipment selection. • Provide other combat fitness equipment as needed: power racks (Olympic lift platforms with wood base and squat rack type), plyometric equipment, speed and agility equipment, functional training equipment, kettlebells, medicine balls. • Office equipment: desk and chair. • Provide an AED.
User-provided Equipment	CCTV cameras per the outlet count. One dedicated flat panel display for video analysis usage. Flat panel display must have **\1** HDMI **/1/** port to connect to moveable hardware platform.
Special Requirements	• Design the rooms to allow for flexibility in use. Provide a method of fastening padding on walls for use during sprint/speed training. Provide acoustical separation from the rest of the facility. • Provide protection of all sprinklers, fire alarm strobe/speaker, thermostats, and other similar features. • Provide natural light where appropriate. Provide glare and heat-gain protection if exterior glazing is provided. • Provide some visual connection to the rest of the facility. Consider providing interior windows to other exercise modules/circulation areas. If windows are provided, provide blinds. • Accommodate queuing of customers in the area immediately outside the entrance. • Provide secure storage either within the room or with a direct adjacency to store items such as speed/agility equipment, cones, ladders, and other fitness equipment. • Provide attractive, color-coordinated HITT logo on one main wall. Walls must be colored white. • Color selection for equipment must match HITT logo color. • Provide vision panels in the doors, minimum 5 ft^2 (0.46 m^2) each, and consider side lites. • Provide space for fitness testing; 25- to 40-yd dash, 5-10-5 cone drill, and kneeling medicine ball throw.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

Table 4-31 Indoor Cycling

Description/ Usage	Classroom to accommodate indoor cycling classes, which includes an instructor on a bike and participants on bikes. These bikes are different from the stationary bikes utilized in the cardio area. This space may be included as part of the programmed space allotted for structured activities.
Ceiling Ht.	10 ft (3.0 m) minimum to lowest element.
Finishes	**Walls.** Painted walls. Coordinate with users to find out any special images such as murals as well as preferred color (light vs. dark). **Floor**. Rubber or wood floor typical. Provide flooring that is appropriate and industry standard for indoor cycling classrooms. Strongly recommend use of platforms for the classroom to provide better view of the instructor. **Ceiling**. Exposed, painted structure. Consider providing ACP or other acoustical banners and treatments.
Plumbing	Provide an electric water cooler.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Health club/weight rooms." For Army projects, provide ceiling fans.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Match requirements of indoor basketball court, per UFC 3-530-01. Lighting must be switched to allow for different levels of lighting. Natural light via windows may be provided but direct sunlight and glare must be avoided. Windows providing internal views to other spaces is desirable. **Lighting control**: Use of occupancy sensors to activate lighting by motion detection is recommended. In addition, grouping lights so a portion of the lights may be turned off, especially if natural daylighting is provided, is required. Independent slide or toggle controls may also be used to control fixtures by groups. Grouping must be coordinated with user.
Communication	**CCTV/CATV/Internal Video**. Provide for up to 3 large flat panel displays on the front wall. The control for these must also be in the center of the front wall near the instructor. **PA/Audio**. Provide speakers for main PA system so announcements from the desk can be heard in this space. Provide ceiling-mounted speakers for high-quality music reproduction. If a lay-in ceiling is provided the speakers must be recessed. Speakers must have a 100-watt minimum output rating and must be capable of reproducing CD-quality sound. Provide wiring, cabling, and other built-in support for a user-provided sound system plugged into the speaker system in the room. Provide the connection for the instructor near the center of the front wall. The instructor will position their stereo equipment close to their bike so they can adjust the music while working out. **Telephone**. None required. **Data**. None required. **Security**. None required.

Acoustics	The indoor cycling classroom must be designed to acoustically separate this space from other spaces. In addition, this space must be designed for proper acoustics for aerobic and other exercise classes. Aerobic activity will require partitions to be sound rated to 53 STC minimum. Where glass walls are used to enhance interior views, front these walls to interior circulation and not into other activity spaces. One exception is the gymnasium.
Casework/ Built-in Equipment	**Architectural Casework**: Provide storage cubicles (cubbies) along one wall of the module for incidental storage during activities. Provide minimum of one cubby for 75% of the total number of participants at room's maximum occupant load (based on 50 ft^2 [4.6 m^2]) per person). Cubby design is generally an open-face cube in modular "banks" aligned on one wall to counter-top height or vertically with the tallest cubicle 5 ft (1.52 m) AFF. Cubbies must be minimum 14 in. by 14 in. (350 mm by 350 mm), 18 in. by 18 in. preferred (450 mm by 450 mm) face opening by minimum 15 in. (375 mm) deep. Construct cubbies of ½-in. (12.5-mm) minimum particle board shell with 1/2 in. (12.5 mm) plywood horizontal shelves. Entire construction veneered with .048 horizontal grade, high-pressure plastic laminate. As an alternative, if solid wood or hardwood veneer-core plywood is used throughout, the surfaces may be finished and sealed with a polyurethane (or equal) coating. Cubbies may also be made from a plastic or solid phenolic type material for added durability. The coating must be cleanable and able to withstand moisture without degrading. Edge trim of cubby frames must be solid hardwood (bonded) or 3 mil PVC edging routed into panel edge. Use of plastic laminate edges is not allowed. If counter-height, provide solid-surface countertop with eased edge front and minimum 1-in. (25-mm) -tall lip where the counter abuts the wall.
Furnishings, Fixtures & Equip. (FF&E)	None required.
User-provided Equipment	Flat panel displays.
Special Requirements	• Design the rooms to allow for flexibility in use. • Provide acoustical separation from the rest of the facility. • Provide secure storage room with a direct adjacency to store fitness equipment. • Per installation request, special lighting or themes may be required. • Provide vision panels in the doors, minimum 5 ft^2 (0.46 m^2) each, and consider side lites. Provide a means to darken the vision panels.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

Table 4-32 Mother's Room

Description/ Usage	This space is used by nursing mothers.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted gypsum wall board. **Floor.** Provide hard-surface flooring matching corridor such as seamless vinyl, hard tile, or other durable material. **Ceiling.** ACP.
Plumbing	Provide countertop-mounted sink with hot and cold water. Provide a cold-water connection for refrigerator ice maker.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to 76 °F (24 °C).
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide one additional outlet at counter height for convenience. Provide additional outlets necessary to operate dedicated equipment.
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line. **Data.** Provide outlets as required for equipment. **Security.** Provide lockable doors.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Provide extended solid-surface countertop for bottle prep/clean functions and to house mini-fridge below.
Furnishings Fixtures & Equipment (FF&E)	Guest chair on casters if table/work surface is provided or a lounge chair with tablet arm; small undercounter refrigerator and microwave.
User-provided Equipment	None required.
Special Requirements	None required.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

CHAPTER 5 ACTIVITY FIELDS

5-1 INTRODUCTION AND PLANNING ISSUES.

This chapter provides criteria for activity fields, including a multipurpose activity field with an encircling running track, softball fields, spectator seating, and support buildings. These features may be included as standalone or as components of a fitness center complex. When programming these fields and support features, different category codes apply and funding sources may be different from the fitness center.

The activity fields must be planned in conjunction with a comprehensive audit of other existing or planned activity fields on the installation to maximize consolidation and shared efficiencies.

5-1.1 Related Activity Areas.

The following are outdoor activity areas that will benefit from being planned in conjunction with, and located in proximity to, the activity fields:

- Tennis courts
- Outdoor basketball courts
- Other sports fields, as needed

5-2 PROGRAM AREAS.

Table 5-1 lists the program areas of the activity fields, breaking them down by support building areas and site areas.

Table 5-1 Multipurpose Field

Functional Program Area	Description/Service Exceptions
Support Building	
Concessions	Accommodates the preparation and sales of food and drink.
Covered public space	Covered, paved exterior area directly adjacent to the concessions service window.
Male toilets	A standard configuration for toilets. This can be expanded if the program and budget allow.
Female toilets	A standard configuration for toilets. This can be expanded if the program and budget allow.
Maintenance bay	Accommodates the storage of a field maintenance vehicle, maintenance supplies, and master lighting controls.
Announcer's booth/press box	Second-story space to accommodate up to three observers and the scoreboard controls.
Dry goods storage	Accommodates storage of non-food items such as paper goods.

Sports activity storage	Accommodates storage of sports activity items such as cones and flags.
Building support/vertical circulation	Accommodates building HVAC, janitor's closet, and non-ABA access to the press box.
Fields and Site Spaces	
Multipurpose field and track	Fixed-size field encircled by a 1312-ft (400-meter) running track per Table 5-8.
Softball field	Fixed-size softball field per Table 5-9.
Bleacher pads	Standard-size concrete pads and portable, aluminum bleachers.
Lighting zone	Area outside the field and bleacher footprint with high mast lights to illuminate the track and field to standardized levels.
Scoreboard zone	Area outside the field with an electronic scoreboard.
Paved parking	Usually shared with the fitness center, other fields, or other facilities.
Unpaved parking	Overflow parking area for sport tournaments or other large group activities.
Site circulation	A mix of hard-surface pathways and grassed areas to connect the various areas of the multipurpose field complex.

5-3 SPACE PROGRAM.

The multipurpose field has a standardized space program as illustrated in Figure 5-1. It is not developed with the fitness center's interactive spreadsheets.

Figure 5-1 Activity Field Space Program

Functional Program Area		Standard ft^2	Standard m^2	Quantity	Total Area ft^2	Total Area m^2
Support Building	Concessions*	200	18.6	1	200	18.6
	Covered public space*	280	26.0	1	280	26.0
	Male toilets*	160	14.9	1	160	14.9
	Female toilets*	160	14.9	1	160	14.9
	Maintenance bay	280	26.0	1	280	26.0
	Press box	350	32.5	1	350	32.5
	Dry goods storage	80	7.4	1	80	7.4
	Sports activity storage	40	3.7	1	40	3.7
	Building support/vertical circulation	30	2.8	1	30	2.8
Subtotal - Net Spaces					**1,580**	**146.8**
Net-to-Gross Factor (incl. construction)				**15%**	**237**	**22.0**
Total Building					**1,817**	**168.8**
Site	Multipurpose field and track	141,570	13,151.9	1	141,570	13,151.9
	Softball field	82,915	7,702.8	1	82,915	7,702.8
	Bleacher pads*	6,750	627.1	2	13,500	1,254.2
	Parking*	450	41.8	38	17,100	1,588.6
	Site circulation*	57,181	5,312.1	1	57,181	5,312.1
Total Site					**312,266**	**29,009.5**
Total Project Area					**314,083**	**29,178.3**

* If the multipurpose and softball field are part of a larger complex of related activity fields, sizes of these areas may be increased if mission, site, and budget allow. Areas without an (*) must not be changed regardless of adjacent functions.

5-4 LOCATION DETERMINANTS.

The location of the activity fields must be coordinated with the fitness center location as described in paragraph 2-1 and the planning issues noted in paragraph 5-1. Ensure adequate site space per Figure 5-1.

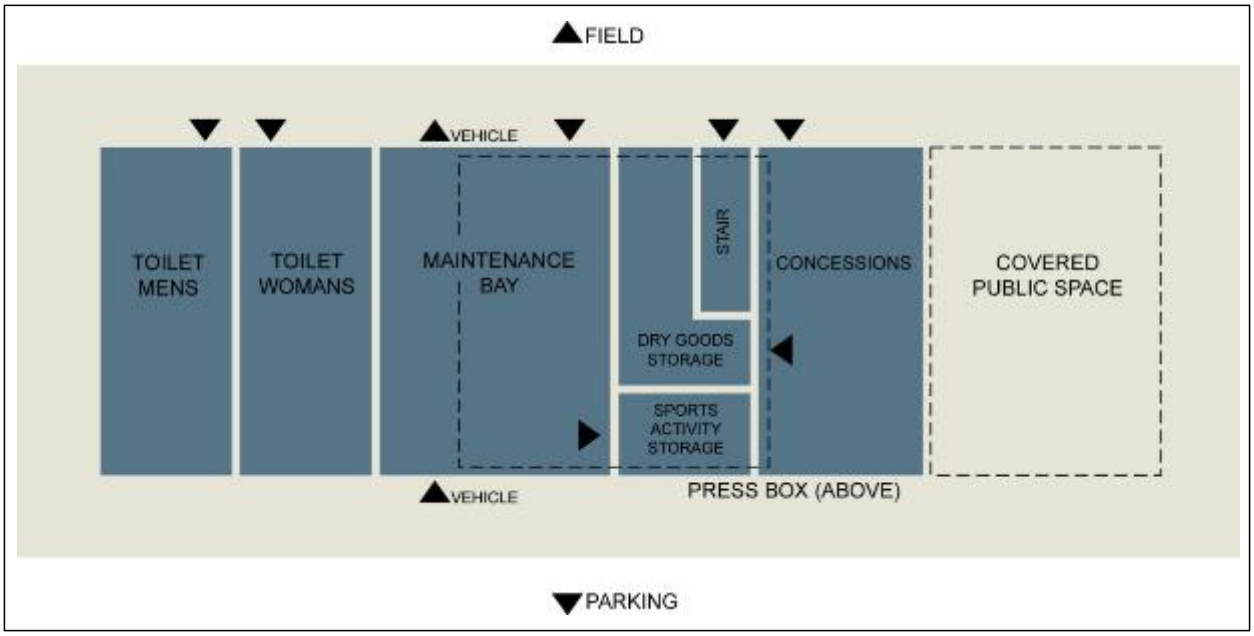
5-5 LAYOUT AND ADJACENCIES.

The appropriate layout and adjacencies for the multipurpose field and associated buildings are illustrated in Figures 5-2 and 5-3. These diagrams do not convey a building or site shape and do not include the softball field(s). If softball fields are being included with the fitness center and multipurpose field, they must be located to take advantage of common features such as parking, circulation paths, and support buildings.

5-5.1 Support Building.

The diagram in Figure 5-2 indicates acceptable relative adjacencies of the support building.

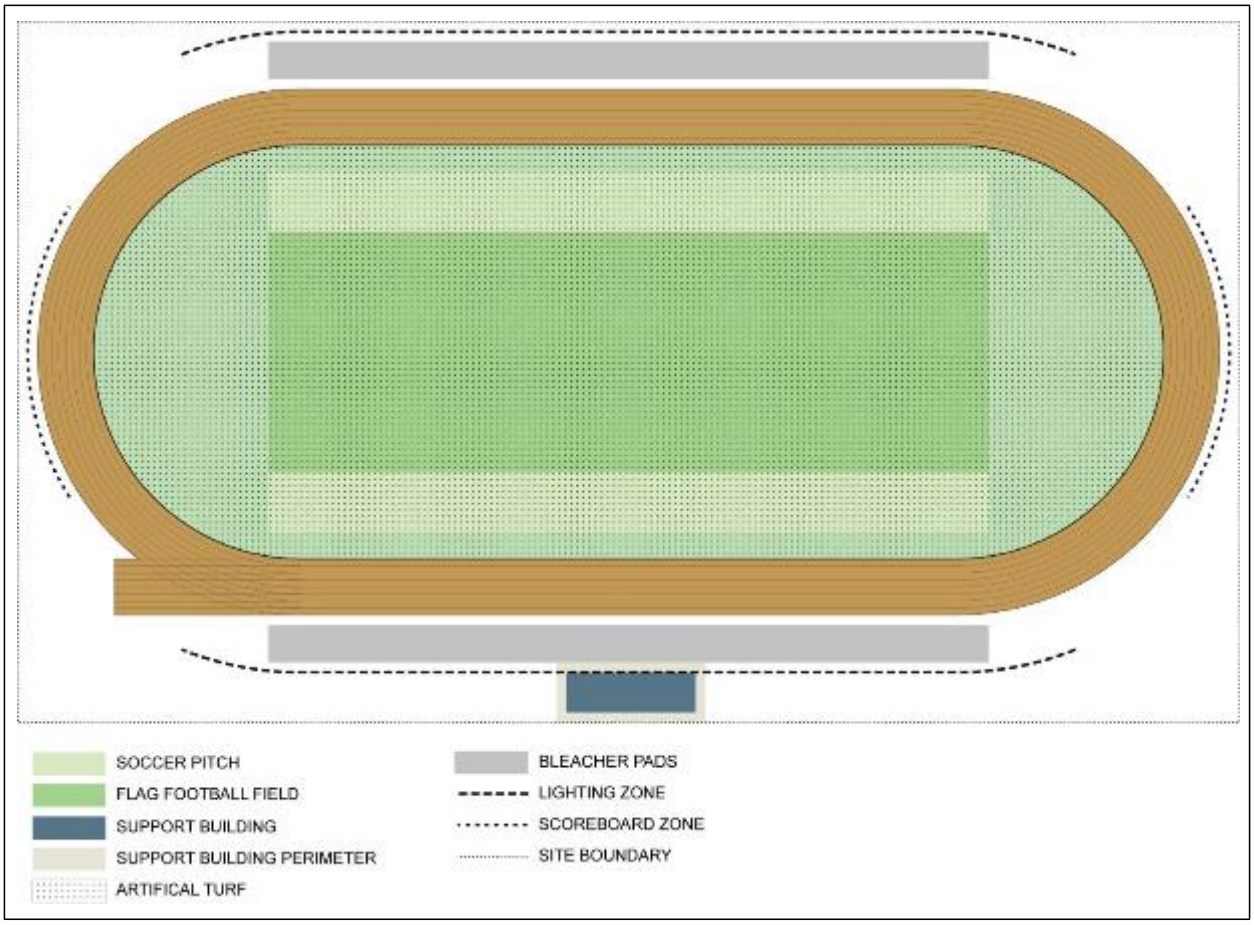
Figure 5-2 Support Building Functional Relationship Diagram



5-5.2 Multipurpose Field and Site.

The diagram in Figure 5-3 indicates acceptable relative adjacencies of the multipurpose field and site spaces.

Figure 5-3 Multipurpose Field and Site Functional Relationship Diagram



5-5.3 Space Assessment.

See Chapter 4 for additional information on space types and their relationships to each other.

5-6 GENERAL DESIGN CRITERIA.

The design of the multipurpose and softball fields must comply with the design guidance in Chapter 3. Additional requirements or exceptions specific to the activity fields are provided here.

5-6.1 Accessibility.

Per *ABA Accessibility Standards* (ABAAS), Section 407.4, the second-story press box space is not required to be accessible as it is not open to the general public, houses less than five persons, and is less than 500 square feet (46.5 m^2). Accessible routes are continuous, unobstructed paths connecting all accessible elements and spaces. The accessible route must comply with ABAAS provisions for location, width minimum of 36 inches (900 mm), passing space, head room, surface, slope (maximum of 1:12 or 8.33 percent), changes in level, doors, egress, and areas of rescue assistance.

5-6.2 Exterior Lighting.

Provide lighting and control systems per paragraph 3-6.4.1 and the additional criteria identified in paragraph 5-8, which notes field lighting levels and control requirements.

5-7 SITE DESIGN.

The site design, parking, other hard-surface areas, and landscaping of the activity fields must comply with the design guidance identified in Chapter 3. Additional requirements for specific areas of the multipurpose and softball fields are provided in paragraph 5-8.

5-8 SPECIFIC DESIGN CRITERIA.

The specific design needs for each functional area of the activity fields are provided in Tables 5-2 through 5-9 in a standard functional data sheet format.

Table 5-2 Concessions

Description/ Usage	Space for preparation and sale of food and drinks.
Ceiling Ht.	10 ft (3.05 m) minimum
Finishes	**Walls.** CMU with heavy-duty epoxy paint. **Floor**. Sealed concrete or seamless vinyl. **Ceiling**. Painted exposed structure.
Plumbing	Two-compartment stainless-steel sink with hot and cold water supply and a clean-out. Provide a separate hand-washing sink. Floor drain. Provide water connections to the ice machine and soda fountain. Provide wall hydrant on exterior wall.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 68 °F (20 °C) to ventilated 10 °F (6 °C) above the 1.0% dry bulb temperature. No mechanical cooling.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide dedicated outlets for the refrigerators, ice machine, and fountain soda machine. Provide countertop-height outlets for POS units, microwave, and other food/warming equipment as required.
Lighting	Provide system per Chapter 3, "Electrical." Provide 40 fc (400 lx) of general ambient lighting. Provide task lighting of 50 fc (500 lx) at the food preparation and service areas. Provide an occupancy sensor on the light controls.
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. None required. **Telephone**. Provide one line per POS. Provide at least one additional general-purpose phone line. **Data**. Provide one outlet per POS. Provide additional outlets, as needed, for associated hardware. **Security**. Consider providing duress alarm control next to the POS units.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Provide 24-in. (600-mm) -deep solid surface work-surface counter for food preparation. Provide two solid surface service counters with service windows opening to the public covered space and the side facing the field. Provide coiling doors at the service windows.
Furnishings, Fixtures & Equip. (FF&E)	Provide a menu board, an under-counter, reach-in refrigerator, a freezer, and an ice maker.
User-provided Equipment	A glass-front, front-loading refrigerated display case; soda fountain machine with under-counter boxed syrup; microwave; and other food preparation/warming equipment as required by the specific menu. Trash receptacles.
Special Requirements	Provide a minimum 36-in (900-mm) -wide access door to the dry goods storage room.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

Table 5-3 Covered Public Space.

Description/ Usage	Covered, paved exterior area directly adjacent the concessions service window.
Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls.** None. **Floor**. Sealed concrete or brick or stone pavers if budget allows. **Ceiling**. Painted exposed structure.
Plumbing	Provide a keyed exterior wall-hydrant; frost-free as dictated by climatic conditions.
HVAC	None.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	None required.
Lighting	Provide system per Chapter 3, "Electrical." Provide 5 fc (50 lx) of general ambient lighting.
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. None required. **Telephone**. Provide emergency telephone. **Data**. None required. **Security**. None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	None required.
Furnishings, Fixtures & Equip. (FF&E)	Provide trash and recycling receptacles. Provide an AED in an exterior-mounted tamper-resistant case with a breakable seal for access.
User-Provided Equipment	None required.
Special Requirements	None required.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

Table 5-4 Men's and Women's Toilets

Description/ Usage	Separate ABA-compliant men's and women's toilet facilities that exit directly to the exterior.
Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls**. Semi-gloss enamel painted, mold-resistant gypsum wallboard with a ceramic tile wainscot. Prefer full-height ceramic tile walls with integral patterns, especially on wet walls. Use a dark-colored epoxy grout. **Floor**. Slip-resistant epoxy no-seam floor with integrated epoxy base to 6 in. (150 mm) AFF. **Ceiling**. Mold-resistant gypsum wallboard with a veneer plaster (level 5) finish and epoxy paint.
Plumbing	**Male:** Two flush-valve floor-mounted urinals, two flush-valve wall-mounted water closets, and two lavatories. Provide wash-out stall urinals, recess-mounted so that top of lip is level with adjacent finished floor. **Female:** Three flush-valve wall-mounted water closets and two lavatories. Provide floor drains for proper drainage located under the water closet partitions. Provide keyed hose bibbs with hot and cold water.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 55 °F (13 °C) to ventilated 10 °F (6 °C) above the 1.0% dry bulb temperature. No mechanical cooling. Exhaust per UFC 3-410-01.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Lighting fixtures must have translucent, damp location, non-breakable protective covers with shatterproof lenses.
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. None required. **Telephone**. None required. **Data**. None required. **Security**. None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Provide solid-surface lavatory countertops supported at both ends, with the front edge supported by galvanized angle reinforcing. Consider use of holes in lavatory countertop for waste disposal; coordinate location of paper towel dispenser. The sink must be integral with the counter. As an option, consider stainless-steel wash trough-style lavatories. Provide stainless-steel, solid plastic (HDPE) toilet and urinal partitions secured at floor and ceiling. Toilet accessories must be stainless steel and include: toilet paper dispensers, paper towel dispenser, trash receptacle, robe and towel hooks, grab bars, feminine hygiene receptacles in women's water closets, seat cover dispensers, and soap dispensers at lavatories. Provide full-width mirror at the lavatories.
Furnishings, Fixtures & Equip. (FF&E)	None required.
User-provided Equipment	None required.
Special Requirements	Exterior doors must have a keyed lockset that is lockable from the exterior only.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft² (m²)	

Table 5-5 Maintenance Bay

Description/ Usage	Space for field maintenance equipment, including truck, field groomer, and main access for field lighting.
Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls.** CMU with heavy-duty epoxy paint. **Floor**. Sealed concrete. **Ceiling**. Painted exposed structure.
Plumbing	Provide floor drain with a filter-cartridge-style oil/water separator. Provide exterior wall hydrant.
HVAC	Provide system per Chapter 3, "HVAC." Temperature operating range: 55 °F (13 °C) to ventilated 10 °F (6 °C) above the 1.0% dry bulb temperature. No mechanical cooling.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. None required. **Telephone**. None required. **Data**. None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Provide lockable cabinets for cleaning supplies. Provide two overhead doors on opposite sides of the bay to allow drive-through with the maintenance vehicle. Provide one separate personnel door to the side of one of the overhead doors. All doors must be lockable.
Furnishings, Fixtures & Equip. (FF&E)	Provide workbenches and lockable tool and parts storage cabinet.
User-provided Equipment	Synthetic turf groomer.
Special Requirements	Place the master control panel for the field lights and irrigation system in this space. Provide a paved approach outside the overhead doors, where equipment can be hosed-off prior to entering the bay.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

Table 5-6 Announcer's Booth/Press Box

Description/ Usage	Second-story space to accommodate observers and scoreboard controls.
Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls.** CMU with heavy-duty epoxy paint. **Floor**. Sealed concrete. **Ceiling**. Painted exposed structure.
Plumbing	None required.
HVAC	Ventilate to not greater than 10 °F (6 °C) above the 1.0% dry bulb temperature. No heating or mechanical cooling provided.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide dedicated power to the wireless scoreboard controls.
Lighting	Provide system per Chapter 3, "Electrical." Provide an occupancy sensor on the light controls.
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. Where required in project scope, provide PA system with speakers to project sound to spectator's area(s). **Telephone**. Provide one line. **Data**. Wireless scoreboard controller. **Security**. None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Provide a seated-height solid surface countertop at field-side window.
Furnishings, Fixtures & Equip. (FF&E)	Three chairs. Provide the control panel for the wireless scoreboard. Wireless scoreboard controls to include a game timer/clock, home and visitor scores, and quarter and half indicators.
User-provided Equipment	None required.
Special Requirements	Provide lockable, horizontal sliding windows facing the multipurpose field for the full width of the wall. The window sill must be at the seated-height countertop and the glazed area must extend to 78 in. (1950 mm) AFF. If the support building serves multiple activity fields, provide a counter and windows on each side that faces a field.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

Table 5-7 Dry Goods and Sports Activity Storage

Description/ Usage	Accommodates separate storage spaces for dry food service supplies such as paper goods (not for food storage) and sports activity items such as cones and flags.
Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls**. CMU with heavy-duty epoxy paint. **Floor**. Slip-resistant sealed concrete. **Ceiling**. Painted exposed structure.
Plumbing	None required.
HVAC	Ventilate to not greater than 10 °F (6 °C) above the 1.0% dry bulb temperature. No heating or mechanical cooling provided.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. None required. **Telephone**. None required. **Data**. None required. **Security**. None required.
Acoustics	No special provisions required.
Casework/Built-in	None required.
Furnishings, Fixtures & Equip. (FF&E)	Provide storage shelving as required.
User-provided Equipment	None required.
Special Requirements	The walls for both storage rooms must extend to underside of structural ceiling. The dry goods storage must only be accessible from the concessions area via a lockable door. The sports activity storage must only be accessible from the exterior via a lockable door.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

Table 5-8 Multi-Purpose Field and Track

Description/ Usage	This table describes the multipurpose field and track and associated features including the bleacher pads, lighting zone, **\1** scoreboard zone, and site circulation. **/1/**
Dimensions	**Track**. A 1312-ft (400-meter) elliptical track: six lanes for medium-sized facilities and smaller, eight lanes for large-sized facilities and larger, and a 328.1-ft (100-meter) dash straightaway. For Air Force only, provide lane markings at 1.24 mile (2.0 km) distance for alternate walk test. See **Special Requirements** below for additional criteria. **Multipurpose field**. Fixed-size field of 360 ft by 160 ft (109.7 m by 48.8 m) playing area, with an additional 10 ft (3.0 m) of unobstructed space on each side. The synthetic turf multipurpose field must be striped for soccer per **\1** *NCAA Soccer Rules* **/1/** and for flag football per United States Flag Football Association (USFFA) *National Rules*. It is preferred that striping be integrated in the factory with the synthetic turf. The field must have white stripes for flag football and yellow stripes for soccer. In general, **\1** NCAA **/1/** and USFFA standards must be followed. See **Special Requirements** below for additional criteria. **Bleacher pads**. Pads are sized to accommodate 5-row tilt-up bleachers with a 5-ft (1.53-m) space around perimeter. The length can be continuous or with 5-ft (1.53-m) gap between each set of bleachers.

Surface Materials	**Track**. Provide a first-class, full-pour polyurethane synthetic surface, including all necessary sub-structure and drainage to obtain long-life durability, pursuant to the guidelines of **\1** *NCAA Cross Country/Track and Field Rules*. ***/1/*** The minimum thickness of the track surface must be ½ in. (13 mm) and the surface color will be determined by the installation. Provide a flush, paved transition strip a minimum width of 18 in. (450 mm) between the outside edge of the track and the surrounding area. This transition strip must not present a tripping hazard. The surfacing system minimum performance standards must reflect ASTM requirements for the materials specified. Running lanes will be marked on the track and markings will be placed for the 1.5-mile (2.41 km) events through use of a standard starting line and finish location arrow. The synthetic track system must be designed and constructed with a minimum five (5) year warranty covering the synthetic track surface against defects, workmanship, and normal use. Provide service start and stop signage for fitness testing. **Multipurpose field**. Provide either a natural grass turf or a synthetic artificial turf surface. As a minimum, the synthetic turf field must be an infill turf product utilizing a UV-stable, extruded-spine monofilament polyethylene fiber system. The finished playing surface must appear as mowed grass with no irregularities and must afford excellent traction for athletic shoes of all types. The finished surface must resist abrasion and cutting from normal use. The infill materials must be a mixture of graded, dust-free, rounded silica sand and crumb rubber. Seams (glued and/or sewn) must be as recommended by the synthetic turf manufacturer. The field must include an adequate drainage layer, including geotextile, panel drains, and stone base below the playing surface designed to prevent the field from excessive ponding of water. Grade field subgrades to provide a minimum of 0.7% slope from crown to sidelines. Drainage mats are not permitted. The synthetic playing field must be designed and constructed with a minimum eight- (8) -year warranty covering the synthetic playing surface against defects, workmanship and normal use, and increased G-max rating. The G-max value of the field must be from 100 to 125 at the completion of the installation and must not exceed a value of 175 during the 8-year warranty period; the increase in G-max value must not increase more than 5% in any single year. This surface must cover the entire area within the inside perimeter of the track. **Bleacher pads**. Reinforced concrete. Pad surface must be flush with surrounding areas. **Site circulation**. Provide concrete pathways with grass in non-paved areas. If budget and design language allow, provide brick or porous concrete pavers in lieu of concrete.
Plumbing and Drainage	**Multipurpose field**. Provide drainage per the selected manufacturer's specifications; do not use plastic cells for drainage. Subbase system must consist of a stone aggregate base on the subgrade to serve as a base for the synthetic turf and remove water from the synthetic turf surface. Subbase system must also include a concrete edge curb and attachment system and a sub-drainage system to convey storm and/or groundwater away from playing field areas. Sub-drainage system must consist of perforated HDPE drainage piping in gravel-filled trenches sloped to provide positive drainage. Provide an appropriate liner, as specified by the manufacturer, over the prepared subgrade and interiors of the sub-drain trenches prior to installation of subbase materials, piping, and trench backfill to prevent groundwater from entering the sub-drainage system. Provide water supply with quick hose disconnects at 4 locations around the perimeter of the field. If facilities include a natural grass turf surface, the field wet-down system is not required. Provide a sprinkler system or other means of watering the turf. **Site circulation**. Provide drinking fountains adjacent to an approach path for the track and multipurpose field. These drinking fountains may also be located on the support building exterior wall.

Power	Provide power to the lights, wireless scoreboard, and lighting control/communications kiosk.
Lighting	Provide system per Chapter 3, "Lighting." IESNA Class III lighting levels for recreation mode and Class II for competition mode.
Fencing	Provide a 4-ft (1.2-m) -tall vinyl-coated chain-link fence around outermost lane of track. The fencing must be 9 gauge (prior to vinyl coating) galvanized steel with vinyl-coated PVC coating, double-knuckle top and bottom with top and bottom rail. Color of vinyl coating specified by installation. Posts are to be 3-in. (75-mm) -diameter galvanized steel with vinyl coating and foundations are to be concrete with a minimum depth of 4 ft (1.2 m) or to the frost line, whichever is greater.
Furnishings, Fixtures & Equip. (FF&E)	**Multipurpose field**. Soccer goals and cones. Provide natural grass turf or synthetic artificial turf grooming and maintenance equipment. **Bleacher pads**. Five-row, tilt-up, portable aluminum bleachers. Provide trash and recycling receptacles. **Scoreboard zone**. Provide an electronic wireless scoreboard that includes game timer/clock, home and visitor scores, and quarter and half indicators. Scoreboard must be sized to ensure visibility from the opposite end of the field. Provide protector (i.e., fencing/net) for scoreboard.
Special Requirements	**Track**. Track design and exact dimensions must be per **\1** *NCAA Cross Country/Track and Field Rules* **/1/** guidelines for running tracks. Track will include lane markings; markings will be placed for 1.5-mile (2.41-km) events. The inner lane must have a width of 48 in. (1200 mm) and all other lanes must have a width of 42 in. (1050 mm). Inner and outer edges of track to have concrete containment curb per track manufacturer's design and requirements. **Multipurpose field**. Fixed-size playing area per **Dimensions** section above. Provide white striping for flag football per USFFA *National Rules*, “Diagram of Eight Man Field.” Provide yellow striping for soccer per **\1** *NCAA Soccer Rules*. **/1/** Provide an installation logo at the center of the field. **Site circulation**. Provide a lighting control/communications kiosk adjacent to an approach path to the track and multipurpose field. The kiosk must include controls for the recreation mode light level on a one-hour maximum timer, a phone or intercom communication link to the fitness center control desk, and a phone or intercom communication link to the installation emergency dispatch.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

Table 5-9 Softball Field

Description/ Usage	This table describes the requirements for the softball field and related features, including dugouts, bleacher pads, lighting, scoreboard, and site circulation.
Dimensions	**Softball Field.** The dimensions are as follows: bases are 70 ft (21.3 m) apart, pitching mound must be 50 ft (15.2 m) from home, and the outfield fence must be 300 ft (91.4 m) from home. The backstop must be 25 ft (7.6 m) from home plate. The side fence must be 25 ft (7.6 m) from the foul line. The synthetic turf softball field must be striped for softball per the **\1** *GSL – USSSA Slow-Pitch Rule Book & By-Laws* **/1/** to include the foul lines, batters' boxes, coach's boxes, and on-deck circles. It is preferred that striping be integrated in the factory with the synthetic turf. Provide breakaway bases (double first base) attached to rubber grommets anchored in the ground that release on impact. The new synthetic turf softball field must utilize an "infill" system consisting of synthetic turf fibers and an infill of sand and crumb rubber. See **Special Requirements** below for additional criteria. **Bleacher pads.** Pads are sized to accommodate 5-row tilt-up bleachers with a 5-ft (1.53-m) space around perimeter. Separate pads and bleachers are to be provided on the home and visitor sides behind backstop.
Surface Materials	**Softball field.** Provide either a natural grass turf or a synthetic artificial turf surface. As a minimum, the synthetic turf field must be an infill turf product utilizing a UV-stable, extruded-spine monofilament polyethylene fiber system. The finished playing surface must appear as mowed grass with no irregularities and must afford excellent traction for athletic shoes of all types. The finished surface must resist abrasion and cutting from normal use. The infill materials must be a mixture of graded, dust-free, rounded silica sand and crumb rubber with a ratio of sand to rubber to be per manufacturer's recommendation but must be a minimum 25% sand to rubber by volume. **\1** Seams (glued and/or sewn) must be as recommended by the synthetic turf manufacturer. To the maximum extent possible, field striping, markings, and inlays must be factory installed. **/1/** The field must include an adequate drainage layer, including geotextile, panel drains, and stone base below the playing surface, designed to prevent the field from excessive ponding of water. Grade field subgrades to provide a minimum of 0.7% slope for drainage. Drainage mats are not permitted. The synthetic playing field must be designed and constructed with a minimum eight (8) year warranty covering the synthetic playing surface against defects, workmanship, and normal use, and increased G-max rating. The G-max value of the field must be from 100 to 125 at the completion of the installation and must not exceed a value of 175 during the 8-year warranty period; the increase in G-max value must not increase more than 5% in any single year. Provide a cast-in-place concrete perimeter edge curb constructed as recommended by the synthetic turf manufacturer. **Bleacher pads.** Reinforced concrete. Pad surface must be flush with surrounding areas. **Site circulation.** Provide concrete pathways with grass in non-paved areas. If budget and design language allow, provide brick or porous concrete pavers in lieu of concrete.

Plumbing and Drainage	**Softball field**. Provide drainage per the selected manufacturer's specifications; do not use plastic cells for drainage. Subbase system must consist of a stone aggregate base on the subgrade to serve as a base for the synthetic turf and remove water from the synthetic turf surface. Subbase system must also include a concrete edge curb and attachment system and a sub-drainage system to convey storm and/or groundwater away from playing field areas. Sub-drainage system must consist of perforated HDPE drainage piping in gravel-filled trenches sloped to provide positive drainage. Provide an appropriate liner, as specified by the manufacturer, over the prepared subgrade and interiors of the sub-drain trenches prior to installation of subbase materials, piping, and trench backfill to prevent groundwater from entering the sub-drainage system. Provide a minimum of 4 quick-couplers (2 on each side of the field) for turf maintenance and washing down the field. Quick-couplers must be located around the field so that a 100-ft (30-m) hose can reach all parts of the field. Locate couplers adjacent to the synthetic turf. If facilities include a natural grass turf surface, the field wet-down system is not required. Provide a sprinkler system or other means of watering the turf. **Site circulation**. Provide drinking fountains adjacent to an approach path for the track and multipurpose field. These drinking fountains may also be located on the support building exterior wall.
Power	Provide system per Chapter 3, "Electrical." Include power for lights, wireless scoreboard, and lighting control/communications kiosk.
Lighting	Provide system per Chapter 3, "Lighting." Match requirements of football fields per UFC 3-530-01.
Fencing	**Backstop Fencing**. Provide a 16-ft (4.9-m) -tall vinyl-coated chain-link softball backstop with 6-ft (1.8-m) top overhang panel sloped at 45 degrees 25 ft (7.6 m) from home plate. The backstop must be 16 ft (4.9 m) wide on the home field side, 16 ft (4.9 m) wide behind home plate, and 16 ft (4.9 m) wide on the visitor side. The fencing must be 9 gauge (prior to vinyl coating) galvanized steel, vinyl coated, and be double-knuckled at the top and bottom. Color of vinyl coating specified by installation. Provide an 8-in. (200-mm) -wide concrete maintenance curb 4 in. (100 mm) above adjacent grade at the base of / below the fence. **Side Fencing**. Provide a 6-ft (1.8-m) -tall vinyl-coated chain-link fence between the backstop and outfield fence with one 4-ft (1.2-m) man gate adjacent to the farthest end of the dugout from home plate and one double 5-ft (1.5-m) (10-ft [3-m] opening) equipment gate halfway between the first to second base line and the outfield fence. Fencing must be 9 gauge (prior to vinyl coating) galvanized steel, vinyl coated, double-knuckle top and bottom with top and bottom rail. Color of vinyl coating specified by installation. Provide an 8 in. (200 mm) wide concrete maintenance curb 4 in. (100 mm) above adjacent grade at the base of /below the fence. **Outfield Fence**. Provide a 6 ft (1.8 m) tall vinyl coated chain link fence around the outfield. Fencing must be 9 gauge (prior to vinyl coating) galvanized steel with vinyl coating, double knuckle top and bottom with top and bottom rail with 4-1/2 in. (112 mm) corrugated plastic tubing over top rail/fence. Color of vinyl coating specified by Installation. Provide an 8-in. (200-mm) -wide concrete maintenance curb 4 in. (100 mm) above adjacent grade at the base of / below the fence. **Foul Pole**. Provide a 20-ft (6.1-m) -tall foul pole with 1.5 ft (0.5 m) by 12 ft (3.7 m) visible galvanized steel mesh wing with optic yellow vinyl coating at the intersection of each foul line and outfield fence.

Furnishings, Fixtures & Equip. (FF&E)	**Softball field**. Bases. Provide natural grass turf or synthetic artificial turf grooming and maintenance equipment. **Bleacher pads**. 5-row, tilt-up, portable aluminum bleachers. Provide trash and recycling receptacles. **Scoreboard zone**. Provide an electronic wireless scoreboard that includes game timer/clock, home and visitor scores, and ball/strike/out indicators. Scoreboard must be sized to ensure visibility from the backstop. Provide protector (i.e., fencing/net) for scoreboard.
User-provided Equipment	None required.
Special Requirements	**Softball field**. Fixed-size playing area per **Dimensions** above. **Site circulation**. Provide a lighting control/communications kiosk adjacent to the side fencing. The kiosk must include lighting system controls on a one-hour maximum timer, a phone or intercom communication link to the fitness center control desk, and a phone or intercom communication link to the installation emergency dispatch. **Dugouts (Optional)**. Provide dugouts for the visitor and home teams. Each dugout to be 8 ft (2.4 m) deep by 20 ft (6.1 m) wide with a minimum 4-in. (100-mm) -thick broom-finished concrete slab floor; surrounded by a 6-ft (1.8-m) -tall vinyl-coated chain-link fence beginning 25 ft (7.6 m) along the base line from home plate. The fencing must have a 4-ft (1.2-m) -wide opening at the end farthest from home plate. Fencing to be 9 gauge (prior to vinyl coating) galvanized steel, vinyl coated, double-knuckle top and bottom with top and bottom rail. The concrete slab floor must extend 4 in. (100 mm) beyond the face of the chain link fencing and be 4 in. (100 mm) above adjacent grade. Provide a single-slope standing seam metal roof with 8 ft (2.4 m) clear to underside of structure inside of the dugout. The roof must start behind/outside of the fence to the field and extend a minimum of 1 ft (0.3 m) beyond the side and back fencing of the dugout. Color of vinyl coating and metal roof as specified by installation.
For use during project execution by the appropriate Service agency	
Occupancy	Staff Customers
Min. net ft^2 (m^2)	

Table 5-10 \1\ Building Support/Vertical Circulation

Description/ Usage	This space is to accommodate building HVAC, janitor's closet, and non-ABA access to the press box.
Min. Ceiling Ht.	N/A
Finishes	**Walls.** CMU with heavy-duty epoxy paint. **Floor.** Sealed concrete or seamless vinyl. **Ceiling.** Painted exposed structure.
Plumbing	Provide a floor drain. Provide a mop sink with hot and cold water and a hose connection.
HVAC	Heating and ventilation only.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	As required for mechanical equipment.
Lighting	Provide system per Chapter 3, "Electrical." Provide an occupancy sensor on the light controls.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Provide shelving in janitor's closet.
Furnishings, Fixtures & Equip. (FF&E)	Mechanical HVAC equipment, as required. If required by installation, provide lockable cabinets for cleaning supplies in janitor's closet.
User-provided Equipment	None required.
Special Req.	None.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

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CHAPTER 6 AUSTERE FITNESS CENTERS (NAVY ONLY)

CHAPTER 1 GENERAL

6-1 PURPOSE.

The purpose of this chapter is to provide implementation requirements for austere construction as established by CNIC. These requirements were developed to address construction of support facilities in CNIC-designated operating environments.

6-2 DEFINITION AND SCOPE.

An austere facility is defined as a structure designed and constructed with minimal infrastructure, footprint area, and finishes, incorporating applicable building codes and facility criteria to assure adherence to all health, accessibility, and life safety standards and regulations required to fulfill the mission, including antiterrorism force protection (AT/FP) appropriate to each site.

- Austere construction is intended for support facilities, such as unaccompanied housing (UH), administration, galleys, and fitness facilities.
- Build austere facilities with the least total ownership costs (TOC) possible, including purchase, maintenance, and use of consistently available alternative local goods.

6-3 APPLICABILITY.

This chapter applies to Navy fitness center facilities designated as austere by CNIC. This chapter modifies requirements provided in other chapters of this UFC.

6-4 MODIFICATIONS.

The following are modifications to this UFC. When designated austere, delete the coordinating paragraph in this UFC and replace with the following Chapter 6 paragraph:

CHAPTER 2 PLANNING AND LAYOUT

2-1 LOCATION DETERMINANTS.

2-1.1 Access.

Locate the fitness center to be visible and easily accessible to a diverse representation of users. Consider sites located along pedestrian paths to the existing or proposed barracks/dormitories, existing or proposed MWR/NEX facilities, and/or the dining facility. To accommodate patron access, consider the relationships to existing or proposed vehicular and pedestrian circulation patterns, bike trails, and bus stops.

2-1.2 Cost.

Design these facilities with consideration of a timeframe appropriate to austere facilities, regionally appropriate acquisition of equipment, base operating support (BOS) access difficulties, and logistical difficulties.

2-3 SPACE PROGRAM.

Refer to UFC 2-000-05N, *Facility Planning Criteria for Navy/Marine Corps Shore Installations*, for space planning spreadsheets for austere fitness facilities.

2-5 SPACE ASSESSMENT.

See the austere functional data sheets in Chapter 6 for additional information on the space types and their relationships to each other.

2-7 PROGRAM AREAS.

2-7.1 Fitness Program, Administrative Areas, and Building Support.

Table 6-1 lists the core and optional areas for the fitness program, administrative areas, and building support. This table identifies functional areas. Program the facility, including areas such as circulation/corridors, exterior wall cavities, and mechanical/electrical/communication rooms to determine the gross area of the building. See UFC 3-101-01 for methods to calculate gross building area.

Table 6-1 \1\ Austere Functional Program Areas

Functional Program Area	Description/ Requirements
Lobby/Reception	
Entry lobby and waiting/display	Entry space in front of control counter and/or vestibule. Combined with a waiting area with seating and display space.
Control counter/equipment issue storage	Sign-in and small gear issue. Provides visual control via LOS to, at minimum, the entry, free weights, and locker room entrance. Visual control over other key areas must be accommodated via LOS or CCTV. Provides area to hold gear for issue (e.g., towels, balls, and racquets).
Public restrooms	Restrooms used primarily by visitors, spectators, and persons not using the locker and shower rooms. Sizing is tied to gym capacity.
Janitor's closet	Space used by custodial staff, with mop sink and storage space.
Administrative	
Director's office	Private office.
Program managers' offices	Workstations.

Administrative/Support Staff	Workstations.
Classroom	Space used for conducting training and large meetings. Classroom sized for 25 persons (750 ft^2 [69.68 m^2) for small facilities, 50 persons (1,500 ft^2 [139.35 m^2]) for medium and large, and 75 persons (2,250 ft^2 [209.03 m^2]) for extra-large and jumbo facilities.
Copy/work/break room	Copier, layout space, storage, small staff break area.
Gymnasium	
Basketball/volleyball court(s)	NCAA-size court(s).
Spectator seating	Minimum of 200 seats, more as required and with additional courts.
Storage/support	Storage area with access to both the gym and to the outside if adjacent intramural fields are present.
Unit PT/Group Exercise	
Group exercise room	One large subdividable room with partitions (for classes and/or unit/command fitness training).
Storage/support	Storage area with access to unit PT/group exercise room.
Fitness Spaces	
Stretching/warm-up/cool-down	Usually one open space; may use floor finishes to separate subspaces; may use alcoves; may use balconies/mezzanines.
Free/plate-loaded weights	
Selectorized (machine) weights	
Cardiovascular (cardio) equipment	
Fitness program manager's office	Private office adjacent to fitness assessment room and fitness spaces. May include fitness testing equipment.
Structured Activities	
Locker rooms	Separate male/female facilities. Each locker room is divided into the three sub areas indicated.
Men's locker room	Programmed per installation population.
Locker/dressing area	Programmed per installation population.
Toilet area	Programmed per installation population.
Shower/drying area	Programmed per installation population.
Women's locker room	Programmed per installation population.
Locker/dressing area	Programmed per installation population.

Toilet area	Programmed per installation population.
Shower/drying area	Programmed per installation population.
Support Areas	
Laundry	For towels and uniforms.

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CHAPTER 3 GENERAL DESIGN CRITERIA

3-3 ARCHITECTURE.

Refer to UFC 3-101-01 for direction as to the appropriate core criteria for architectural details and finish concerning:

- Exterior finishes, vapor retarders, thermal insulation, and air infiltration.
- Design and detail roof systems to resist maximum wind for the area.
- Austere construction requires durable materials and finishes throughout.

In addition to UFC 3-101-01, the following requirements in paragraphs 3-4.3, 3-5.1, and 3-5.2 are specific to austere fitness centers.

3-4.3 Exterior Finishes.

Exterior surfaces requiring paint must use a minimum of one prime coat and two finish coats.

3-5.1 Interior Construction.

Ability to repair, refinish, and reconfigure are important in austere construction. For austere projects, the use of light-frame construction for interior wall construction is preferred. Concrete/masonry is optional; minimize load-bearing walls where appropriate.

Construct cabinets to American Woodworking Institute (AWI) custom grade with heavy-duty hardware.

3-5.2 Finishes.

Refer to Table 6-2 for austere interior finishes. For additional information on finishes in specific areas, see the functional data sheets in Chapter 6.

Ceilings are to be exposed and painted, including all exposed plumbing, mechanical fire stops, and electrical conduit, unless it is more cost-effective to provide a finished ceiling.

Table 6-2 Austere Interior Finishes

General Space	Recommended Finishes			
	Floor	Base	Walls	Ceiling
Entry/vestibule	CONCS/WM	RB	P	P
Control counter/equipment issue storage	CONCS	RB	P	P
Public toilets	CONCS or PT	RB	P or CT	P
Janitor's closet	CONCS	RB	P	P
Administrative office	CONCS	RB	P	P
Classroom/conference room	CONCS	RB	P	P
Copy/work room	CONCS	RB	P	P
Basketball/volleyball courts	RSF	RB	P	P
Group exercise room	RSF	RB	P	P
Fitness spaces	RSF	RB	P	P
Locker rooms	PT	CT	P	P
Toilets	PT	CT	P/CT wet walls	P
Showers	PT	CT	CT full height	P
Laundry	CONCS	RB or CT	P or CT	P
Stairwells	CONCS	RB	P	P

Key:

CONCS – Sealed concrete
CT – Ceramic tile
P – Paint
PT – Porcelain tile
RB – Rubber base
RSF – Resilient sports flooring
WM - Walk-off mat (surface)

3-6 SERVICES.

3-6.1 Plumbing.

Avoid plumbing chases whenever possible by placing plumbing in wall cavities. Fixture clearances must be appropriately sized for the intended occupants and use low-flow WaterSense requirements where feasible.

- Provide hot and cold water to laundry facilities.
- Provide easily accessible shutoff valves at all fixtures.
- Water closets must be commercial-quality. Use low-consumption type only if appropriate for the austere location. It is recommended that areas with low water pressure use power-flush-type water closets. Use elongated, one-piece construction with a closed front seat and a lid. Provide fixtures in a neutral color.

- Provide flush-valve toilets, dual-flush manual type.
- Provide hose bibbs on one exterior wall of each building and near air-cooled mechanical equipment; frost-free as dictated by climatic conditions. Provide floor drains in all janitor's closets and laundry rooms, if applicable.
- Use the following flow fixtures as standards: washerless faucets at lavatories with single-lever faucets. Provide overhead rainfall type showerheads with maximum 2.2 gallons per minute (0.14 liter per second [l/sec]) flow rate. Locate showerheads a minimum of 75 inches (1875 mm) above the shower base.

3-7 FURNISHINGS AND EQUIPMENT.

Furnishings, fixtures, and equipment (FF&E) procurement packages must be designed by the same design agent as the facility to ensure complete coordination. Final approval of FF&E specifications will be determined by the design team, including guidance/input received from the respective NAVFAC interior designers. A turn-key approach to FF&E procurement within military construction projects is directed to the greatest extent possible and practical. This will ensure a coherent FF&E package and the most practical use of funding.

Specified furnishings must be as minimal as possible to meet the required mission of the facility. Durability, flexibility, and sustainability must be the major prerequisites for all products provided. Special attention must be given to the geographic location and extreme weather conditions of the facility to provide the most practical solutions to endure the situation. Surge capabilities must be considered as required by the specific location and facility requirements.

3-8 SITE DESIGN AND ORGANIZATION.

Apply austere decision-making processes to assess, modify, and incorporate location, antiterrorism circulation, and lighting plans appropriate to local conditions.

3-8.2 Parking and Access Drives.

Apply austere decision-making to assess, modify, and incorporate requirements such as pedestrian circulation, bus access, service vehicle parking, and lighting plans appropriately to local conditions and to limit parking as much as possible while still meeting the facility mission. Review the security study and incorporate its requirements into the design. Ensure existing and proposed parking is in compliance with antiterrorism requirements. In austere facilities, parking for residents, visitors, staff, and service personnel must be extremely minimal and only as critical to the mission. Maintenance parking for service functions does not necessarily require dedicated space. Use the expected frequency of maintenance vehicles to determine whether dedicated parking is needed. Locate service access and parking to avoid disturbing residents.

3-8.3 Service Drive.

Limit (or eliminate) use of screen walls.

3-9 SUSTAINABLE DESIGN.

Comply with UFC 1-200-02. For projects designated austere (CONUS and OCONUS), the Chief Engineer of NAVFAC has waived third-party certification requirements.

CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-1 INTRODUCTION.

This chapter identifies the specific design needs for each functional area outlined in the space program.

The interior construction specialties, equipment, and furnishings criteria provided in these tables are broken down as follows:

- Casework/Built-in Equipment. This includes anything physically attached or plumbed to the building, such as counters, cabinets, casework, toilet accessories, fixed window treatments, and laundry machines.
- Furnishings, Fixtures, and Equipment (FF&E). This includes contractor-furnished, contractor-installed loose items such as desks, tables, chairs, and bookshelves.
- User-provided Equipment. This includes all government-furnished, government-installed items, which are typically limited to office equipment such as computers, printers, copiers, and flat panel displays (if mounted, flat panel display mount would be built-in).

4-3 FUNCTIONAL DATA SHEETS.

When designated austere, delete the coordinating table in this UFC and replace with the following Chapter 6 table:

Table 6-3 (Replace Table 4-1) Austere Entry

Description/ Usage	The entry serves as the primary entrance to the facility for patrons.
Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted surfaces. **Floor**. Sealed concrete, moisture and slip-resistant. Provide a surface walk-off mat/area at the entrance door. Provide rubber base. **Ceiling**. Exposed painted structure.
Plumbing	Provide electric water cooler(s) in proximity of public toilets/locker rooms.
HVAC	Provide system per Chapter 3, “HVAC.”
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV**. Provide at least one outlet or as needed to cover the entrance. **CATV/Internal Video**. Consider a CATV outlet. **PA/Audio**. Provide a speaker. **Telephone**. Provide one line. **Data**. Provide an outlet. **Security.** None required.
Acoustics	No provisions required.
Casework/ Built-in Equipment	None.
Furnishings, Fixtures & Equip. (FF&E)	Furniture must be durable, easy to clean, and moisture-resistant, if provided. Provide a means to display installation and staff information.
User-provided Equipment	Provide CCTV cameras per the outlet count.
Special Req.	Provide an airlock at the main entrance. Exterior doors must have continuous or heavy-duty hinges. Provide a grated snow-trap for Northern Tier bases. Signage.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-4 (Replace Table 4-2) Austere Control Counter/Equipment Issue/Storage

Description/ Usage	The control counter is often referred to as the front desk or reception desk. It is the focal point of information exchange within the building and is the check-in location for patrons. Patrons must not be able to access other facility spaces without passing the control desk and checking in. Do not use check-in/counting methods that restrict rapid access/egress to/from the facility, such as a turnstile. Equipment such as towels and balls will be issued from the control desk. It must provide for direct supervision of the facility and greeting, informing, and directing patrons to their particular activity area. Additionally, the control desk serves as the focal point for safety and emergency situations. Staff access to the counter must permit access to the free weight and treadmill areas for emergency response.
Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted surfaces. **Floor**. Sealed concrete, moisture and slip-resistant finish. Provide rubber base. **Ceiling**. Exposed painted structure.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC." Provide an emergency HVAC shut-off control in accordance with UFC 4-010-01.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide power for all equipment per Chapter 3, "Electrical." Perform a power requirement survey as power requirements are extremely site- and locale-specific.
Lighting	Provide system per Chapter 3, "Electrical." Provide 30 fc (300 lx) of general ambient lighting. Provide fixed 50 fc (500 lx) task lighting at the control counter.
Communication	**CCTV**. All monitors must be viewable from this area. **CATV/Internal Video**. None required. **PA/Audio**. Provide PA and audio system controls at the control counter for room-by-room and "all call" communication. Provide intercom capability as directed by installation. Provide a speaker. **Telephone**. Provide at least two general-purpose phone lines. **Data**. Data outlets must be provided for every piece of equipment identified as requiring data, plus a 25% spare capacity for flexibility. Pieces of equipment include, but are not limited to, computers, copier/printer/fax, and ID check system. **Security**. None.
Acoustics	No provisions required.
Casework/ Built-in Equipment	Provide a 24-in (600-mm) -deep counter with built-in base cabinets. Provide file drawers and storage drawers with a minimum of two lockable drawers for each POS. The counter must be dual height for standing transactions, seated office functions, and ABA customer service. Note that ABA-height counter must have knee-hole space on both sides of the counter. The counter must be a durable solid surface material such as concrete or solid surfacing material; laminate is not permitted. Provide a towel return drop opening in the counter top with space for a laundry cart below, if required by operations. Modesty panels and apron must be of durable materials. Provide supports such as steel angle braces for counters with knee-hole space. Provide wall cabinets. Storage must accommodate towels and small athletic equipment such as balls. Provide PA controls.

Furnishings, Fixtures & Equip. (FF&E)	Chairs and stools. Provide an AED.
User-provided Equipment	Desktop computer for administrative functions, CCTV monitors, and printers.
Special Req.	Attendants at the control desk must have direct LOS visual control over the following, at minimum: entry, free weight area, treadmill section of the cardiovascular area, and locker room entrance. Visual control over other key areas must be accommodated via LOS and/or CCTV and are identified in the individual functional data sheets.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-5 (Replace Table 4-4) Austere Laundry

Description/ Usage	The laundry accommodates cleaning and drying of towels and uniforms. Some installations contract out towel laundry; however, there is still a requirement to provide laundry for uniforms. Locate adjacent to the control counter. It is preferred that the location be on an outside wall.
Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted CMU or mold-resistant gypsum wallboard. Provide durable finishes, rub rails, and metal/high-impact plastic corner guards. **Floor**. Sealed concrete with rubber base. **Ceiling**. None or epoxy painted mold-resistant gypsum wallboard.
Plumbing	Provide hot and cold water and drain connections in recessed washer outlet box to each of the washing machines and one laundry sink. Provide floor drains. Provide connections and floor drain to an ice machine, if provided.
HVAC	Provide system per Chapter 3, “HVAC.” Temperature operating range: 68 °F (20 °C) to 76 °F (24 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Laundry Rooms, Central." Provide separate vents for each dryer and vent dryers per UFC 3-410-01.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Regardless of size, enclose laundry rooms with a 1-hour fire barrier.
Power	Provide outlets per Chapter 3, "Electrical". Provide a dedicated circuit for each washer (or washer extractor) and for each dryer (or dryer tumbler). If hard-wired (non-plug connected), provide wall-mounted safety disconnect switch within sight of the equipment it controls.
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. Provide one speaker. **Telephone**. None required. **Data**. None required. **Security**. None required.
Acoustics	No provisions required.
Casework/ Built-in Equipment	Large, high-capacity commercial washers and dryers.
Furnishings, Fixtures & Equip. (FF&E)	Provide storage shelves for laundry supplies. Laundry carts.
User-provided Equipment	None.
Special Req.	Provide easy access to rear of dryers (or tumblers) to allow maintenance and cleaning of vents (see **HVAC**). Provide space for storage of laundry carts. Coordinate door openings and dimensions with room layout and equipment sizes, e.g., laundry carts, washers/extractors, dryers/tumblers, and ice machines.
For use during project execution by the appropriate Service agency	
Occupancy	Staff.
Min. net ft^2 (m^2)	

Table 6-6 (Replace Table 4-5) Austere Public Toilets

Description/ Usage	These toilet rooms are used primarily by patrons and staff if no locker and shower rooms are provided. They must be adjacent to the lobby and gymnasium. Provide unisex or separate male and female restrooms.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Semi-gloss enamel painted, mold-resistant gypsum or ceramic tile wainscot. **Floor**. Sealed concrete or non-slip porcelain tile with dark-colored epoxy grout. Slope tile to drain. **Ceiling**. Exposed painted structure.
Plumbing	Provide wall-hung water closets, wall-hung urinals, and lavatories based on UFC 3-420-01 for the calculated occupancy of the gymnasium. Provide a floor drain.
HVAC	Provide system per Chapter 3, “HVAC.” Exhaust per UFC 3-410-01.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. Provide a speaker. **Telephone**. None required. **Data**. None required. **Security**. None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Solid-surface countertop with either undermount or integral sink. For single-occupancy toilets, wall-hung lavatories without countertop are allowed. Solid plastic (HDPE) toilet and urinal partitions. Toilet accessories: Toilet paper dispensers, paper towel dispenser, trash receptacle, robe hooks, grab bars, sanitary napkin disposal (female water closet stalls), seat cover dispensers, and soap dispensers. Mirror.
Furnishings, Fixtures & Equip. (FF&E)	None.
User-provided Equipment	None.
Special Req.	None.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-7 (Replace Table 4-5) Austere Janitor's Closet

Description/ Usage	This space is for use of custodial staff and includes mop sink and storage space for cleaning equipment and supplies.
Min. Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Semi-gloss enamel painted, mold-resistant gypsum wallboard. **Floor**. Sealed concrete. **Ceiling**. Not required but where provided must be moisture-resistant and cleanable.
Plumbing	Provide a floor drain. Provide a mop sink with hot and cold water and a hose connection.
HVAC	Provide system per Chapter 3, “HVAC.” Exhaust per UFC 3-410-01.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. None required. **Telephone**. None required. **Data**. None required. **Security**. None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Provide shelving.
Furnishings, Fixtures & Equip. (FF&E)	If required by installation, provide lockable cabinets for cleaning supplies.
User-provided Equipment	None required.
Special Req.	Locate in proximity of other areas with plumbing. This closet includes storage for pails, mops, vacuums, and related cleaning supplies and equipment. Include a lockable door (which can be opened from the inside). Provide space for lockable cabinets for cleaning supplies, as required by installation.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-8 (Replace Table 4-8) Austere Administrative Office

Description/ Usage	The administrative office provides space for the director, program manager(s) and/or support staff. This space may also be used for conference and copy room functions for staff.
Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted gypsum wall board. **Floor**. Sealed concrete with rubber base. **Ceiling**. Exposed painted structure.
Plumbing	None required.
HVAC	Provide system per Chapter 3, “HVAC.”
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV.** Provide monitoring capability when directed by the installation. **CATV/Internal Video:** One outlet required for office. **PA/Audio:** Provide a speaker. Provide controls in the office with room-by-room and "all call" communication. Provide intercom capability as directed by installation. **Telephone.** Provide one line per staff plus one additional line for fax and copier. **Data.** Provide one outlet per staff plus one outlet for each printer, copier, and scanner. **Security.** None required.
Acoustics	No provisions required.
Casework/ Built-in Equipment	None.
Furnishings Fixtures & Equipment (FF&E)	Workstations—provide furniture for 64 ft^2 (6 m^2) workstation: desk chair and side chair for open offices. Provide task lighting and adequate space for filing and overhead storage.
User-provided Equipment	Computers and other office equipment.
Special Requirements	Provide an interior window with blinds to accommodate visual supervision over the fitness area and the control counter, where possible. Provide a vision panel, minimum 5 ft^2 (0.46 m^2), in the door.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-9 (Replace Table 4-9) Austere Classrooms

Description/ Usage	This optional space is used for conducting meetings and training. This function may be incorporated into the administrative office area. When provided as a separate space, program for 25 persons at 750 ft^2 (69.7 m^2)
Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted gypsum wallboard. **Floor**. Sealed concrete with rubber base. **Ceiling**. Exposed painted structure.
Plumbing	None required.
HVAC	Provide system per Chapter 3, “HVAC.”
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV.** Provide outlets as required for coverage. **CATV/Internal Video.** Provide one outlet. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line. **Data.** Provide a minimum of one outlet. **Security.** None required.
Acoustics	No provisions required.
Casework/ Built-in Equipment	None.
Furnishings Fixtures & Equipment (FF&E)	Provide tables, chairs, and an AV cart, as required.
User-provided Equipment	Provide CCTV cameras per the outlet count.
Special Requirements	Provide a vision panel, minimum 5 ft^2 (0.46 m^2), in the door if space is provided.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-10 (Replace Table 4-10) Austere Copy/Work/Break Room

Description/ Usage	This optional space is used as a staff workroom for copying, meetings, breaks, and lunches and may be incorporated into the administrative office area.
Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted gypsum wall board. **Floor**. Sealed concrete with rubber base. **Ceiling**. Exposed painted structure.
Plumbing	Provide a two-compartment stainless steel sink with hot and cold water. Provide a cold-water connection for refrigerator ice maker.
HVAC	Provide system per Chapter 3, “HVAC.”
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide one additional outlet at counter height for convenience if casework is provided.
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line. **Data.** Provide outlets as required for equipment. **Security.** None required.
Acoustics	No provisions required.
Casework/ Built-in Equipment	Solid-surface countertops if casework is provided.
Furnishings Fixtures & Equipment (FF&E)	Table, chairs, microwave, coffee machine, and refrigerator, as required.
User-provided Equipment	Copier, fax machine, printers, and other office equipment, as required.
Special Requirements	Provide a vision panel, minimum 5 ft^2 (0.46 m^2), in the door if space is provided
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-11 (Replace Table 4-11) Austere Men's and Women's Lockers/Dressing

Description/ Usage	Separate men's and women's locker/dressing rooms will be used by those participating in fitness/sports activities for changing, dressing, and securing personal effects. It is open and directly adjacent to the toilet/shower facilities. As such, moisture and humidity must be addressed in the locker/dressing rooms. Distribution of lockers for each gender are determined on a case-by-case basis.
Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls.** Epoxy or semi-gloss enamel painted CMU or mold-resistant gypsum wallboard. **Floor**. Non-slip porcelain tile with dark-colored epoxy grout. Slope tile to drain. **Ceiling**. Exposed painted structure.
Plumbing	Provide and locate floor drains as required to ensure proper drainage and no standing water on the floor. Provide an electric water cooler.
HVAC	Provide system per Chapter 3, “HVAC.” Temperature operating range: 70 °F (21 °C) to 78 °F (26 °C). Provide supply air from the dry side of this space (opposite the adjacent toilet/shower wet side) and exhaust from the wet area. Exhaust per UFC 3-410-01. Provide ceiling fans with wall-mounted controls (do not have to be HVLS fans).
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Where shower spaces are open to the locker room area, provide corrosion-resistant sprinklers and escutcheons such as stainless steel throughout the locker room.
Power	Provide outlets per Chapter 3, "Electrical." Provide counter-height outlets at the vanity area.
Lighting	Provide system per Chapter 3, "Electrical." Lighting fixtures must have translucent, damp location, unbreakable protective covers. Minimize shadowing at face of lockers.
Communication	**CCTV**. None required. **CATV/Internal Video**. Provide CATV outlets for wall or ceiling mounts. **PA/Audio**. Provide PA speakers as needed for full coverage. Provide speakers for the separate audio system. Provide an emergency call/alarm. **Telephone**. None required. **Data**. None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Provide solid plastic (HDPE) lockers and benches. Lockers must be a minimum of 15 in. wide by 24 in. deep (375 mm by 450 mm). Typically provide a mix of full-and half-sized Z-shaped lockers. The location's climate will determine the ratio of half- to full-sized lockers: colder climates will require a higher percentage (or 100%) of full-sized lockers to accommodate bulkier cold weather gear. Steel lockers are not permitted. Provide minimum 16-in. (400-mm) -wide integral (usually part of the locker system) benches. Mount lockers at a level above the floor to ensure operating hardware is easily reachable. Provide a full-height wall mirror.
Furnishings, Fixtures & Equip. (FF&E)	Provide a scale and a wall clock. Provide a flat panel display.

User-provided Equipment	Provide blood pressure monitor.
Special Req.	Provide sloped-top lockers to preclude the tops of the lockers being used for storage.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-12 (Replace Table 4-12) Austere Men's and Women's Showers

Description/ Usage	These separate male and female areas are directly adjacent to (and may be open to) the corresponding gender's locker/dressing and toilet areas and include private shower stalls. If the facility includes a pool, the pool entry/exit must be adjacent to this area. Shower compartment construction options include constructed separation walls, field-assembled pre-manufactured shower partitions and pre-manufactured solid surface shower compartments.
Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Full-height ceramic tile with dark-colored epoxy grout on cementitious backer units. **Floor**. Non-slip porcelain tile with dark-colored epoxy grout. Slope tile to drain. **Ceiling**. Exposed painted structure.
Plumbing	Provide minimum 36-in (900-mm) -wide private shower stalls for men and women. Provide a minimum of one floor drain at each shower stall and additional drains as needed to ensure proper drainage.
HVAC	Provide system per Chapter 3, “HVAC.” Temperature operating range: 70 °F (21 °C) to 78 °F (26 °C). Provide supply air from the dry side (adjacent locker/dressing area) and exhaust from the wet area (toilet/shower). Exhaust per UFC 3-410-01. If constructed, separation walls are used from floor to ceiling; locate exhaust outlets in each space.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Provide corrosion-resistant sprinklers and escutcheons such as stainless steel throughout the shower room.
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical."
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. Provide an emergency call/alarm. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Solid plastic (HDPE) shower partitions secured at floor and ceiling or permanent walls between showers; see **Finishes** for wall finish. If the facility includes a pool, provide swim mats or tiles that are textured, anti-slip, self-draining, and raise the walking surface above standing water.
Furnishings, Fixtures & Equip. (FF&E)	None required.
User-provided Equipment	None required.
Special Req.	Design the space to block direct views from the public areas into the shower room areas.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-13 (Replace Table 4-13) Austere Men's and Women's Toilets

Description/ Usage	Separate men's and women's toilet facilities are open and directly adjacent to the corresponding gender's locker/dressing and shower areas.
Ceiling Ht.	9 ft (2.74 m) minimum.
Finishes	**Walls.** Ceramic tile wainscot with dark-colored epoxy grout on cementitious backer units at wet walls/fixture areas. Epoxy or semi-gloss painted, mold-resistant gypsum wallboard elsewhere. **Floor**. Non-slip porcelain tile with dark-colored epoxy grout. Slope tile to drain. **Ceiling**. Exposed painted structure.
Plumbing	Provide wall-hung water closets, wall-hung urinals, and lavatories based on UFC 3-420-01 for the calculated occupancy of the facility. Provide floor drains to fully drain area.
HVAC	Provide system per Chapter 3, “HVAC.” Temperature operating range: 70 °F (21 °C) to 78 °F (26 °C). Provide supply air from the dry side of this space (adjacent locker/dressing area) and exhaust from the wet area (toilet/shower). Exhaust per UFC 3-410-01.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety." Where shower spaces are open to the toilet room, provide corrosion-resistant sprinklers and escutcheons such as stainless steel throughout the toilet room.
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Lighting fixtures must have translucent, damp location, unbreakable protective covers with shatterproof lens.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. Provide an emergency call/alarm. **Telephone.** None required. **Data.** None required. **Security.** None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	Solid-surface countertop supported at both ends and with the front edge supported by galvanized angle reinforcing. The sink may be either undermount or integral with the counter. Solid plastic (HDPE) toilet and urinal partitions secured at floor and ceiling. Toilet accessories: toilet paper dispensers, paper towel dispenser, trash receptacle, robe and towel hooks, grab bars, feminine hygiene receptacles in women's water closets, seat cover dispensers, and soap dispensers at lavatories. Provide wall-mounted shelves and full-width mirror at the lavatories. Provide a full-length mirror.
Furnishings Fixtures & Equip (FF&E)	None required.
User-provided Equipment	None required.

Special Req.	Design entrances to prevent direct views into this area.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-14 (Replace Table 4-20) Austere Gymnasium/Basketball/Volleyball Courts

Description/ Usage	Optional space as approved by CNIC. Provide a covered outdoor basketball/volleyball court. Court size must meet NCAA standards. **\1** See Appendix D of this UFC for a link to the NCAA basketball court diagram. **/1/**
Ceiling Ht.	28 ft (8.53 m) clear height to lowest overhead element.
Finishes	**Walls**. Provide durable wall system up to 12 ft (3.66 m) in height, such as CMU or concrete with heavy-duty epoxy. Above 12 ft (3.66 m), use semi-gloss enamel. **Floor**. Synthetic multipurpose, resilient athletic flooring. Flooring must meet DIN standards for the specified function per *ACSM's Health/Fitness Facility Standards and Guidelines*; however, where primary space use is basketball, minimum ball rebound must be 93%. **Ceiling**. Exposed, painted structure.
Plumbing	No plumbing fixtures in the gymnasium. Ensure access to nearby electric water coolers.
HVAC	Provide system per Chapter 3, “HVAC.” Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Gym, sports arena (play area)." Provide durable air grill covers and do not place air grills in line with basketball nets. Locate ductwork to avoid trapping balls.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety," inclusive of mechanical damage. Provide protection for sprinklers, exit signs, manual pull stations, and other exposed components; minimize equipment that protrudes into activity space or safety zones near activity spaces. Install component equipment (except manual pull stations) minimum 8 ft (2.4 m) AFF for safety considerations. Provide manual pull stations with protective covers. Provide upright sprinklers with head guards.
Power	Provide outlets per Chapter 3, "Electrical." Provide power for the scoreboard; shot clocks; and a high, wall-mounted clock. Provide power requirements for other functions such as retractable backboards and divider curtain. Locate power outlets along sidelines at center court.
Lighting	Provide system per Chapter 3, "Electrical." Provide lighting levels for basketball in accordance with IESNA Class III adjustable up to Class II. Provide keyed light switches. Provide fixtures with wire cages or appropriate shatterproof luminaires. Do not locate fixtures directly above basketball backboards.
Communication	**CCTV**. Provide at least one outlet in each divided space. **CATV/Internal Video**. None required, unless specified by installation. **PA/Audio**. Provide speakers with proper spacing. **Telephone**. Provide one line with internal two-way communication. **Data**. Provide data outlets in recessed floor boxes routed to scoreboard, centered under the anticipated scoring table location but outside the court boundaries. **Security.** None required.
Acoustics	No provisions required.

Casework/ Built-in Equipment	• Provide retractable basketball nets/backboards at two per half court or six per full court. Tournament courts only require 2 goals. Breakaway rims must be installed on all goals. • Provide volleyball built-in flush floor insert sleeves in each court. • Motor-operated, vertical-acting (roll-up) divider curtain with manual override. Ensure the motor is easily accessible for maintenance. • Provide an electronic scoreboard that is visible to officials, players, and spectators. • Provide game lines on flooring for full- and half-court basketball and volleyball. • Provide 6-ft (1.83-m) -high attached safety padding with bottom edge on top of floor base on all walls that can be impacted by a player. • Provide one pair of 30-second timing clocks for the main court.
Furnishings, Fixtures & Equip. (FF&E)	Provide volleyball stanchions, net, standard protective pads, net antenna, as required. Provide wrestling mat, exercise mat, protective floor coverings with portable rolling stand, seating, scoring table, and chairs as required by installation.
User-provided Equipment	CCTV cameras per the outlet count.
Special Req.	• Interior entrance doors into the gym must have vision panels, minimum 5 ft^2 (0.46 m^2) each, and ensure visual access from the control counter to the gym entrance. Where line of sight is not possible, CCTV monitoring of gym entrance must be provided. • Provide minimum 10 ft (3.05 m) of unobstructed floor space as a safety zone between the outer edge of the playing area and any feature or obstruction. Provide minimum 12 ft (3.7 m) side to side and 18 ft (5.5 m) end to end of unobstructed floor space as a safety zone between the outer edge of the playing area and any adjacent court playing area. • Design for moisture control and prevention of condensation on floor surface. Design for under-floor ventilation requirements, under-slab vapor barrier, estimated dew point occurrence, local water table, and local soil conditions. • Provide exterior double doors with removable latch post for equipment access. • Mitigate glare on the play and spectator areas. Any glass panels must be a minimum of 18 ft (5.49 m) AFF and 0.5-in. (13-mm) -thick tempered, laminated safety glass. • Do not locate windows, doors, or other obstructions within 7 ft (2.14 m) of all backboard centerlines. • Ensure no glazing or lighting can create glare or distraction on the play areas and cross-court play. Do not use window treatments to mitigate glare.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers. Participants. Spectators.
Min. net ft^2 (m^2)	

Table 6-15 (Replace Table 4-21) Austere Gymnasium Storage/Support

Description/ Usage	Optional space as approved by CNIC.
Ceiling Ht.	10 ft (3.05 m) minimum.
Finishes	**Walls.** Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted CMU or painted gypsum wall board. **Floor**. Sealed concrete with rubber base. **Ceiling**. None required.
Plumbing	None required.
HVAC	Provide system per Chapter 3, “HVAC.” Temperature operating range: 65 °F (18 °C) to 85 °F (29 °C).
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical."
Lighting	Provide system per Chapter 3, "Electrical." Provide fixtures with wire cages or appropriate shatterproof luminaires.
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **PA/Audio**. None required. **Telephone**. None required. **Data**. None required. **Security**. None required.
Acoustics	No special provisions required.
Casework/ Built-in Equipment	None.
Furnishings, Fixtures & Equip. (FF&E)	Shelving and storage cabinets as required.
User-provided Equipment	None.
Special Req.	None.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-16 (Replace Table 4-24) Austere Unit PT/Group Exercise Room

Description/ Usage	This is typically one large room that is partitionable and can be used for large unit physical training or for multiple smaller classes that require only minimal equipment. Activities/classes include aerobics, martial arts, and yoga.
Ceiling Ht.	10 ft (3.05 m) minimum clear to lowest overhead feature.
Finishes	**Walls**. Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted CMU. Painted, double-layer high-impact gypsum board on studs is also acceptable. **Floor**. Synthetic multipurpose, resilient athletic flooring. Flooring must meet DIN standards for the specified function per *ACSM's Health/Fitness Facility Standards and Guidelines*. **Ceiling**. Exposed painted structure.
Plumbing	None required. Provide access to electric water coolers.
HVAC	Provide system per Chapter 3, “HVAC.” Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Health club/aerobics room."
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, "Electrical." Provide power at flat panel display mounting locations and for sound system.
Lighting	Provide system per Chapter 3, "Electrical." Provide 30 fc (300 lx) minimum at the floor. To address safety concerns, coordinate lighting design with equipment layout and ensure that equipment users, particularly those using horizontal benches, are not exposed to glare of direct/down lighting. Provide protection for all fixtures when appropriate for specific activity.
Communication	**CCTV**. Provide at least one outlet in each divided space. **CATV/Internal Video**. Provide outlets for monitors coordinated with their location. **PA/Audio**. Provide speakers with proper spacing. **Telephone**. Provide one line with internal two-way communication. **Data**. Provide data outlets in the walls or in recessed floor boxes. **Security**. None required.
Acoustics	No provisions required.
Casework/ Built-in Equipment	Provide one acoustical operable partition. Partition must be recessed into an alcove. Provide 6-ft (1.83-m) -tall mirrors on at least two walls at a minimum of 18 in. (450 mm) above the floor. If required, provide infrastructure and speakers for sound system for each divided space. Provide wall- or ceiling-mounted flat panel display mount in each divided space as required. Provide personal effects storage, such as cubbies, for customers in the room.
Furnishings, Fixtures & Equip. (FF&E)	Provide other fitness equipment as needed: indoor cycling equipment, stair steps, exercise balls, and small dumbbells. If required, provide sound system with mp3 and auxiliary input capability. Provide an AED.
User-provided Equipment	CCTV cameras per the outlet count. Provide flat panel displays.

Special Req.	Provide vision panel in the door, minimum 5 ft^2 (0.46 m^2). Design the rooms to be rectangular to allow for flexibility in use. Provide storage room with a direct adjacency to store items such as mats, stair steps, wall padding, and other fitness equipment as required.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

Table 6-17 (Replace Table 4-25) Austere Fitness Area

Description/ Usage	This area is typically the focal point of the facility. The area is divided into four sections: Stretching/warm-up/cool-down, free/plate-loaded weights, selectorized (machine) equipment, and cardiovascular equipment. The stretching/warm-up/cool-down area is open space within the larger room. It can also serve as transition areas between the other sections. The cardiovascular equipment area can be located in one or multiple areas throughout the facility. The free/plate-loaded weights area includes dumbbells, plate racks and plate-loaded equipment, and benches. The selectorized (machine) equipment consists of pin-selected weight equipment. The cardiovascular equipment consists of items such as treadmills, stationary bikes, and stair climbers.
Ceiling Ht.	12 ft (3.66 m) minimum to the lowest element. 14 ft (4.27 m) is preferred.
Finishes	**Walls**. Utilize a durable and scrubbable eggshell or satin finish, whichever has higher gloss, for painted CMU. Provide high-impact wall guards up to 18 in. (450 mm) above finished floor in the free weight area. **Floor**. Use permanently adhered resilient athletic flooring consisting of dual durometer layers of natural and synthetic rubbers, calendared and vulcanized together. The top layer is a non-porous, slip-resistant, textured surface; the bottom layer is a cushioned performance layer. In the stretching/warm-up/cool-down spaces, use ¼ in. (6 mm) thickness; in cardio, selectorized machine weights, and free weight areas, use 3/8 in. (9 to 10 mm) thickness. Impact and athletic flooring system cannot be accommodated by interlocking flooring tiles or movable furnishings such as mats. **Ceiling**. Exposed, painted structure.
Plumbing	Provide a minimum of two electric water coolers.
HVAC	Provide system per Chapter 3, “HVAC.” Temperature operating range: 68 °F (20 °C) to 74 °F (23 °C). Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Health club/weight rooms." Provide ceiling fans.
Fire Protection	Provide system per Chapter 3, "Fire Protection and Life Safety."
Power	Provide outlets per Chapter 3, Electrical." **Free weight area:** Provide outlets for wall- or ceiling-mounted flat panel displays. **Selectorized equipment area:** If a fitness tracking system will be provided, coordinate equipment outlets with the specific equipment selected. Provide flush-floor outlets for commercial-grade equipment in a grid pattern sized appropriately for equipment spacing and to accommodate fitness tracking systems. Provide outlets for wall- or ceiling-mounted flat panel displays. **Cardiovascular equipment area:** Coordinate equipment outlets with the specific equipment selected. Provide flush-floor outlets for commercial-grade equipment in a grid pattern sized appropriately for equipment spacing and to accommodate fitness tracking systems. Provide dedicated circuits for all treadmills. Coordinate flat panel display outlet locations with CATV outlet locations and the equipment selected. If cardiovascular equipment incorporates monitors, ensure outlets are located appropriately and provide outlets for wall- or ceiling-mounted flat panel displays as necessary to ensure adequate viewing angles for all equipment.

Lighting	Provide system per Chapter 3, "Electrical." Provide 30 fc (300 lx) uniform lighting. To address safety concerns, coordinate lighting design with equipment layout and ensure that equipment users, particularly those using horizontal benches, are not exposed to glare of direct/down lighting.
Communication	**CCTV**. Provide outlets as needed for coverage. **CATV/Internal Video**. Provide outlets for wall- or ceiling-mounted flat panel displays throughout the fitness area. Mount at proper viewing height for cardiovascular exercise machines in that area; height as selected by fitness area designer. The quantity and location of the CATV outlets must be determined by the sports fitness center designer and the installation fitness program manager and must be coordinated with the equipment layout. **\1** Consider options for wireless transmission of audio broadcast from video monitors. **/1/** **PA/Audio**. Provide PA speakers as needed. Provide a separate audio system with speakers as needed for full coverage. Provide separate volume control and separate channels for individual activity areas. **Telephone**. None required. **Data**. Provide data outlets in recessed floor boxes in the cardiovascular and selectorized equipment areas and entertainment systems. Data to equipment for fitness tracking is optional. **Security**. None required.
Acoustics	No provisions required.
Casework/ Built-in Equipment	Provide 6-ft (1.83-m) -tall mirrors on at least two walls at a minimum of 18 in. (450 mm) above the floor. One of the two walls must be in the free weight area.
Furnishings, Fixtures & Equip. (FF&E)	**\1** Fitness equipment must be commercial grade. Exercise mats, wall clocks, and trash containers. **/1/** Provide self-serve equipment cleaning supply stations throughout that include disinfectant spray bottles and disposable or reusable towels. Provide an AED.
User-provided Equipment	CCTV cameras per the outlet count.
Special Req.	If this space is provided on the second floor, ensure the access is sized to accommodate the fitness equipment. The foundation/floor in this space must be designed to accommodate all live and dead loads associated with the equipment. Provide storage either within the room or with a direct adjacency to store items such as mats, spare equipment, punching bags, and other sports equipment. If doors are provided, include vision panels, minimum 5 ft^2 (0.46 m^2) each.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net ft^2 (m^2)	

APPENDIX A BEST PRACTICES

A-1 STRUCTURE.

A-1.1 Substructure.

For the concrete slab on grade at the gymnasium, consider moisture control and prevention of condensation on the floor surface. Utilize relative humidity (RH) testing as recommended by the Maple Flooring Manufacturers Association (MFMA). Consider under-floor ventilation requirements, under-slab vapor barrier, estimated dew point occurrence, local water table, and local soil conditions. Where continuous water is anticipated beneath floors due to local conditions, a subsurface drainage system is recommended.

A-1.2 Superstructure.

Where feasible, use pre-engineered systems and components for building framing. For example, a pre-engineered metal building system may be an economical solution at the gymnasium. Coordinate HVAC ductwork and lighting arrangements with the structural layout.

A-2 PLUMBING.

For facilities with sensor-operated flush valves and/or faucets, take into consideration the effects on facility operation created by a power outage. Facilities expected to operate without power shall have appurtenances to ensure bathroom functionality during these conditions.

A-2.1 Shower Count

Provide one shower per 15 anticipated fitness facility users per hour for each male and female.

A-3 INTERIORS.

A-3.1 Signage.

Educational/inspirational/motivational signage/wall graphics should be considered in coordination with the installation’s health promotion objectives.

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APPENDIX B \1\ SAMPLE INTERACTIVE SPREADSHEET.

Figure B-1 illustrates a sample interactive spreadsheet completed for a hypothetical Navy fitness center.

Figure B-1 Sample Interactive Worksheet for a Navy Fitness Center

Sample Navy Fitness Facility Project

Select Service Branch: Navy

Select size of facility:
Navy size options are to the right. Check box next to appropriate size. Refer to UFC Section 2.1 for population criteria.

Check box next to appropriate facility size.

Extra Small	☐	For populations of <500
Small	☐	For populations of 501-3,000
Medium	☐	For populations of 3,001-7,000
Large	☐	For populations of 7,001-14,000
Extra Large	☐	For populations of 14,001-30,000
Jumbo		For populations over 30,000, enter 1 here: 1

Based on data entered above, facility size basis is: Jumbo — For populations of >30,000

Confirm facility size basis is correct (yes or no): Yes

Many of the spaces below are determined by the size and/or population criteria confirmed above. Where appropriate or necessary, modify each space or select the appropriate options to determine the total net facility size.

Fitness Spaces			Default quantities	m^2	$ft.^2$
Lobby/Reception					
Entry Lobby			6 Vestibule/Lobby Module(s) (for 2-3 ppl).	55.74	600
Control Counter			4 Counter Module(s).	46.45	500
Equipment issue storage			4 Storage Module(s).	65.03	700
Vending			1 Vending Machine(s).	1.86	20
Waiting/Display			5 Seating/Display Module(s) (for 4 ppl).	41.81	450
Spectator peak-time circulation	For this option, select yes or no:	Yes	3 Circulation Module(s).	83.61	900
Public restrooms/phones	For this option, select size of restroom:	2 male/ 3 female	2 male/ 3 female Public Restroom(s).	20.90	225

Fitness Facilities Space Program Worksheet — Page 1 of 5 — Use with UFC 4-740-06, Fitness Facilities

Sample Navy Fitness Facility Project

		Default quantities	m^2	$ft.^2$
Gymnasium				
Basketball/volleyball Court		3 Two-court/200-seat Module(s).	4892.86	52,668
Additional Spectator seating	To change default, enter new quantity:	0 Additional 200-seat Module(s). 600 total seats.		
Basic storage/support		5 Storage Module(s).	325.15	3,500
Additional court storage				
Unit PT/Group Exercise				
Partitionable Room(s)		75 people at 4.6 m2 (50 ft.2)/person.	348.38	3,750
Storage/support		10% of partitionable room area.	34.84	375
Fitness Spaces				
Stretching		12 people at 4.6 m2 (50 ft.2)/person.	55.74	600
Cardiovascular Equipment		150 items at 4.6 m2 (50 ft.2)/item.	696.75	7,500
Selectorized (machine) weights		54 items at 4.6 m2 (50 ft.2)/item.	250.83	2,700
Free/Plate-loaded weights		45 stations at 6.0 m2 (65 ft.2)/stations.	271.73	2,925
Finess Program Manager's Office				
Fitness Assessment Room		1 Office(s).	11.61	125
Structured Activities				
Structured Activity Space		3 Flexible space Module(s).	222.96	2,400
Racquetball Courts		8 Racquetball Court(s).	594.56	6,400
Spectator/officiating				
Structured activity storage		10% of Structured Activity Space.	22.30	240
Locker Rooms				
Space criteria for men's and women's locker, shower, and toilet areas are provided at the end of the spreadsheet because they are determined by selections made throughout.				
Sauna, cool-down area	To change default, select new:	Large M/F (2) Saunas/cool-down area.	26.76	288
Steam Room, cool-down area	To change default, select new:	Large M/F (2) Steam Rooms/cool-down area.	30.66	330
Hot Tub	To change default, select new: Medium	Medium Unisex Hot Tub.	11.71	126

Sample Navy Fitness Facility Project

Fitness Spaces (continued)			Default quantities	m^2	$ft.^2$
Support Areas					
Laundry			5/10 machine combo Laundry Room.	44.59	480
Equipment repair and receiving			Repair/receiving Room.	141.44	1,523
Storage			Storage Room.	63.75	686
Additional Programmatic Storage	For this option, enter required sf:	200	200 sf Additional Storage.	18.58	200
Core HAWC Spaces					
Lobby/Reception					
Director's Office					
Program Managers' Offices					
Support Staff Workstations					
Classrooms/Training rooms					
Resource Room/Computer Lab					
Storage/support					
Ergometry and Fitness Testing *					
Wellness Assessment *					
Administrative Spaces (required or optional)					
Director's Office			1 Office.	11.15	120
Program Managers' Offices			1 Office(s).	9.29	100
Support Staff Workstations			5 Workstation(s).	29.73	320
Copy/file/work/break Room			3 Workroom Module(s).	22.30	240
Classroom/Training Room			5 15-person Classroom/Training Module(s).	195.09	2,100
Classroom/Training Storage			5 Storage Module(s).	27.87	300

Sample Navy Fitness Facility Project

Optional or Service-specific Program Spaces			Default quantities	m^2	$ft.^2$
Indoor Track					
Indoor Track	To change default, select new:		1/8th-mile, 4-lane Indoor Track	989.11	10,647
To change the default selection (described to the right), choose the size of track desired. The description to the right will then change to reflect the new choice. To return to the default, delete the selection above.					
Indoor track lobby	To change default, enter new quantity:		2 Indoor track lobby(ies).	26.76	288
Additional Group Exercise Room					
Massage Room	For this option, select yes or no:	Yes	1 Massage Room(s).	11.15	120
Physical Therapy Training	For this option, select yes or no:	No			
Expanded Retail 1	For this option, select yes or no:	No			
Expanded Juice Bar 1	For this option, select yes or no:	Yes	1 Expanded Juice Bar Module(s).	13.94	150
Expanded Juice Bar Seating	For this option, enter required modules:	2	2 Two-table seating Module(s).	27.87	300
Family Changing Room	Does this facility include a pool (yes/no)?	Yes	5 Family Changing Room(s).	51.10	550
Male DV Locker Room *					
Female DV Locker Room *					
Child Play Area/Parent Child Area *			1 Parent/child Module(s).	74.32	800
HAWC Demonstration Kitchen					
HAWC Relaxation Room *					

Locker Rooms					
The following Locker Room spaces are based on total building occupancy, which is driven by the selctions made on this spreadsheet.					
Navy allocates the locker area at a 60% Male and 40% Female split.			To change this default split, select new:		
Men's Locker Room				384.14	4,135
Locker/changing area	To change default, select new:		508 Lockers in 335 slots.		
Navy designates 2 spaces (slots) for every 3 lockers (66%). This is 1 full-sized & 2 half-sized lockers for every 3 required. To change this default, select new configuration. ALSO: See Women's Locker/changing area.					
Shower/drying area			23 Showers.		
Toilet area			17 Water closets/lavatory modules.		

Sample Navy Fitness Facility Project					
Woman's Locker Room				278.61	2,999
Locker/changing area	To change default, select new:		338 Lockers in 223 slots.		
Shower/drying area			15 Showers.		
Toilet area			17 Water closets/lavatory modules.		
Building Totals					
			Subtotal - Total Net Building Area	10,533.0	113,380
	Is this facility more than one story (yes/no)?	Yes	Net-to-gross Factor @ 0.28	2,949.2	31,746
			TOTAL GROSS BUILDING	13,482.2	145,126
Site Spaces			Default quantities	m^2	$ft.^2$
Staff Parking			15 Paking Spaces.	627.08	6,750
Loading dock			1 Loading Dock.	8.36	90
Service Drive/trash			1 Service Drive Module.	69.68	750
Customer Parking			500 Parking Spaces.	20902.50	225,000
Bicycle Rack Area			2 10-bike Rack(s).	29.73	320
Patio					
			TOTAL GROSS SITE SUPPORT	21,637.4	232,910
			TOTAL GROSS FACILITY (BUILDING + SITE SUPPORT)	35,119.6	378,036

Fitness Facilities Space Program Worksheet Page 5 of 5 Use with UFC 4-740-06, Fitness Facilities

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APPENDIX C GLOSSARY

C-1 ACRONYMS AND ABBREVIATIONS.

ABA	Architectural Barriers Act
ABAAS	Architectural Barriers Act Accessibility Standards
AC	Air-Conditioning
ACP	Acoustic Ceiling Panel
ACSM	American College of Sports Medicine
ADA	Americans with Disabilities Act
AED	Automatic External Defibrillator
AFCEC	Air Force Civil Engineer Center
AFF	Above Finished Floor
ASTM	ASTM International
AV	Audiovisual
AWI	Architectural Woodwork Institute
C	Celsius
CATV	Cable Television
CCTV	Closed-circuit Television
cd	Candela
cfm	Cubic Feet per Minute
CMU	Concrete Masonry Units
CNIC	Commander, Navy Installations Command
CONUS	Continental United States
dB	Decibel
deg.	Degree
DIN	Deutsches Institut für Normung eV (German Institute for Standardization; similar to ANSI)

DOD	Department of Defense
Emax	Maximum Illuminance
Emin	Minimum Illuminance
EPDM	Ethylene Propylene Diene Methylene Rubber
F	Fahrenheit
fc	Foot-Candle
FF&E	Furnishings, Fixtures, and Equipment
ft.	Foot
ft^2	Square Foot
GFCI	Ground Fault Circuit Interrupt
HDMI	High-Definition Multimedia Interface
HDPE	High-Density Polyethylene
HITT	High Intensity Tactical Training
Ht.	Height
HVAC	Heating, Ventilating and Air Conditioning
HVLS	High-Volume, Low-Speed
IESNA	Illuminating Engineering Society of North America
in.	Inch
in^2	Inch Square
km	Kilometer
LOS	Line of Sight
lx	Lux
m	Meter
m^2	Square Meter
max.	Maximum
MCCS	Marine Corps Community Services

min.	Minimum
mm	Millimeter
MWR	Morale, Welfare and Recreation
NAF	Non-Appropriated Funds
NAVFAC	Naval Facilities Engineering Command
NCAA	National Collegiate Athletic Association
NEX	Navy Exchange
NFPA	National Fire Protection Association
OCONUS	Outside the Continental United States
PA	Public Address
POS	Point of Sale
PT	Physical Training or Physical Therapy
PVC	Polyvinyl chloride
req.	Requirement(s)
SF	Square Feet
STC	Sound Transmission Coefficient
UFC	Unified Facilities Criteria
USFFA	United States Flag Football Association
USRA	United States Soccer Federation
UV	Ultraviolet
VCT	Vinyl composition tile
WBDG	Whole Building Design Guide

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APPENDIX D REFERENCES

DEPARTMENT OF DEFENSE (DOD)

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 1-200-01, *DoD Building Code (General Building Requirements)*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

UFC 2-000-05N (P-80), *Facility Planning Criteria for Navy/Marine Corps Shore Installations*

UFC 3-101-01, *Architecture*

UFC 3-120-01, *Design: Sign Standards*

UFC 3-120-10, *Interior Design*

UFC 3-201-02, *Landscape Architecture*

UFC 3-410-01, *Heating, Ventilating, and Air Conditioning Systems*

UFC 3-410-02, *Direct Digital Control for HVAC and Other Building Control Systems*

UFC 3-420-01, *Plumbing Systems*

UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*

UFC 4-021-02, *Electronic Security Systems*

UFC 4-750-02N, *Design: Outdoor Sports and Recreational Facilities*

AMERICAN COLLEGE OF SPORTS MEDICINE (ACSM)

ACSM's Health/Fitness Facility Standards and Guidelines, http://www.humankinetics.com/products/all-products/acsms-health-fitness-facility-standards-and-guidelines-5th-edition

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ANSI/ASHRAE 62.1, *Ventilation for Acceptable Indoor Air Quality*, https://www.ashrae.org/technical-resources/bookstore/standards-62-1-62-2

ARCHITECTURAL BARRIERS ACT (ABA)

ABA Accessibility Standards, https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/aba-standards

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

North American Architectural Woodwork Standards (NAAWS), http://www.naaws-committee.com/

ASTM INTERNATIONAL

http://www.astm.org/index.html

E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*

E303, *Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester*

F1292, *Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment*

CONSUMER PRODUCT SAFETY COMMISSION (CPSC)

\1 *Public Playground Safety Handbook*, https://www.cpsc.gov/s3fs-public/325.pdf

GLOBAL SPORTS LEAGUE – UNITED STATES SPECIALTY SPORTS ASSOCIATION (GSL – USSSA)

GSL – USSSA Slow-Pitch Rule Book & By-Laws, https://usssa.com/docs/2018/2018_SP_RuleBook.pdf

NATIONAL COLLEGIATE ATHLETIC ASSOCIATION (NCAA)

NCAA Men's and Women's Basketball Court Diagram, https://www.ncaa.org/sites/default/files/2017MBBWBB_NCAA_Basketball_Court_Diagram_20170622.pdf

NCAA Cross Country/Track and Field Rules, https://www.ncaapublications.com/p-4564-2019-2020-cross-country-and-track-and-field-rules.aspx

NCAA Soccer Rules, http://www.ncaapublications.com/p-4544-2018-and-2019-soccer-rules.aspx ***/1/***

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

http://www.nfpa.org

NFPA 70, *National Electrical Code*

NFPA 101, *Life Safety Code*

NFPA 780, *Standard for the Installation of Lightning Protection Systems*

UNITED STATES FLAG FOOTBALL ASSOCIATION (USFFA)

National Rules, http://www.usffa.org/rulebook.htm

USA RACQUETBALL ASSOCIATION (USRA)

Standard Specifications for Racquetball Court Construction, http://www.teamusa.org/USA-Racquetball/How-To-Play/Rules/Court-Specification

UFC 4-740-06
12 January 2006
Change 1, 21 March 2022

UNIFIED FACILITIES CRITERIA (UFC)

YOUTH CENTERS

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UNIFIED FACILITIES CRITERIA (UFC)

YOUTH CENTERS

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location
1	21 March 2022	3-2, 3-5.3.2.1 changed Navy to preference for 1 story structure, same as Air Force.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY

Document: UFC 4-740-06, *Youth Centers*
Superseding: There is no superseding data; this is a new, unified criteria document.

Description: UFC 4-740-06 provides guidelines for evaluating, planning, programming, and designing Youth Centers. The information in this UFC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental Unites States and overseas. It also applies to the procurement of design/build services for the above-noted projects. Alteration and renovation projects should update existing facilities to meet the guidance and criteria within budgetary constraints.

Need: The Youth Center is a social and recreational center primarily for use by children ages 6 to 18 in support of a Youth Program, as defined by DoD Instruction 6060.4 *Youth Programs (YPS)*. The Youth Center supports opportunities for youth to develop their physical, social, emotional, and cognitive abilities and to experience achievement, leadership, enjoyment, friendship, and recognition**.** Youth Program activities are generally offered free of charge or at a reasonable cost to parents to encourage participation and make them affordable to families.

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CHAPTER 1 INTRODUCTION

1-1 SCOPE OF DOCUMENT.

This UFC provides guidelines for evaluating, planning, programming, and designing Youth Centers. The information in this UFC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental Unites States and overseas. It also applies to the procurement of design/build services for the above-noted projects. Alteration and renovation projects should update existing facilities to meet the guidance and criteria within budgetary constraints. This UFC is not intended as a substitution during design for thorough review by individual Program Managers and Operations Staff in the appropriate Service.

1-2 USERS OF THIS DOCUMENT.

This UFC is intended to be a source of basic architectural and engineering information for all individuals involved in the planning, design, or evaluation of Youth Centers. Note: where one Service's criteria vary from the other Services' criteria, it is noted in the text Specific users of the UFC include the following:

1-2.1 Architects and Engineers.

Architects and Engineers (A/Es) who will provide design services under the direction of the individual design agencies, including the Army Corps of Engineers (COE), Army Community and Family Support Center (CFSC), Naval Facilities Engineering Command (NAVFAC), and Navy Personnel Command (NPC).

1-2.2 Planning Personnel.

Planning personnel will use this UFC for programming new or replacement facilities, pre-design planning, or assessing the extent of improvements required in an existing Youth Center in order to achieve the standard established herein.

1-2.3 Additional Users.

Additional users include the following:

a. Headquarters Staff and Field Operating Agencies

b. Major Command Staff/Regions

c. Installation Commanders

d. Installation Facilities Management

e. Installation Technical Proponents

f. Program Directors

g. Facility/Program Operations Staff

1-3 SCOPE OF FACILITY.

The Youth Center is a social and recreational center primarily for use by children ages 6 to 18 in support of a Youth Program, as defined by DoD Instruction 6060.4, *Youth Programs (YPS)*. The Youth Center supports opportunities for youth to develop their physical, social, emotional, and cognitive abilities and to experience achievement, leadership, enjoyment, friendship, and recognition. Youth Program activities are generally offered free of charge or at a reasonable cost to parents to encourage participation and make them affordable to families.

The Youth Center facility may comprise up to three functional program areas. Not all of the three program areas are required, but if a certain program area is provided, it must include certain elements to meet individual program requirements. Beyond the required spaces, each program area may have additional spaces required or allowed by the individual Services.

The three functional program areas and their respective required elements are described in paragraphs 1-4 through 1-6. The other facility spaces are described in paragraph 1-7. All of these spaces are described in greater detail in Chapters 2 and 4. Additionally, due to the numerous possible variations of Youth Center programs, a special space program tool has been developed to help users navigate the intra- and inter-Service permutations. This tool is described in paragraph 2-2; it may be helpful to review this material in conjunction with these program descriptions.

1-4 SAC PROGRAM AREA.

Included in the Youth Center facility, but generally separate from the youth program functions, is a School-Age Care (SAC) program. This area supports the SAC program and includes the SAC Activity Rooms, the SAC Toilets, and support and outdoor areas.

Note: the **Navy** does not provide the dedicated SAC toilet—SAC youth share the toilets in the Youth Program Area. See Table 3-1 for more on this Service Exception.

The SAC program provides before- and after-school accountable childcare for a fee. This may include having the school bus pick-up and drop-off the children both before and after school. If children are dropped off by bus after school, the Youth Center keeps them until parents can pick them up from the center. The SAC program varies by Service:

a. The **Army** SAC program is generally for children ages 6 to 10. The Army generally accommodates its SAC program in separate facilities. See Child Development Center Standard Designs, for School-age Children 6-10 Years of Age, approved December 2004.

b. The **Navy** program is generally for children ages 6 to 12. The Navy does not separate the SAC functions from the youth program functions.

c. The **Air Force** program is for children ages 6 to 12.

d. The **Marine Corps** SAC program is generally for children ages 6 to 12.

1-5 YOUTH PROGRAM AREA.

This program area includes the following spaces:

1-5.1 Commons.

This area is the heart of the program area, around which all other program spaces generally revolve. It should accommodate social units of 12 to 15 youth gathering in pockets, while allowing these groups to interact with and feel part of the larger space. Subsets of the Commons include the Game Area, Snack Bar Eating Area, television (TV) viewing, and general gathering and conversation areas. All these spaces are generally in one open and inviting space, but the subset spaces may be defined by variations in ceiling heights or finishes.

1-5.2 Activity Rooms.

There are two categories of Activity Rooms that are the same size, but have different design characteristics. Each Service may specify General Activity Rooms, Special Activity Rooms, or both, depending on the size of the facility and its program needs.

The General Activity Room may be configured for gatherings, club meetings, arts and crafts (with the addition of a sink), or for other general uses. For these types of activities, this room accommodates up to 30 youth with the appropriate staff supervision.

The Special Activity Room is designed for active functions such as dance or martial arts. As such, it may have a higher ceiling, different flooring, and features such as dance bars and mirrors. For these types of activities, the room accommodates 10 to 15 youth with the appropriate staff supervision. This room is not intended for team sport activities, however. Those activities are accommodated in the multipurpose room.

1-5.3 Homework/Computer.

The Homework and Computer functions are required as part of the Youth Program, but the Services vary as to how they accommodate these functions:

a. The **Army** generally provides separate Homework and Computer rooms, sized identically. For small programs/facilities, this function may be combined into one space;

b. The **Navy and Marine Corps** provide a separate Computer Room and typically accommodate homework activities in one of the Activity Rooms; and

c. The **Air Force** accommodates both functions in one Homework/Computer Room.

1-5.4 **Outdoor Activity Area**.

There is a need for outdoor activity space as part of the Youth Program. This may be accommodated though the SAC Outdoor Activity Area or an additional outdoor space may be programmed as part of the Youth Program.

1-6 **TEEN PROGRAM AREA**.

This area provides older teens their own space to socialize and have access to more independent activities in a home-like environment. Activities may include things like table games, video games, computers, and television watching. Teens should be given more latitude and independence than the younger youth. This area includes the Teen Room/Lounge and an outdoor Teen Patio.

1-7 **ADDITIONAL FUNCTIONAL AREAS AND OPTIONAL SPACES**.

These spaces do not necessarily fall into any of the dedicated program areas.

1-7.1 **Administrative Area**.

The administrative area includes the facility lobby, the check-in area, the communications room, and staff offices and work areas.

1-7.2 **Other and Optional Spaces**.

Other spaces include various toilets (the Services accommodate toilets differently—see Table 3-1) and the multipurpose room. The multipurpose room accommodates large motor activities and team sports. There are different size options for the multipurpose room that vary by Service.

Optional spaces vary by Service and may include separate spaces not directly related to a program, such as a kitchen, or spaces that are optional within a program space such as a dedicated music/multimedia room (part of the Youth Program). The **Navy** normally does not permit kitchens in their Youth Centers.

1-8 **USERS OF FACILITY**.

The primary facility users are as follows:

a. Youth participants,

b. SAC program participants,

c. Teen participants,

d. Facility staff,

e. Volunteers,

f. Other program partners, and

g. Parents.

1-9 **RELATED DOCUMENTS**.

DoD Instruction 6060.4 provides the program requirements for Youth Centers and DoD Instruction 6060.3 provides the program requirements for SAC. Also review DoD School-age Program Inspection Checklist and the *NSACA Standards for Quality School-Age Care.*

Refer also to the following Service-specific related documents:

a. For **Army** projects, this UFC will serve as the framework for the revision of the *Youth Center Definitive Standard Design;*

b. For **Navy** projects, use this UFC in conjunction with the Navy Youth and School-age Care (SAC) Standards and Metrics;

c. For **Air Force** projects, use this UFC in conjunction with the *USAF Services Design Guide for Youth/School Age Center;* and

d. For **Marine Corps** projects, this UFC serves as the primary criteria document for Youth Centers.

CHAPTER 2 PLANNING AND LAYOUT

2-1 SIZE DETERMINANTS.

Several factors determine the size of the facility.

2-1.1 Needs Validation Assessment.

Conduct a Needs Validation Assessment (NVA) or Project Validation Assessment (PVA) to determine the need for each of the three program areas (see paragraphs 1-4 through 1-6), the optional spaces, and the size of the populations to be served by each program. The three program areas may be sized differently within a single facility. In some cases, one or more program areas may not be needed if the population served is too small or if that population is served by other, existing facilities. When reviewing existing facilities, consider both facilities on the installation and facilities within the community, such as the Boys & Girls Clubs of America, 4-H, and other community centers.

Note: Each Service may have different requirements with regard to the programs provided as part of this facility. While the NVA or PVA and the criteria in this UFC provide guidelines for the size of a Youth Center, the final space program will need to be carefully determined by installation representatives and the appropriate Service program office.

2-1.2 SAC Program Size.

Once the need and population size for the SAC program area has been determined, the SAC area is sized based on the number of SAC activity rooms needed. Each room serves two ratio groups or a total of 30 children. An **Air Force** SAC room serves two ratio groups or a total of 24 children. A ratio group represents the ratio of children to adult caregivers, or 15 children to one adult caregiver. The **Air Force** ratio group is 12 children to one adult caregiver.

The maximum number of SAC rooms permitted per facility is eight. If the needs assessment determines that more than eight rooms are required, provide multiple facilities.

Included in the SAC program are dedicated SAC toilets, and a storage closet for each SAC room. The **Navy** does not provide a dedicated SAC toilet—SAC children share the toilets in the Youth Program area.

2-1.3 Youth Program Size Classifications.

Once the need for the Youth program area has been determined, the size is classified by the number of youth to be accommodated in the *primary* program spaces. (Additional youth may be accommodated in optional spaces, like the Multipurpose Room.) Therefore, each size category provides for appropriate space in the Commons and support areas and provides the appropriate number of activity rooms.

Tables 2-1.1 and 2-1.2 illustrate these size classifications with the appropriate Service exceptions. The **Army** provides a combined Computer/Homework Room for their small youth program. For larger programs, they provide separate Computer Rooms and Homework Rooms. Due to the fact that the **Army** provides this additional program space for their larger programs, the number of youth that can be accommodated is greater than the other Services. These differences are reflected in Table 2-1.2.

In general for all Services, as noted above, the number of youth to be accommodated in the size classifications only account for the dedicated Youth program spaces. When programming the Youth program area, consider that additional youth may be accommodated in other areas such as the Multipurpose Room.

TABLE 2-1.1 NAVY, AIR FORCE, AND MARINE CORPS YOUTH PROGRAM SIZE CLASSIFICATIONS

Size Classification (No. of Youth)	Activity Rooms (General or Special)	Homework/ Computer Rooms*
Up to 60 Youth	1	1
61 to 90 Youth	2	1
91 to 135 Youth	3	2
136 to 155 Youth	4	2

*__Navy and Marine Corps__ provide a separate Computer Room and typically accommodate the homework function in the Activity Rooms. The **Air Force** combines the Homework function with the Computer Room.

TABLE 2-1.2 ARMY YOUTH PROGRAM SIZE CLASSIFICATIONS

Size Classification (No. of Youth)	Activity Rooms (Gen. or Spec.)	Computer Rooms	Homework Rooms
Up to 60 Youth	1	1 combined room	
61 to 105 Youth	2	1	1
106 to 150 Youth	3	1	1
151 to 170 Youth	4	1	1

2-1.4 **Teen Program Size Classifications**.

Once the need for the Teen program area has been determined, classify the size as follows:

a. Up to 15 teens,

b. 16 to 30 teens,

c. 31 to 45 teens, and

d. 45 to 60 teens.

2-1.5 **Optional Spaces**.

Once the program areas have been sized, determine which optional spaces to include. Optional spaces are identified in paragraph 2-1.5.3. Optional spaces vary by Service. The Base representatives, in conjunction with the program manager, must decide which optional activity spaces to provide. Note the following when selecting optional activities:

If an existing facility is being renovated to accommodate the Youth Center function, the amount of space available will likely determine what options may be provided. See paragraph 2-5 for more information on alterations to existing facilities.

Consider what can be provided within both the operational and construction budgets.

Optional spaces include the following:

a. Multipurpose Room;

b. Kitchen. **Navy** normally does not permit kitchens;

c. Music Room(s);

d. Additional Parent Waiting (in addition to the waiting area in the lobby). **Navy** does not permit additional parent waiting;

e. Laundry Room. **Navy** normally does not permit laundry rooms;

f. Youth Program Outdoor Activity Area; and

g. Outdoor Open Area (large play area).

2-1.6 **Administrative Area**.

Size the administrative area respective of all the program areas provided. For example, if a facility is to have only one or two SAC activity rooms and small youth and teen programs, a small administrative area will probably be sufficient. However, if a facility is to have only one or two SAC activity rooms, a small teen program, but a large youth program, a medium or large administrative area will probably be required. Carefully consider the entire program when sizing the administrative area.

2-1.7 **Administrative Spaces**.

Administrative office space, both private offices and workstations, should be thoroughly justified to and approved by the program manager. In general, the administrative area includes the following:

a. Lobby,

b. Check-in,

c. Staff Offices,

d. Staff Workstations,

e. Break/Staff Training Room,

f. Copy/file Room,

g. Storage,

h. Communications Room,

i. Staff/Visitor's Toilets/Janitor's closet (see Paragraph 3-5.1 for more information on toilets), and

j. Administrative Site Support (including staff and patron parking, drop-off/bus drive, and service drive).

2-1.8 **Office Limits**.

The overall number of private offices is limited to five and the number of workstations is limited to eight. These limits are regardless of the size of the Administrative Area. However, programmers should consider the overall size of the Administrative Area when selecting the number of private offices and workstations. For example, a small General Administrative Area will not typically require five private offices.

The **Navy** places additional limits on private office quantities. A small General Administrative Area is permitted one office. A medium General Administrative Area is permitted one office or two with additional justification. A large General Administrative Area is permitted two offices. An extra large General Administrative Area is permitted two offices or three with additional justification.

2-1.9 **Other Size Considerations**.

If the projected installation requirements exceed the largest size allowances for a program area, provide multiple Youth Centers. Further, when the total program populations are broken down into distinctive geographic locations, consider providing multiple facilities sized individually for the geographic populations.

2-2 **SPACE PROGRAM**.

The space program for Youth Centers is developed through the use of an interactive spreadsheet. It is completed by first entering the appropriate Service branch; then selecting the appropriate sizes for the three Program areas, the additional program spaces and options, the administrative area, and the site areas. The selections will vary depending on the Service branch selected. This is a result of the appropriate Service exceptions. As selections are made, the program areas are calculated and summed for both the building and the site.

This spreadsheet is available as a downloadable, zipped Microsoft© Excel© file from the Whole Building Design Guide DoD page (http://dod.wbdg.org) web site.

2-2.1 **Spreadsheets**.

Samples of the interactive spreadsheet with the Service branch selected as “Army” and “Navy” are illustrated in Figures 2-1 and 2-2, respectively. Figure 2-1 is a blank Army form and Figure 2-2 shows a completed Navy sample. These two Services were chosen to illustrate some of the differences in the options available on the form depending on the Service selected in the first line.

2-2.2 **Appendix B**.

The data upon which the interactive spreadsheet is based is illustrated in Appendix B. Do not use Appendix B to develop the space program—use only the interactive spreadsheet.

2-2.3 **Planning and Coordination**.

The space program developed through the use of the interactive spreadsheet serves as a guideline for the Youth Center planning team and generally represents the maximum space allowed. The final space program for a new Youth Center will need to be carefully determined by installation representatives and the appropriate Service program office guided by the criteria in this UFC.

FIGURE 2-1. SAMPLE BLANK INTERACTIVE SPREADSHEET FOR AN ARMY YOUTH CENTER

Select Service Branch:	Army		Gross m^2	Gross $ft.^2$
School Age Care (SAC): Enter no. of SAC Rooms *The Army generally accommodates SAC in other facilities. When provided, the SAC program includes no. of SAC rooms selected plus space for storage and toilets.		SAC Building		
Youth Program: Select Size of Youth Program *The Army Youth program adds an additional, dedicated homework room, except for small programs where it is combined with the comoputer room.		Youth Building		
Teen Program: Select Size of Teen Program		Teen Building		
Additional Spaces and Options				
Select Size of Multipurpose Room *Army options include items 1 through 5.		Multipurpose Room		
Select Kitchen size		Kitchen		
Select Music Room option (no. of rooms)		Music Rooms		
Select Additional Parent Waiting option *This is an additional waiting area located near the Activity Rooms and is in addition to the waiting area in the lobby.		Parent Waiting		
Select Laundry Room option *A One-washer Room includes one washing machine and two dryers. A Two-washer Room includes two washing machines and three dryers.		Laundry		
Administrative Area				
Select Size of General Admin. Area		General Admin. Area		
Office Requirements Enter no. of private offices required: Enter no. of workstations required:		Private offices Workstations		
		Subtotal Admin. Area and Offices		
		TOTAL GROSS BUILDING		
Site				
SAC Site Program: Tied to SAC building selection (entered above)		SAC Site Support		
Youth Site space not permitted without Youth Program		Youth Site Support		
Teen Site: Tied to Teen Program building selection (entered above)		Teen Site Support		
Select Outdoor Open Area Option		Outdoor Open Area		
Administrative: Tied to building selection (entered above)		Admin. Site Support		
		TOTAL GROSS SITE SUPPORT		
		TOTAL GROSS FACILITY (BUILDING + SITE SUPPORT)		

FIGURE 2-2. SAMPLE COMPLETED INTERACTIVE SPREADSHEET FOR A NAVY YOUTH CENTER

MCON P-000, Youth Center, Sample Naval Air Station, Virginia Beach, Virginia

			Gross m^2	Gross $ft.^2$
Select Service Branch:	Navy			
School Age Care (SAC): Enter no. of SAC Rooms	2	SAC Building	228.76	2,462
*For Navy, SAC Program includes the number of SAC rooms selected plus appropriate space for storage.				
Youth Program: Select Size of Youth Program	61 to 90 Youth	Youth Building	430.72	4,636
*The Navy Youth program deletes the space allowance for vending machines and the activity room storage closet is smaller.				
Teen Program: Select Size of Teen Program	16 to 30 Teens	Teen Building	115.44	1,243
Additional Spaces and Options				
Select Size of Multipurpose Room	3. Half-court w/ bleachers	Multipurpose Room	466.34	5,020
*Navy options include items 1 through 4.				
Kitchen is not normally permitted for Navy				
Select Music Room option (no. of rooms)	1 room	Music Rooms	6.69	72
Parent Waiting is not permitted for Navy				
Laundry Rm not normally permitted for Navy		Laundry		
*A One-washer Room includes one washing machine and two dryers. A Two-washer Room includes two washing machines and three dryers.				
Administrative Area				
Select Size of General Admin. Area	Large	General Admin. Area	182.02	1,959
Office Requirements				
Enter no. of private offices required:	2	Private offices	27.20	293
Enter no. of workstations required:	4	Workstations	21.76	234
*Navy limits private offices: Small Admin. gets 1 office. Medium gets 1 or 2. Large gets 2. Ex. Large gets 2 or 3. See Section 2-1.6 for more details.		Subtotal Admin. Area and Offices	**230.98**	**2486**
		TOTAL GROSS BUILDING	**1479.00**	**15,920**
Site				
SAC Site Program: Tied to SAC building selection	(entered above)	SAC Site Support	355.81	3,830
Select Youth Site option	No	Youth Site Support		
*In facilities where Youth Program is provided but SAC is not, Youth Site area is mandatory. If SAC is provided, Youth Site area is optional.				
Teen Site: Tied to Teen Program building selection	(entered above)	Teen Site Support	185.80	2,000
Select Outdoor Open Area Option	No	Outdoor Open Area		
Administrative: Tied to building selection	(entered above)	Admin. Site Support	1915.60	20,620
		TOTAL GROSS SITE SUPPORT	**2457.21**	**26,450**
		TOTAL GROSS FACILITY (BUILDING + SITE SUPPORT)	**3,936**	**42,370**

2-3 **LOCATION DETERMINANTS**.

Several factors determine the most appropriate and cost-effective location for a Youth Center.

2-3.1 **Access**.

The Youth Center should be easily accessible by buses (dropping off), privately-owned vehicles (either dropping off/picking up or parking), and by youth patrons via foot or bicycle. Weigh these considerations against the effect on traffic during peak pick-up/drop-off times. For example, a location near or adjacent to a school or child development center may be convenient for patrons, but it may cause traffic congestion at peak times. To accommodate parent/patron access, provide adequate parking as close as possible, taking into account antiterrorism (AT) requirements (see paragraph 3.8).

2-3.2 **Safety**.

Consider the above-noted pedestrian and bicycle traffic by the youth patrons. Minimize the degree to which pedestrian and bike paths cross vehicular paths in the approach to the Youth Center site. If pedestrian and bike paths cross or run adjacent to busy streets and intersections, provide mitigation measures, such as bollards, to increase safety. Also consider the location of bus access for drop-off and pick-up.

2-3.3 **Cost**.

Design these facilities with the objective of achieving the lowest life cycle cost. To do so, the project's design program must adequately define the scope and performance requirements and match those needs against a budget. Conversely, the budget must adequately support an appropriate and high-quality program and the performance requirements outlined and identified in this UFC.

2-3.4 **Related Facilities**.

Consider locating near other facilities such as youth sports fields, open park space, etc.

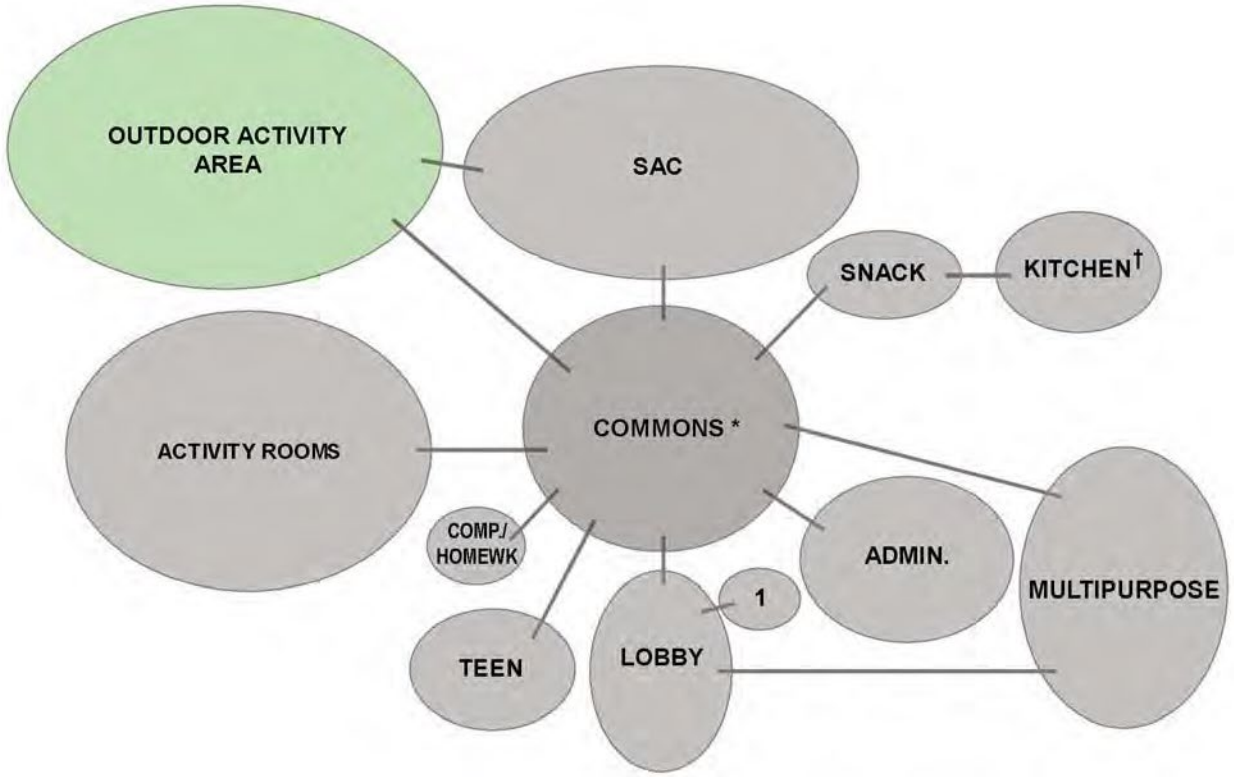
2-4 **LAYOUT AND ADJACENCIES**.

The appropriate layout and adjacencies are illustrated through a bubble diagram and adjacency matrices.

2-4.1 **Functional Relationship Bubble Diagram**.

The bubble diagram in Figure 2-3 indicates acceptable relative adjacencies of the functional spaces.

FIGURE 2-3. FUNCTIONAL RELATIONSHIP BUBBLE DIAGRAM



1 = Check-in
* Commons includes the Game Area and the Eating Area.
† Kitchen is optional for all Services except Navy for which it is normally not permitted.

2-4.2 **Adjacency Matrices.**

Figures 2-4 and 2-5 further illustrate the acceptable relative adjacencies of functional spaces and should be used in conjunction with Figure 2-3. Figure 2-4 provides the adjacencies for **Army**, **Air Force** and **Marine Corps** facilities. Figure 2-5 provides the adjacencies for **Navy** facilities.

FIGURE 2-4. ADJACENCY MATRIX

Functional Spaces	Lobby/Building Entrance	Check-in	Administrative Offices	Break/Staff Training Room	Copy/File Room	Staff Lockers	SAC Activity Rooms	SAC Toilets †	SAC Outdoor Activity Area	Commons	Game Area	Snack Bar/Vending †	Eating Area	Kitchen * †	Homework/Computer Room †	General Activity Room(s)	Special Activity Room(s)	Music/Multimedia Room *	Parent Waiting Area *	Youth/Teen Toilet †	Teen Room/Lounge	Teen Patio *	Multipurpose Room †	Multipurpose Room Storage/Gear Issue	Laundry * †	Staff/Public Toilets †	Youth Outdoor Activity Area *	Outdoor Open Area *	Pick-up and Drop-off (Bus)	Service Drive/Trash	Staff Parking	Patron Parking
Lobby/Building Entrance		1	3				3			1					1/3				3		1	1	3			3			1		3	3
Check-in			3				2			2	2	2	2		2	2	2	2	2		2	2	2			1			2			
Administrative Offices				1	1	3																			3	3				3		
Break/Staff Training Room					1	1																										
Copy/File Room																																
Staff Lockers																																
SAC Activity Rooms								1	1	1			3	3																		
SAC Toilets †																																
SAC Outdoor Activity Area																											2/3	2/3				
Commons											1	1	1	3	1	1	1	1	1	1	3		1			3	3	2				
Game Area												3	3							3	3											
Snack Bar/Vending †													1	1							1/3	3										
Eating Area																					2/3	3										
Kitchen * †																														3		
Homework/Computer Room †																3					3											
General Activity Room(s)																			3	3												
Special Activity Room(s)																			1/2	3												
Music/Multimedia Room *																			3	3												
Parent Waiting Area *																										3						
Youth/Teen Toilet †																					3		3									
Teen Room/Lounge																						1										
Teen Patio *																																
Multipurpose Room †																								1	3			1				3
Multipurpose Room Storage/Gear Issue																											3	3				
Laundry * †																																
Staff/Public Toilets †																																
Youth Outdoor Activity Area *																												1				
Outdoor Open Area *																																
Pick-up and Drop-off (Bus)																															2	2
Service Drive/Trash																																
Staff Parking																																3
Patron Parking																																

1 = Direct physical access/adjacency
2 = Direct visual access/visual control
3 = Near but not necessarily adjacent

* = Optional space
† = There are one or more Service Exceptions associated with this space.

FIGURE 2-5. NAVY ADJACENCY MATRIX

Functional Spaces	Lobby/Building Entrance	Control/Check-In	Administrative Offices	Break/Staff Training Room	Copy/File Room	Staff Lockers	SAC Activity Rooms	SAC Toilets	SAC Outdoor Activity Area	Commons	Snack Bar/Vending	Computer Room	General Activity Room(s)	Special Activity Room(s)	Music/Multimedia Room	Youth/Teen Toilet	Teen Lounge	Teen Patio	Multipurpose Room	Multipurpose Room Storage/Gear Issue	Staff/Public Toilets	Youth Outdoor Activity Area/Hard Surface	Youth Outdoor Activity Area/Covered	Outdoor Open Area	Pick-up and Drop-Off (Bus)	Service Drive/Trash	Staff Parking	Patron Parking
Lobby/Building Entrance		1	3							2						3					3				1		3	3
Control/Check-In			3				2	2		2	2	2	2	2	2	2	2		2		1				2			
Administrative Offices				1	1	3															3							
Break/Staff Training Room					1	1																						
Copy/File Room																												
Staff Lockers																												
SAC Activity Rooms								3	1	1		3																
SAC Toilets										1																		
SAC Outdoor Activity Area																						2/3	2/3	2/3				
Commons											1	1	1	1	1	1	3		1			3	1	2				
Snack Bar/Vending																	3											
Computer Room													3				3											
General Activity Room(s)																3						3	3	3				
Special Activity Room(s)																3												
Music/Multimedia Room																3												
Youth/Teen Toilet																	3		3									
Teen Lounge																		1			3							
Teen Patio																								3				3
Multipurpose Room																				1				1				
Multipurpose Room Storage/Gear Issue																						3		1				
Staff/Public Toilets																												
Youth Outdoor Activity Area/Hard Surface																							1	1				
Youth Outdoor Activity Area/Covered																								2/3				
Open Outdoor Play Area																												
Pick-up and Drop-Off																											3	1
Service Drive/Trash																												
Staff Parking																												3
Patron Parking																												

1 = Direct physical access/adjacency 2
= Direct visual access/visual control 3
= Near but not necessarily adjacent

2-4.3 **Space Assessment**.

See the Functional Data Sheets in Chapter 4 for additional information on the space types and their relationships to each other.

2-5 **ALTERATIONS TO EXISTING FACILITIES**.

2-5.1 **Regulatory Authorities**.

Refer to the following for the appropriate authorities for each Service:

a. **Army**. The standard may be modified to accommodate the existing structure. However, all proposed modifications to the standard must be sent to the Army Corps of Engineers, Engineering & Support Center, HSV (CEHNC) for review and HQDA (CFSC‑CYS) for approval prior to the initiation of concept design.

b. **Navy and Marine Corps**. Authorities are contained in OPNAVINST 11010.20 and NAVFACINST 11010.45. Prior to planning alterations to an existing facility to convert it to a Youth Center, the activity should consult the following: Navy: NPC (Pers 656D/659) and Marine Corps: MCCS HQ (MRY/MRD).

c. **Air Force**. HQ AFCEE for architectural and publication coordination; HQ Air Force Civil Engineering Support Agency (AFCESA) for technical issues relating to fire, life safety, and certification; HQ AFSVA for functional requirements; and HQ USAF/ILV for functional policies.

2-5.2 **Other Considerations**.

Consider the site of the existing facility and its limitations with regard to the Youth Center's needs. Only consider permanent facilities for conversion to a Youth Center. Exceptions may be made for other buildings that are in excellent condition, subject to the location determinants in paragraph 2-3.

Consider adaptability to the intent of the building program. For instance, can the building accommodate a multipurpose room? Does it have site space for the outdoor activity area and the teen patio? Whether planning a conversion, alteration, addition, or new construction, antiterrorism requirements must be taken into account (see paragraph 3.8). Also consider barrier-free design requirements as noted in paragraph 3-7.

CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL.

Use UFC 1-200-01 for guidance on the use of model building codes for design and construction of Department of Defense facilities. See paragraph 3-5 for the appropriate governing codes for building services.

3-2 STRUCTURE.

1\ The Youth Centers for the **Army** must be a single-story structure. The **Air Force and Navy** may allow two-story Youth Centers, but prefer a single-story structure. /**1**/

3-2.1 Foundation.

The foundation is site specific and must be designed upon known geotechnical considerations, by an engineer knowledgeable of the local conditions.

3-2.2 Superstructure.

Provide clear spans as required for the activity areas and multipurpose room. Use pre-engineered components for superstructure framing, where feasible.

3-2.3 Materials.

Consider climate conditions, high humidity, industrial atmosphere, saltwater exposure, or other adverse conditions when selecting the following:

a. The type of cement and admixtures used in concrete,

b. The concrete cover on reinforcing steel in concrete membrane,

c. The coatings on structural members,

d. Expansion joints,

e. The level of corrosion protection, and

f. The structural systems.

3-3 EXTERIOR DESIGN.

In general, keep the building’s image, theme, and fixtures consistent with the programs offered. Design the Youth Center to reflect a residential, non-institutional character. The building design should comply with the Service command and installation architectural standards and design guides. Also consider the local geographical and cultural environment. The building and site should provide a visually attractive and welcoming appearance with ample parking, and signs giving directions to the site.

3-3.1 **Entrances**.

The main facility entrance to the lobby should serve as a welcome and transition point—elements such as a covered entry are very desirable. Such a feature might be combined with a covered walkway that connects the building to short-term parking to protect arriving youth and parents from inclement weather. If a covered walkway feature is provided, it should be structurally independent from the main Youth Center structure. In cold climates, provide a canopy (or a recess) at required egress doors to ensure that doors can completely open without obstruction from snow and ice.

Consider providing separate entrances to the multipurpose room and the teen room. Alternatively, consider providing a paved path from the parking area to a multipurpose room exit. The **Navy** requires a separate, exterior entrance to the Teen Room/Lounge that is independent from the main lobby but visible from the check-in.

3-3.2 **Doors and Windows**.

Residential size and type of doors and windows should be provided. Casement and other projecting types of windows must be recessed or located so as to be free from dangerous protrusions. Ensure windows and doors comply with antiterrorism criteria as noted in paragraph 3-8.

3-3.3 **Exterior Finishes**.

Keep the exterior color, texture, and design consistent with the programs offered, the local environment and appropriate for the building type. Design the Youth Center to reflect a residential-style, non-institutional character—the design should communicate a sense of fun while complying with installation architectural standards. The physical environment supports the operational quality of a center and profoundly affects the behavior and development of youth, as well as the efficient functioning and sense of well being in adult staff. Also coordinate the exterior finishes with the Service-specific design standards noted below in paragraph 3-4.2 for interior finishes.

Consider climate conditions, high humidity, industrial atmosphere, salt-water exposure, or other adverse conditions when selecting exterior finishes, including the roof system, to ensure durability.

3-3.4 **Exterior Signage**.

Equip the main entrance with an attractive, clearly located sign that provides the program hours of operation. Ensure that signage complies with Installation requirements. (**Air Force** use UFC 3-120-01.) Sign placement and type are site-specific, but signs must be strategically located, adequately lit, and of sufficient size to permit proper viewing by individuals approaching the facility.

3-4 **INTERIOR DESIGN**.

Use construction and finishes (walls, floor, and ceiling) that support the image and theme of the facility and that are consistent with the programs offered. Use finishes that are extremely durable with good acoustical, noise reducing characteristics. The interior design should offer the same interest, excitement, and professionalism that can be found in comparable commercial hospitality facilities. As with the exterior, design the Youth Center to reflect a high energy, non-institutional character that communicates a sense of fun. Consider techniques to display and celebrate the youth's artwork. For **Navy** facilities consider bright and vibrant colors and wall murals in common areas.

3-4.1 **Interior Construction**.

Use high-quality, durably constructed counters, casework, and cabinets. Specify Architectural Woodwork Institute (AWI) Premium or Custom for finishes per *AWI Quality Standards Illustrated*. Provide casework and cabinet doors and drawer faces of veneer panel core. Provide doors, drawers, and casework faces as plastic laminate at a minimum. Where no water source is present, use countertops of plastic laminate as a minimum with hardwood or solid surface edging. Where a water source is present, use countertops of solid surface/solid composite plastics only. Specify 20-mm (.75-in.) minimum thickness for plywood, plywood backing, and solid wood panels.

Confirm the amount (linear mm/ft.) of counter/casework for each space within the Youth Center with the following Service-specific contacts:

a. The Installation Manager for **Army** and **Air Force** projects and

b. HQ Program Managers for **Navy** and **Marine Corps** projects.

All Interior glass must be tempered safety glass and mirrors must be break-resistant materials.

3-4.2 **Finishes**.

Finishes should take into account the intended uses and be appropriately durable. They must meet the requirements listed in NFPA 101, *Life Safety Code.* Also coordinate the interior design with the following Service-specific standards or agencies:

a. **Army**. DG 1110-3-122, *Interior Design Guide and Installation Design Guide Standards*;

b. **Navy**. PERS-656;

c. **Air Force**. *Air Force Interior Design Guide*, Major Command and installation design standards, and Engineering Technical Letter (ETL) 00-06, *Air Force Carpet Standard*; and

d. **Marine Corps**. MCCS HQ MRY/MRD.

3-4.2.1 In moist climates, do not cover the inside of exterior walls with impervious materials such as mirrors or vinyl wall coverings. This is due to a concern over mold developing in the wall.

3-4.2.2 For the teen room/lounge, consider guiding a teen focus group in selection of an interior color scheme. For more information on finishes in specific areas, see the Functional Data Sheets in Chapter 4. The **Navy** requires the involvement of a teen focus group in the selection of interior color schemes for the Teen Room/Lounge.

3-5 **SERVICES**.

Also see paragraph 3-9 for information on sustainable design and energy consumption.

3-5.1 **Plumbing**.

Design domestic hot and cold water, sanitary and storm drainage, propane, fuel oil, or natural gas systems to meet the requirements of UFC 3-420-01.

Navy requirements differ from the other Services on toilet requirements. See Table 3-1 for this Service exception.

TABLE 3-1. TOILET REQUIREMENTS BY SERVICE

<table>
<tr><th>Service</th><th>SAC</th><th>Youth</th><th>Teens</th><th>Staff</th><th>Visitors</th></tr>
<tr><td>Army, Air Force, and Marine Corps</td><td>Separate male/female (child-use only).</td><td colspan="2">Separate male/female (child-use only) shared by Youth & Teens.</td><td colspan="2">Separate male/female shared by staff and visitors.</td></tr>
<tr><td>Navy</td><td colspan="2">Separate male/female (child-use only) shared by SAC & Youth.</td><td colspan="4">Multiple unisex toilets shared by Teens, Staff, and Visitors.</td></tr>
</table>

3-5.2 **Heating, Ventilating, and Air Conditioning (HVAC)**.

Design the HVAC system to comply with the requirements of the most current edition of the International Mechanical Code (IMC). Use UFC 3-410-02N as supplemental guidance. Comply with antiterrorism requirements in the design of the HVAC system (see paragraph 3-8).

Consider climate conditions, high humidity, industrial atmosphere, salt-water exposure, or other adverse conditions when selecting exterior HVAC components to ensure durability.

3-5.3 **Fire Protection and Life Safety**.

Design fire protection and life safety to comply with UFC 3-600-01*;* the National Fire Protection Association (NFPA) Standards; and the requirements listed below. Complete compliance with the NFPA 101 is required by Public Law (USC Title 10, Section 1794) and may not be waived except by the Secretary of each military Service.

In case of conflict between this UFC and the latest edition of NFPA 101, contact the appropriate Service representative below for resolution:

a. **Army**. USACE District Fire Protection Engineer

b. **Navy**. NAVFAC FEC/EFD/EFA Fire Protection Engineer

c. **Air Force**. HQ AFCESA/CES

d. Marine Corps. HQ Fire Protection Engineer

3-5.3.1 **Occupancy Classification.**

The entire facility, except for the multipurpose room, will be classified as an educational occupancy as defined in NFPA 101. The multipurpose room, if provided, will be classified as an assembly occupancy as defined in NFPA 101.

3-5.3.2 **Exiting Requirements**.

Use the NFPA 101-listed occupant load factors for the purpose of designing the means of egress as follows:

a. Use the factor for “Educational Use, Classrooms” for the entire facility except the multipurpose room and

b. Use the factor for “Assembly Use, Concentrated use, without fixed seating” for the multipurpose room.

3-5.3.2.1 Rooms normally occupied by second-grade children and older may be located no more than one floor above the ground floor. Note: Only the **Air Force \1** and **Navy /1/** allow a Youth Center of more than one floor.

3-5.3.2.2 Provide at least two separate, accessible exits on every story. Any interior stair serving as an exit will be enclosed by fire resistant construction as required by NFPA 101 and allow discharge from the stairway directly to the outside.

3-5.3.2.3 Provide corridors of at least 1830 mm (72 in.) clear width.

3-5.3.2.4 Egress corridors may not be used as a portion of a supply, return, or exhaust air system serving adjoining areas.

3-5.3.2.5 Provide sufficient doors between the multipurpose room and the building core areas to accommodate the egress of at least one-half of the maximum multipurpose room occupant load into the building core areas. Size the main

entrance/lobby and other exits directly connected to the main entrance/lobby to accommodate the exit of the multipurpose occupants along with the occupants of the building core areas.

3-5.3.2.6 Equip all exit doors from the facility to the outside with panic hardware.

3-5.3.2.7 Where cold weather vestibules are provided at activity room exits and exits other than the primary entrance, use a non-latching-type door held closed by a hydraulic door closer for inside door. Install panic egress hardware only on the exterior door.

3-5.3.2.8 Provide either of the following methods to protect the means of egress:

a. Provide a direct exit to the outside from every room normally occupied by children, or

b. Design corridor walls to form smoke partitions. Use magnetic hold-open devices for all fire doors and kitchen doors.

3-5.3.2.9 Provide a smooth, accessible, and unobstructed evacuation route to a safe gathering area not less than 23 m (75 ft.) from the facility for all activity rooms. The route must not cross any emergency vehicle access path, parking area, or street. The evacuation route must be at least 1020 mm (44 in.) wide, and turns and bends in the route should be wider to account for use of wheelchairs. Provide gates with not less than 1020 mm (44 in.) clear width as necessary in the play area fence. Provide sufficient outdoor lighting for the egress path to meet NFPA 101 minimum illumination requirements.

3-5.3.3 **Exit Marking.**

Provide exit signs in accordance with UFC 3-530-01 and UFC 3-600-01. Install exit signs in child occupied rooms when exterior exit doors are provided.

3-5.3.4 **Additional Exiting Requirements for Extreme Cold Weather Locations.**

If the facility location meets the weather criteria outlined below, provide for horizontal exiting within the facility according to NFPA 101 and the criteria in this section.

Extreme cold weather locations are those with more than 50 hours per year with a dry-bulb temperature below –15 degrees C (5 degrees F) between the hours of 0900 and 1600. (See UFC 3-400-02 for information on obtaining this data.)

3-5.3.4.1 Provide a two-hour area separation wall dividing the facility areas roughly in half on either side of the wall. When a gymnasium is provided, provide the separation wall between the gymnasium and the core areas.

3-5.3.4.2 Design corridor doors in the two-hour area separation wall to recess into

the wall providing a smooth continuous wall surface. Install magnetic latches to hold door open, which release when the fire evacuation signal sounds. Install swinging doors that swing in opposite directions.

3-5.3.4.3 Install magnetic latches to hold open other doors in the two-hour area separation wall that release when the fire evacuation signal sounds.

3-5.3.4.4 Seal and fire stop all penetrations of the two-hour separation wall for conduit, piping, HVAC and electric service to maintain the fire rating of the wall.

3-5.3.5 **Emergency Lighting.**

Provide emergency lighting in all areas required by NFPA 101 and at the front desk area for desk attendant to make emergency calls and carry out other duties necessary for the safety and security of the children. Whenever possible, incorporate the emergency lighting into the normally provided lighting fixtures.

3-5.3.6 **Flammability Codes and Standards.**

Use textiles and upholstered components complying with the applicable interior finish requirements stated in NFPA 101 and other applicable local, state, or federal standards. In addition, comply with the following:

a. Use carpets tested for Volatile Organic Compounds (VOCs) and that bear a green label from the Carpet and Rug Institute indicating that the carpet emissions are within the acceptable range and

b. Use products containing less than 0.05 parts per million (ppm) of formaldehyde. Any product purchased with formaldehyde levels above 0.05 ppm must bear a label in accordance with 29 CFR 1910.1048.

3-5.3.7 **Fire Hydrants.**

Provide at least one fire hydrant within 45 m (150 ft.) of the building's fire department connection.

3-5.3.8 **Fire Separation.**

3-5.3.8.1 Provide one-hour fire-rated construction to separate the multipurpose room from the building core areas.

3-5.3.8.2 Provide a one-hour fire-resistive barrier around the laundry room, if provided, and at least a 45-minute fire-rated door.

3-5.3.8.3 Other fire separations are not required in a typical one-story Youth Center fully protected with an automatic sprinkler system. Additionally, smoke barriers are not required if direct exits are provided from each room normally occupied by children (see paragraph 3-5.3.2).

3-5.3.9 **Fire Extinguisher Cabinets.**

If fire extinguishers are required by the local installation, provide recessed fire extinguisher cabinets. Recessed cabinets located in fire-rated walls must be listed or approved fire-rated cabinets that can be installed in fire rated walls without having to "build-out" the wall.

3-5.3.10 **Fire Suppression Systems.**

Provide complete automatic sprinkler systems meeting the requirements of UFC 3-600-01. Wet pipe sprinkler systems are the preferred system type because of the high reliability and low maintenance requirements. Take care to avoid freezing sprinkler pipes located in attic spaces. Sprinkler systems subject to freezing may be dry pipe sprinkler systems. Note the following additional criteria:

a. Design the sprinkler system water flow indication to activate the building fire evacuation system;

b. Discharge inspectors' test connections to a safe, outside location onto a hard surface outside of areas where children play or congregate. Indicate discharge location on drawings;

c. Use quick response type sprinkler heads; and

d. Ensure that the fire department connection is accessible without entering or transiting an outdoor play area or crossing a discharge path.

e. Pipe penetrations of the exterior wall must be no greater than 610 mm (24 in.) above finished grade.

If the optional kitchen is included, provide a wet chemical or water spray hood duct and cooking surface fire extinguishing system according to NFPA 96.

3-5.3.11 **Fire and Alarm System.**

3-5.3.11.1 Provide an automatic fire evacuation alarm system according to NFPA 72 and complying with the installation's requirements. Note the following requirements:

3-5.3.11.2 Locate the fire alarm control panel in an environmentally controlled location in the facility.

At a minimum, meet the following criteria for circuits in the systems:

a. Initiating circuits – Class B, Style C

b. Notification circuits – Class A, Style Z

c. Signaling Circuits – Class B, Style 3.5

3-5.3.11.3 Fully addressable control panels with addressable supervisory sensors,

pull stations, notification devices, and other devices are recommended.

3-5.3.11.4 Provide audio and visual notification devices/strobes in accordance with NFPA 72 and UFC 4-021-01.

Note: **Army** and **Navy** require the following additional criteria: Provide a voice evacuation system that is capable of accepting input from a remote location. This system must be UL listed for fire alarm use. The voice evacuation system will satisfy the requirements of the Mass Notification System. Provide a single type of visual notification device that will serve as the fire alarm visual alarm notification and as the Mass Notification System visual alarm notification that complies with NFPA 72 and is labeled “Alert.” The spacing and location of the visual notification devices must meet the requirements of NFPA 72.

3-5.3.11.5 The signal type/tone will be the same throughout the building, and will be heard on the playgrounds. Sufficient alarm notification devices will be provided so that the signal is not excessively loud in any location (15 dB above ambient is the target level).

3-5.3.11.6 Provide manual pull stations inside the facility at each exterior exit door.

3-5.3.11.7 Building smoke detection is not required and should not be provided except for the one smoke detector that is required by NFPA 72 to be located over the fire alarm control panel. Heat detectors are not required in any area because the facility is fully sprinkled. Smoke detectors must be installed in HVAC ducts as required by NFPA 90A.

3-5.3.11.8 Provide either a graphic or alphanumeric annunciator at the front desk or vestibule.

3-5.3.11.9 Provide and install a fire alarm transmitter compatible with the installation fire alarm receiving equipment to transmit fire alarm and system supervisory signals to the installation fire alarm reporting center. Consult with the Installation Fire Chief or fire system maintenance activity. This may be a sole source item.

3-5.4 **Electrical**.

Provide electric service and distribution equipment, wiring receptacles and grounding, interior and exterior lighting and control, emergency lighting, telephone, communication systems, fire alarm, and intrusion systems in accordance with NFPA 70*;* UFC 3-520-01*;* and the latest installation design requirements. See the latest edition of *Electric Current Abroad* to determine voltages and cycles in overseas locations. Service grounding system and all wiring methods must meet the current NFPA 70 requirements. All service equipment must be Underwriters Laboratories (UL) listed. Alternately, published proof from an approved independent testing laboratory may be provided.

3-5.4.1 **Lighting.**

Vary lighting levels and types throughout the Youth Center. Provide a combination of

task and ambient light to create interest. Consider that most public spaces in the Youth Center should exhibit a more residential or hospitality-oriented character than an office or educational facility. For more information on the specific spaces, refer to the Functional Data Sheets in Chapter 4 and UFC 3-530-01.

3-5.4.2 Communications and Data.

Provide a junction box with rigid conduit to the ceiling for telephone and data connections. Telephone and data outlets may be independent of each other or combined into a single junction box. If these connections can be combined into a single junction box then the cover plate to that junction box must allow for multiple connections. In some unique situations, the cable television (CATV)/internal video connection can also be combined into a single junction box with the appropriate cover plate.

Confirm the preference for individual or combined telephone/data/video outlets with the following Service-specific contacts:

a. The Installation Manager for **Army** and **Air Force** projects and

b. HQ Program Managers for **Navy** and **Marine Corps** projects.

The **Navy** requires that each space supplied with a data connection have two hard-wired connections: a primary and an alternate. The alternate serves as a back-up and is generally not activated. Facilities that will contain Navy and Marine Corps Intranet computers must comply with UFC 3-580-10.

3-5.4.3 Alarm System.

Consider providing an alarm system for intrusion detection to protect equipment and assets. Provisions for an alarm system must be justified during the planning/programming process. For **Navy**, the individual Navy Installation desiring an alarm system may fund the system as collateral equipment.

3-5.4.4 Closed Circuit Television (CCTV).

CCTV is designed to deter and reduce the risk of child abuse and protect staff from any unwarranted allegations of child abuse. Service requirements vary on CCTV systems—note the following criteria:

3-5.4.4.1 **Army.** The video surveillance system for Army programs is to be digital, which allows for speed (quicker access to images), reduced space requirements (few tapes to store), and higher quality images. Locate the central monitor in the administrative/reception area. Design the system to provide documentation of the following areas:

a. All activity spaces,

b. Hallways to include exit doors,

c. Kitchen to include delivery entrance and storage room,

d. Reception area (front desk/lobby area/main entrance), and

e. Outdoor Activity Areas to include the outdoor storage area that children can access.

This equipment, external to the outlets, is considered personal property. All video monitoring security systems will be coordinated with U.S. Army Community and Family Support Center, Child and Youth Services Directorate for the latest specifications for Video Monitoring Equipment. All patrons must be notified of the camera surveillance.

3-5.4.4.2 **Navy.** Provide conduit (minimum 19 mm (.75 in.)) and cabling in each activity space with the central monitors located at the check-in desk and a remote monitor located in the Youth Center Director's office. The conduit will accommodate government-furnished/government-installed, locally-funded video equipment. This may require outlets higher in the ceilings, walls, or both. Provide electrical service adjacent to anticipated location of cameras and monitors.

3-5.4.4.3 **Air Force.** Provide the entire CCTV system including cameras, monitors, conduit, cabling, power, and junction boxes required for a complete and operational system. Place monitors at the main check-in desk where they can be easily viewed by staff and in the Youth Center Director's office.

3-5.4.4.4 **Marine Corps.** Provide the entire CCTV system including cameras, monitors, conduit, cabling, power, and junction boxes required for a complete and operational system. Place monitors at the main check-in desk where they can be easily viewed by staff and in the Youth Center Director's office.

3-6 **SITE WORK**.

3-6.1 **Landscaping**.

Design landscaping s to reflect the programs offered and the local geographical environment. Choose plants that are easy to maintain and enhance the visual quality of the facility in all seasons. Indigenous species are preferred. Refer to the local installation landscape standards. For **Air Force**, also refer to the *USAF Landscape Guide* and any Major Command standards.

Do not use poisonous or toxic plants or rocks. Table 3-2 provides a non-comprehensive list of common plants that are known to be poisonous. Table 3-3 provides a list of plants for which no evidence currently exists of a poisonous quality. These lists are provided by the Maryland Poison Center. Within the United States, check with local extensions of the U.S. Department of Agriculture for more information about the nature of common plantings in specific locations. These lists are not intended to serve as a guide for plants to use or not use but are merely provided for informational purposes. Refer to a comprehensive, commercially-available field guide for complete lists of poisonous plants.

TABLE 3-2. COMMON POISONOUS PLANTS

Amaryllis	Jerusalem cherry
Azalea	Jimsonweed
Barberry	Jonquil
Black locust	Lily-of-the valley
Boxwood	Mistletoe
Caladium	Mountain laurel
Castor bean	Narcissus
Chinaberry	Nephthytis/Arrowhead
Chinese evergreen	Nightshade family
Chrysanthemum	Oak (acorns)
Crown of thorns	Peony
Daffodil	Philodendron family
Dumbcane/Dieffenbachia	Poison ivy/oak/sumac
English ivy	Pokeweed
Euonymous	Privet
Four o'clock	Rhododendron
Fruit pits or seeds	Snowball bush/Hydrangea
Gladiola	Water hemlock
Holly	Wisteria
Hyacinth	Yew
Iris	

TABLE 3-3. COMMON NON-POISONOUS PLANTS

African violet	Marigold
Christmas cactus	Mulberry (ripe berries only)
Coleus	Norfolk pine tree
Corn plant	Peperomia
Crocus	(spring) Petunia
Dandelion	Poinsettia*
Dogwood	Prayer plant
Dracaena	Pyracantha/Firethorn
Easter lily	Rose
Ferns	Rubber tree plant
Ficus*	Sansevieria/Snake plant
Forsythia	Scheffiera*
Fuchsia	Spider plant
Geranium	Swedish Ivy
Hibiscus	Tulip*
Honeysuckle	Wandering Jew
Impatiens	Wax plant
Jade plant	Wild strawberry/Snakeberry
Lilac	Zebra plant

***** Sap may be irritating.

3-6.2 **Drop-off Area/Bus Stop**.

Comply with antiterrorism standards noted in paragraph 3-8 below. Consider providing a sign at the entry to the bus drop-off lane that reads, “Bus Drop-Off Lane Only. All Other Vehicles Prohibited.”

3-6.3 **Parking and Access Drives**.

Provide adequate parking for both staff and patrons with the appropriate access drives. Consider location of bicycle racks near the facility entrance in a secure location.

3-6.4 **Service Drive**.

Verify the size of required service vehicles prior to planning the service access areas. Provide a back-up spur for dead-end and service drives that exceed 30 m (100 ft.) in length. Access should be near the serviced areas, i.e., kitchen (if provided), garbage dumpster/storage (indoor or outdoor), mechanical room, and service entry, if one is designated. Provide a service vehicle apron and consolidate service access when possible. Screen or separate the service area from public use or traffic areas with attractive fences, depressions, berms, and landscaping. Ensure proper drainage if depressions are used. Do not cross outdoor activity areas with service access. Ensure compliance with antiterrorism standards noted in paragraph 3-8, particularly for dumpster separation and access control.

3-6.5 **General Site Lighting**.

Ensure that parking areas and the facility have adequate lighting for safety, evacuation, and security measures. See UFC 3-530-01.

3-6.6 **SAC Outdoor Activity Area**.

The SAC Outdoor Activity Area should comply with the *Handbook for Public Playground Safety* guidelines for developmentally-appropriate play spaces and groupings. It should also comply with ASTM F1487. See Table 4-4.2 for more information on this space.

3-6.7 **Youth Outdoor Activity Area**.

If both SAC and Youth programs are accommodated in a facility, the youth program may share the SAC Outdoor Activity Area, in which case there are no additional criteria. If SAC is not provided or if an additional, separate Youth Outdoor Activity Area is programmed, it should at a minimum meet the *Park, Recreation, Open Space and Greenway Guidelines*. Also consider providing features such as an exterior basketball court.

3-6.8 **Teen Patio**.

See Table 4-10.2 for more information on this space.

3-6.9 **Optional Outdoor Open Area**.

This optional area is intended for large area outdoor activities, such as team sports. Consider designing features to accommodate a regulation soccer field or a little-league baseball field. At a minimum, this space should also meet the *Park, Recreation, Open Space and Greenway Guidelines*.

3-7 BARRIER FREE DESIGN REQUIREMENTS.

Design Youth Centers to be barrier-free and accessible in compliance with the Architectural Barriers Act (Public Law 90-480) of 1968, http://www.access-board.gov/ufas/ufas-html/ufas.htm - ABA. Provide barrier free design requirements in accordance with the Uniform Federal Accessibility Standards (UFAS), published as Federal Standard (FED-STD)-795, http://www.access-board.gov/ufas/ufas-html/ufas.htm, and 28 CFR Part 36, the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG), http://www.access-board.gov/adaag/html/adaag.htm.

3-8 ANTITERRORISM.

For antiterrorism requirements, refer to UFC 4-010-01 and UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*.

3-9 SUSTAINABLE DESIGN.

Use an integrated approach to the planning and design of Youth Centers that minimizes energy consumption and optimizes life cycle cost renewable energy possibilities. Use a practical combination of site selection and siting, energy conserving building envelope technologies, energy efficient lighting, occupant sensing controls, variable frequency drives for motors and exhaust fans, and high efficiency HVAC systems to achieve this goal. Incorporate renewable energy principles such as day-lighting, passive and active solar heating, natural ventilation, and photo-voltaics where they are life cycle cost effective.

3-9.1 Service Specific.

See the following Service-specific requirements:

3-9.1.1 **Army.** Design Youth Center projects with consideration for sustainable ratings in eight facility categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Facility Delivery Process, Current Mission, and Future Missions. The minimum rating for the Army's Sustainability Project Rating Tool (SPiRiT) must be in accordance with the current rating. Most projects can reach the sustainability rating without increasing costs, while improving installation sustainability and balancing available resources with customer requirements. Understanding and applying the principles of Sustainable Design and Development and using the SPiRiT rating process improves day-to-day decisions and project quality.

3-9.1.2 **Navy and Marine Corps.** Use the United States Green Building Council (USGBC) LEED™ Green Building Rating System to measure the sustainability of the completed project. It can also be used during planning and design as a source of green building strategies. LEED™ addresses sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality. The minimum LEED™ rating of "Certified" should be met within budgetary constraints. Actual certification is encouraged, but not required.

Follow the guidance in UFC 3-400-01.

3-9.1.3 **Air Force.** It is Air Force policy to apply sustainable development concepts in the planning, design, construction, environmental management, operation, maintenance, and disposal of facilities and infrastructure projects, consistent with budget and mission requirements.

Each Major Command should incorporate sustainable development using LEED™ criteria. The *Air Force Sustainable Facilities Guide* will provide tools and suggested guidelines for selecting candidate projects. The goal is to have all MILCON/NAF projects in the FY09 program capable of achieving LEED™ certification. Submission to the USGBC for actual LEED™ certification is at MAJCOM discretion. This policy does not apply to Host Nation or NATO funded projects.

Sustainable development concepts will benefit the Air Force by creating high-performance buildings with long-term value. They are to be integrated into the development process and balanced with all other design criteria to achieve best value for the Air Force. The economic analysis process need not change, but the elements to consider will now include sustainable technologies and their potential for long-term savings. Complete Air Force policies may be found in the *Air Force Sustainable Facilities Guide* found at http://www.afcee.brooks.af.mil/dc/dcd/arch/rfg/index.html.

3-9.2 **Other Sustainable Design Criteria**.

The following general references provide more information:

3-9.2.1 When specifying products that are included in EPA's list of affirmative procurement guideline items, designers must include the requirement for these products to meet or exceed the recycled material content standards established by EPA. The list of products and their corresponding recycled content requirements are found at www.epa.gov/cpg/products. Listed products likely to be used in Youth Centers include building insulation, carpet and cushion, cement and concrete, latex paint, floor tiles, patio blocks, restroom dividers, and structural fiberboard.

3-9.2.2 The "Whole Building Design Guide" www.wbdg.org further explains the environmental issues related to building materials and provides technical guidance on green building material selection.

3-9.3 **DoD Energy Budget**.

Design of new facilities must ensure that building energy consumption does not exceed the DoD energy budget figures.

CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-1 INTRODUCTION.

This chapter identifies the specific design needs for each functional area as outlined in the space program. Tables 4-1 through 4-11 provide this data in a standard Functional Data Sheet format.

These Data Sheets are available as a Microsoft© Word© file for use during project execution. The file is available with the Space Program spreadsheets, downloadable from the Whole Building Design Guide DoD page (http://dod.wbdg.org/) web site.

TABLE 4-1. LOBBY

Description/ Usage	The Lobby serves as the entrance to the facility. This entrance should be recognizable from the outside and be close to the school bus drop-off, base bus stop, and patron parking. The lobby should be open and friendly and serve to introduce the rest of the facility. It should have a comfortable area for waiting. The Check-in (see Table 4-2) is an integral part of the lobby.
Min. Ceiling Ht.	2.74 m (9 ft.) minimum.
Finishes	**Walls.** Provide a low-maintenance, durable finish. Prefer a wainscot. Consider painted gypsum wallboard or the use of vinyl wall covering where budget and practical considerations allow. **Floor.** Provide a low-maintenance, durable, moisture and slip-resistant finish suitable for this high traffic area. Consider seamless vinyl, stained concrete, or stone or quarry tile. Provide a walk-off mat/area at the entrance door. **Ceiling.** Provide a decorative ceiling. Consider exposed, painted structure.
Plumbing	None required. Consider providing a drinking fountain.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code. Consider outlets for display cases.
Lighting	430 lux (40 fc). General ambient lighting. Consider decorative and task lighting.
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Consider providing one line for local or toll-free calls. **Data.** None required. **Security.** None required.
Casework	Consider providing display cases in this space and along corridors for display of projects.
Furnishings Fixtures & Equip. (FF&E)	Floor mat at entrance; soft padded furniture for seating/waiting area; tables; magazine rack, and tack surfaces. Consider providing a pay phone. For **Army**, consider providing a ceiling or wall-mounted TV and security monitors.
Special Req.	Airlock at main entrance. Signage.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-2. CHECK-IN

Description/ Usage	The Check-in area is the primary area to monitor and control access into and out of the building. Youth will be checked in here, and all visitors must register at this point. It must have visible control over all primary entrances/exits and the Commons and access points to other spaces. Game supplies may be stored at the check-in desk. The audio and CCTV controls will also be located here. 
Min. Ceiling Ht.	2.74 m (9 ft.) minimum.
Finishes	**Walls.** Painted gypsum wallboard. Consider vinyl wall coverings. **Floor.** VCT with vinyl or rubber base. Consider carpet or cushioning properties behind the counter. **Ceiling.** ACP. Consider using the ceiling to define and separate this area from the Lobby.
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide power for all equipment. Perform a power requirement survey, as this area's power requirements are extremely site and locale specific.
Lighting	540 lux (40 fc). General ambient lighting. Provide task lighting; consider decorative fixtures.
Communication	**CCTV.** All lobby monitors must be viewable from this area. **CATV/Internal Video.** None required. **PA/Audio.** PA controls. Provide a speaker. **Telephone.** Provide one line per two points of sale (POS). Provide at least two additional general-purpose phone lines. **Data.** Provide one outlet per POS. Provide additional outlets, as needed, for associated hardware. **Security.** None required.
Casework	Provide a 610 mm (24 in.) deep counter with built-in cabinets. Provide file drawers and storage drawers with a minimum of two lockable drawers for each POS. The counter should be dual height for standing transactions, seated office functions, and ADA customer service. Note that ADA-height counter should have knee-hole space on both sides of the counter. Consider a durable material for the counter such as solid surface—laminate edges are not permitted. Consider supports such as steel angle braces for counters with knee-hole space. Modesty panels and apron must be of durable materials. Consider providing wall and base cabinets and equipment counter.
Furnishings Fixtures & Equip. (FF&E)	Point-of-Sale units, desktop computer for administrative functions. CCTV monitors. Printers. Chairs and stools. Scanner or swipe-card check-in device.
Special Requirements	Consider providing a gate between desk and surrounding area. Consider providing a coiling door or grille at the counter to serve as a security screen.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-3.1 ADMINISTRATIVE OFFICES

Description/ Usage	The Administrative Offices consist of a mix of closed and open office space. The quantity and selection of closed offices is facility specific. The remaining staff sits in open offices or workstations arranged in an open office plan with systems furniture. All offices are used for planning, developing, organizing, supervising, implementing, promoting, and evaluating facility operations. The offices should be free from frequent distraction, have a professional appearance, and provide a sense of work place.
Min. Ceiling Ht.	2.44 m (8 ft.) minimum.
Finishes	**Walls.** Painted gypsum wallboard or vinyl wall covering. **Floor.** Carpet with vinyl or rubber base **Ceiling.** ACP
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum
Fire Protection	Provide system per paragraph 3-5.3.
Power	Ensure an adequate number of circuits to power all equipment. Provide a minimum of one quad outlet in closed offices on at least three walls. Gang outlets with data and telephone. Workstations should provide at least one quad outlet per staff. Provide additional outlets as necessary to operate shared equipment such as printers, fax, etc.
Lighting	540 lux (50 fc). General ambient fixtures.
Communication	**CCTV.** Provide one outlet for remote monitor in Director's office and one for the School-age Coordinator. **CATV/Internal Video:** None required. **PA/Audio:** Provide a speaker. **Telephone.** Provide one line per staff plus one additional line for fax and copier. **Data.** Provide one outlet per staff plus one outlet for each printer, copier, scanner, etc. **Security.** None required.
Casework	None required.
Furnishings Fixtures & Equipment (FF&E)	Private Offices—provide furniture for 11 m^2 (120 $ft.^2$) office: desk, credenza, filing cabinet, desk chair and two side chairs. Workstations—provide furniture for 4.5 m^2 (48 $ft.^2$) workstation: desk chair and side chair for open offices. Workstation systems furniture must provide adequate space for filing and overhead storage.
Special Requirements	Provide vision panels in office doors.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-3.2 BREAK/ STAFF TRAINING ROOM

Description/ Usage	Used for staff training, meetings, breaks, and lunches. Consider that staff lockers may be in this area (see Table 4-3.4).
Min. Ceiling Ht.	2.44 m (8 ft.) minimum.
Finishes	**Walls.** Painted gypsum wallboard or vinyl wall covering. **Floor.** VCT with vinyl or rubber base. **Ceiling.** ACP
Plumbing	Provide a sink. Consider water connection for refrigerator icemaker.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code. Provide one additional outlet at counter height for convenience. Provide additional outlets necessary to operate dedicated equipment such as the coffee machine, refrigerator, time clocks, microwave, and various training equipment.
Lighting	540 lux (50 fc). Consider dimmable lights.
Communication	**CCTV.** None required. **CATV/Internal Video.** Consider providing one outlet. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line. **Data.** Provide a minimum of one outlet. Consider providing additional outlets for training purposes. **Security.** Provide a vision panel in the door.
Casework	Solid-surface countertop; see paragraph 3-4.1 for length criteria. Provide lockable wall and base cabinets. Provide storage for training materials and AV cart.
Furnishings Fixtures & Equipment (FF&E)	Table and chairs, microwave, coffee machine, and refrigerator. Bulletin board with tack surface. Dry-erase board. AV cart with TV, VCR, and DVD for training purposes. Projector and screen. Computers.
Special Requirements	Provide a vision panel in the door.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-3.3 COPY/FILE AREA

Description/ Usage	This area could be either enclosed and centralized or open and decentralized within the Administrative area. It houses copy machines, printers other than those dedicated to specific individuals, filing cabinets, and storage for general office supplies. In addition, provide sufficient space to act as a workroom for staff to allow for collating documents, presentations, and work projects.
Min. Ceiling Ht.	2.44 m (8 ft.) minimum.
Finishes	**Walls.** Painted gypsum wallboard or vinyl wall covering. **Floor.** VCT with vinyl or rubber base. **Ceiling.** ACP
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code and dedicated outlets for copiers and printers.
Lighting	540 lux (50 fc)
Communication	**CCTV.** Consider providing one outlet. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide at least one line for telephone and one additional line, if appropriate, for a facsimile machine. **Data.** As necessary for network printers. **Security.** Lockable area for filing or lockable filing cabinets.
Casework	610-mm (24-in.) deep countertop. Lockable base and wall cabinets and storage shelves.
Furnishings Fixtures & Equipment (FF&E)	Photocopy machine and other office equipment, as appropriate. Work table for collating documents and other work.
Special Requirements	If this is a dedicated room with a door, provide a vision panel.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-3.4. OPTIONAL STAFF LOCKER AREA

Description/ Usage	This optional area is used by all staff for the storage of personal articles only. It is not intended as a rest room or shower facility. It is usually part of or adjacent to the Break/Staff Training room (see Table 4-3.2).
Min. Ceiling Ht.	2.44 m (8 ft.) minimum.
Finishes	**Walls.** Painted gypsum wallboard or vinyl wall covering. **Floor.** VCT with vinyl or rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code.
Lighting	540 lux (50 fc).
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Casework	None required.
Furnishings Fixtures & Equipment (FF&E)	Half-sized lockers with key/combination locks. **Navy** requires padlock lockers
Special Requirements	If this is a dedicated room with a door, provide a vision panel in the door.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-3.5 STAFF/VISITORS TOILETS/ JANITOR'S CLOSET

Description/ Usage	See Table 3-1 for Service-specific toilet requirements. These are separate male and female toilets for use by adult staff and visitors. **Navy** provides multiple unisex toilets that are shared by Teens, staff, and visitors—see Table 4-9.
Min. Ceiling Ht.	2.44 m (8 ft.) minimum.
Finishes	**Walls.** Epoxy or enamel painted, moisture-resistant gypsum wall board with a ceramic tile wainscot. Consider full ceramic tile walls. **Floor.** Ceramic tile. **Ceiling.** Painted, moisture-resistant gypsum board. None needed for janitor's closet.
Plumbing	Provide wall-hung water closets, wall-hung urinals, and lavatories based on the applicable code for the calculated occupancy. Provide a floor drain.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum. Ventilate to the exterior per code.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code.
Lighting	540 lux (50 fc).
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** Provide lockable doors. Provide a vision panel in the door.
Casework	Solid-surface countertop with either underhung or integral sink. Solid composite toilet and urinal partitions. Not necessary for **Navy** unisex toilets.
Furnishings Fixtures & Equipment (FF&E)	Toilet accessories: toilet paper dispensers, paper towel dispenser with integral trash receptacle, robe hooks, grab bars, and soap dispensers. Mirror.
Special Requirements	Provide a Janitor's closet associated with or in proximity of these toilets. This closet includes a mop sink with hot and cold water, a floor drain, and storage for pails, mops, vacuums, and related cleaning supplies and equipment. Include a lockable door, (which can be opened from the inside) with a vision panel. Provide lockable cabinets for cleaning supplies. Provide exhaust ventilation directly to the outside.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-3.6. OPTIONAL LAUNDRY

Description/ Usage	This optional Laundry Room may be used for washing sports uniforms or other items associated with the operation and maintenance of a Youth Center. It is sized in one of two modules: a one-washer room or a two-washer room. The **Navy** normally does not provide laundry without justification.
Min. Ceiling Ht.	2.74 m (9 ft.) minimum.
Finishes	**Walls.** Painted water-resistant gypsum wallboard. **Floor.** VCT or seamless vinyl. **Ceiling.** None or Acoustical Ceiling Panels. Consider washable and humidity resistant panels. Gypsum wallboard ceiling may also be used.
Plumbing	Hot and cold water to each of the washing machines and one laundry sink. Floor drains. Provide recessed plumbing cabinets for each utility connection to the machines.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum. Provide separate vents to the outside for the dryers. Provide adequate dehumidification as part of the building systems.
Fire Protection	Provide system per paragraph 3-5.3. Note requirement for 1-hour rated construction and 45 min.-rated door with self closer.
Power	Provide outlets per code. Provide power to each washer and dryer.
Lighting	540 lux (50 fc) general ambient lighting.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Provide one speaker. **Telephone.** None required. **Data.** None required. **Security.** Provide a vision panel in the door.
Casework	None required.
Furnishings Fixtures & Equipment (FF&E)	Large, high capacity washers and dryers—provide one more dryer than washer (either one washer and two dryers, or two washers and three dryers). Provide for storage of laundry supplies. Consider providing a folding table and hanging rack.
Special Requirements	Provide easy access to rear of dryers to allow easy maintenance and cleaning of vents (see HVAC).
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-4.1. SAC ACTIVITY ROOMS

Description/ Usage	These rooms accommodate a variety of activities and program options for youth in the SAC program. These rooms may be used for multiple activities such as arts/crafts, hobbies, performing arts/drama, science, and study. The room should be able to accommodate multiple activities at the same time. **Note**: the Services vary on how they configure these rooms; see floor finishes below for more information.	
Min. Ceiling Ht.	2.44 m (8 ft.) minimum and (12 ft.) maximum.	
Finishes	**Walls.** Gypsum wallboard—first 1.22 m (4 ft.) with a protective wall covering wainscot and paint above 1.22 m (4 ft.). **Floor.** Provide 100% hard surface flooring (prefer vinyl composition tile) and the use of area carpets to allow flexibility of room configuration. Vinyl or rubber base. **Air Force** requires 50% carpet (in clean area), 50% seamless, impervious, non-skid, non-textured hard-surface flooring (in play area). Vinyl or rubber base. Navy will allow stained concrete for hard-surface flooring. **Ceiling.** ACP.	
Plumbing	Provide one two-compartment sink with hot and cold water. To facilitate arts and crafts activities, consider making this a deep sink. To prevent scalding of youth, limit water temperature to 43 C (110 F). Provide a floor drain.	
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.	
Fire Protection	Provide system per paragraph 3-5.3.	
Power	Provide duplex outlets at 2.44 m (8 ft.) on center at perimeter walls; provide at least one GFI duplex above countertop; provide duplex outlets for TV (near cable outlet), refrigerator, and microwave.	
Lighting	540 lux (50 fc) minimum. Consider providing as much as 750 lux (70 fc) to accommodate arts and craft activities.	
Communication (in each room)	**CCTV.** Provide minimum one outlet. Consider the shape of the room and the panning range of the camera to determine if additional outlets will be necessary. **CATV/Internal Video.** Provide one outlet. **Navy** does not support CATV in this space. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Consider providing at least two outlets. **Security.** Do not create corners or “nooks” not visible from other areas of the room.	
Casework	Provide lockable base and wall cabinets with adjustable shelves. Solid surface countertops are required where water is present and preferred elsewhere.	
Furnishings Fixtures & Equip. (FF&E)	Tables, chairs, soft seating areas, computers, tack board, and marker board. Consider age-appropriate dimensions for all furniture and fixtures. Consider providing undercounter refrigerator and microwave for life skills training. Provide storage for each youth. Consider individual lockers.	
Special Requirements	Provide tackable surfaces on the walls. Include vision panels in interior doors and large windows in the interior walls. Provide exterior doors to outside activity area. **Army** requires exterior doors to be alarmed. Navy does not require exterior doors. Provide a dedicated storage closet (the space for this has been included in the space program) with hanging rods and/or shelves for each SAC Activity Room.	
For use during project execution by the appropriate Service agency		
Occupancy	Staff. Patrons/Youth.	
Min. net m^2 (ft^2)	Room.	Storage Closet.

TABLE 4-4.2 OUTDOOR ACTIVITY AREA

Description/ Usage	The Outdoor Activity Area should be designed to meet the requirements for NSACA accreditation. It should be conducive to creative play and must include three zones: hard-surface area, shaded area, and an open area. A certified playground safety inspector should be involved in the design of the Outdoor Activity Area or, at a minimum, the design review.
Min. Ceiling Ht.	N/A
Finishes	**Walls.** N/A **Floor.** Hard-surface Areas—cast-in-place concrete over well-compacted sub-grade is generally the most durable, low-maintenance surface material. Consider color additives or surface finishes to improve the appearance and reduce glare. Avoid smooth steel trowel finishes, which can become slippery when wet. Use Zones—Use zones are the areas under and around playground equipment and are defined by ASTM 1487. Use surface materials that meet the shock absorbency criteria recommended by CPSC and ASTM guidelines. Generally, poured-in place resilient safety surfaces are the best option. **Ceiling.** N/A
Plumbing	Provide a keyed, tamper-resistant hose bibb. Consider providing misters in hot, dry climates—connect to potable water system and provide code-compliant back-flow prevention. Consider providing an irrigation system—consider safety factors such as tripping hazards and the use zones in the design.
HVAC	N/A
Fire Protection	N/A
Power	N/A
Lighting	Provide security lighting on a timer for after-hours activation and on a switch for staff control.
Communication	**CCTV.** None required. The **Army** provides outdoor camera coverage. **CATV/Internal Video.** None required. **PA/Audio.** Provide speakers for adequate coverage. Speakers to be outdoor type. Consider outdoor noise levels when spacing speakers. **Telephone.** None required. **Data.** None required. **Security.** Do not create blind spots or hidden areas.
Casework	Provide an enclosed, weather-tight, vandal-proof storage shed for outdoor equipment. It should be readily accessible to the major play zones and be architecturally or thematically compatible with the Youth Center, including the roof design. Ventilate the storage shed and provide concrete floors sloped to the door for drainage. Provide visibility into the shed and eliminate blind spots created by the shed for child-abuse concerns. Locks must be selected to operate at the exterior of the door but not allow children to be trapped inside the structure.
Furnishings Fixtures & Equip. (FF&E)	CPSC-compliant, age-appropriate play equipment. Consider other items such as sports equipment, balls, outdoor tables and chairs, etc.
Special Requirements	Per paragraph 3-7, comply with ADAAG Amendment 15.6 for play areas. It includes technical provisions for ground level and elevated play components, accessible routes, ramps and transfer systems, ground surfaces and soft contained play structures.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-5.1. COMMONS

Description/ Usage	This is the "heart" of the facility. It is the space that connects the basic components of a youth center such as the activity rooms, computer room, teen room, multipurpose room, and the SAC area. The area should be open and inviting and offer defined areas where smaller groups of youth can gather for such activities as eating, gaming, and group conversations. The Commons should naturally "grow" out of the Lobby. The entrances to the other youth center components should be well defined and act as "portals" to these other areas. The game area, snack bar/eating area, and vending area could be sub areas within the Commons. The **Navy** normally does not provide a vending area. The Commons should also provide access to the outdoor activity areas but not the Teen Patio.	
Min. Ceiling Ht.	2.4 m (8 ft.) minimum with 3.66 m (12 ft.) recommended; up to 5.49 m (18 ft.) may be considered. Consider varying the ceiling heights to provide interest and variety of scale.	
Finishes	**Walls.** Painted gypsum wallboard or vinyl wall covering. **Floor.** VCT with vinyl or rubber base. If budget allows, consider stained concrete, terrazzo tile, or some other natural stone tile. **Ceiling.** Along with the height, vary the ceiling finishes to help define the sub areas of the Commons. Consider painted gypsum board or decorative finishes.	
Plumbing	None required. Consider providing a drinking fountain.	
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.	
Fire Protection	Provide system per paragraph 3-5.3.	
Power	Provide outlets per code. Additional outlets are required in the game area and for the CCTV and CATV system. Also consider other additional outlets for special events held in this space, e.g. like a dance.	
Lighting	215 to 430 Lux (20 to 40 ft. candles) general ambient lighting. Provide a variety of other accent and task lighting fixtures to create interest. Provide dedicated fixtures over the pool and gaming tables. Consider providing dimming in some areas.	
Communication	**CCTV.** Provide sufficient quantity to allow adequate coverage. **CATV/Internal Video.** One or two outlets. **PA/Audio.** Provide at least one speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.	
Casework	None required.	
Furnishings Fixtures & Equipment (FF&E)	Tables, chairs, soft and padded furniture, and television(s). Additional specific furniture requirements are described in the associated areas.	
Special Requirements	This space will be greatly enhanced by skylights or clerestory windows. **Army** requires the exterior doors to be alarmed. A general Youth Program storage closet is programmed and generally provides storage for the Commons and Game Area. It is likely located off of the Commons. If it is a separate room, provide a vision panel in the door.	
For use during project execution by the appropriate Service agency		
Occupancy	Staff. Patrons/Youth.	
Min. net m^2 (ft^2)	Area.	Storage Closet.

TABLE 4-5.2. GAME AREA

Description/ Usage	This area is used for table games such as pool, ping pong, foosball, or air hockey. May also be used for board and video games. The Game Area may be a part of the Commons, but some passive separation should be provided to give this area a unique feel.
Min. Ceiling Ht.	2.44 m (8 ft.) minimum. Provide at least 3.35 m (11 ft.) above pool tables.
Finishes	**Walls.** Painted gypsum wallboard or vinyl wall covering. Provide a wainscot if budget permits. **Floor.** Consider varying floor finishes to help define zones within the game area. Consider VCT with vinyl or rubber base and carpet for acoustical protection. **Ceiling.** ACP or painted gypsum board ceiling may be used to help define this area from the Commons.
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code and for games that require electricity.
Lighting	Provide lighting levels appropriate to the individual games.
Communication	**CCTV.** Provide sufficient quantity to allow adequate coverage. **CATV/Internal Video.** One or two outlets. **PA/Audio.** Provide at least one speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Casework	Consider providing a game cabinet. If provided, consider its location with respect to how it may limit the flexibility of the room.
Furnishings Fixtures & Equipment (FF&E)	Table games such as pool, ping pong, foosball, or air hockey. Board games and video games. Chairs, tables, and stools.
Special Requirements	Consider the acoustics of this area as games can get noisy.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-5.3. SNACK BAR/EATING/VENDING AREA

Description/ Usage	This area provides the snack and beverage service for the center. It may have various configurations depending on the Service branch, size of facility, and types of programs offered. The snack bar is a service counter that offers a limited menu such as chips, sandwiches, and sodas. Vending supports the snack area with a limited selection of food and beverages. There are usually no more than three vending machines in a youth facility. The **Navy** normally does not provide a vending area. The eating area is directly adjacent to these functions and is part of the Commons. Seating should be comfortable and easily arranged. Consider two- and four-top tables.
Min. Ceiling Ht.	2.44 m (8 ft.) minimum with the eating area complying with the requirements of the Commons.
Finishes	**Walls.** Ceramic wall tile or other hard surfaces approved for the snack bar to a minimum of 1.22 m (4 ft.) from finished floor. **Floor.** Provide hard-surface flooring such as VCT, seamless vinyl, or quarry tile or other durable material. **Ceiling.** ACP or painted gypsum board.
Plumbing	Two-compartment countertop sink with hot and cold water supply. Floor drain. If an ice-maker is desired, provide a cold-water connection
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide dedicated outlets for the vending machines and countertop height convenience outlets for microwave and other equipment as required.
Lighting	430 lux (40 fc) general ambient lighting. Provide task lighting. Consider accent fixtures and lighting to provide special ambience.
Communication	**CCTV.** Provide sufficient quantity to allow adequate coverage. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker and intercom connection. **Telephone.** None required. **Data.** Provide one outlet. **Security.** None required.
Casework	Countertop with base and wall cabinets at the front opening. Behind the service corridor, provide base and wall cabinets. Countertop at sink area to be solid-surface. Drink rail.
Furnishings Fixtures & Equipment (FF&E)	Under cabinet or counter microwave, refrigerator, freezer, and other small appliances as required. Also provide a menu board. Vending machines. Tables and chairs/stools in the eating area. Consider an icemaker.
Special Requirements	Provide a roll-up door for the snack bar.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	Snack Bar. Eating Area.

TABLE 4-6. OPTIONAL KITCHEN

Description/ Usage	This optional area provides a commercial-grade kitchen with an adequate cooking battery and storage for both cold and dry goods. The kitchen is generally used to prepare refreshments for day-to-day consumption by patrons and for special events. There are two size options: a small kitchen generally adequate for preparing ad hoc meals for day-to-day patrons, and a larger kitchen capable of preparing a planned menu for a larger group of people. The **Navy** normally does not provide a kitchen.
Min. Ceiling Ht.	2.44 m (8 ft.) minimum.
Finishes	**Walls.** Ceramic wall tile or hard surfaces approved for kitchen to a minimum of 2.44 m (8 ft.) from finished floor. **Floor.** Quarry tile or other non-slip, durable material. **Ceiling.** Water and mildew resistant lay-in panels or painted gypsum wall board.
Plumbing	As necessary to support the cooking and cleaning battery designed for the kitchen, including an ice machine. Floor drains must also be provided that comply with all local building and health codes.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum. Provide exhaust.
Fire Protection	Provide system per paragraph 3-5.3. Provide commercial hood and duct system and listed fire suppression system for the range.
Power	Provide outlets per code and dedicated circuits for the specified kitchen equipment.
Lighting	540 Lux (50 ft. candles).
Communication	**CCTV.** None required. The **Army** provides camera coverage for both the kitchen and the dry storage area. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** None required. **Security.** None required.
Casework	Design the counters and cabinetry with consideration of the overall kitchen design and equipment selection.
Furnishings Fixtures & Equipment (FF&E)	Commercial-grade, stainless steel equipment for the preparation, cooking, and cleaning areas, and may include the following: frozen and refrigerated food cabinets, three-compartment dish table, dish wash spray assembly, baking and convection oven, minimum four-burner cook top, storage racks, dishwashers, ice machine, and prep-tables.
Special Requirements	Consider providing a pass-through window to the snack bar.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-7.1. COMPUTER ROOM

Description/ Usage	This area serves primarily for computer use by SAC, youth, and teens. Consider that computer use must be monitored for appropriate use. Provide direct visual access into this room from public areas to highlight this room as a showcase. In **Air Force** facilities, the area should also provide an area designated for homework. Air Force prefers this space to be more private for study activities.
Min. Ceiling Ht.	2.44 m (8 ft.).
Finishes	**Walls.** Painted gypsum wallboard or vinyl wall covering. **Floor.** Anti-static carpet with vinyl or rubber wall base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum with 24/7 operation.
Fire Protection	Provide system per paragraph 3-5.3.
Power	As necessary to support all the equipment in this room. Locations of outlets should be specific to the layout of the room and may include recessed, flush, floor-mounted junction boxes. Provide an Isolated Ground Panel Board.
Lighting	430 lux (40 fc) general ambient indirect lighting. Provide fixtures designed for use in computer environments to reduce glare and reflections.
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** Provide one outlet. **Navy** does not allow CATV in this space. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide one outlet for each computer and additional outlets, as required, for other equipment and printers. **Security.** Lockable doors. Provide a vision panel in the door.
Casework	Consider built-in countertops for computers, monitors, printers, etc. If counters are provided, ensure access to power and data outlets. Consider ergonomically correct seating heights for the range of ages that will be using the computers when considering built-in counters.
Furnishings Fixtures & Equipment (FF&E)	Tables, chairs, computers, printers, tack boards, and marker boards. Consider modular computer workstations. Consider providing lockable storage. Consider ergonomically correct seating heights for the range of ages that will be using the computers when selecting the furniture. Height-adjustable furniture may be required.
Special Requirements	If exterior windows are provided, equip with shading devices.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-7.2. ARMY HOMEWORK ROOM

Description/ Usage	Only the **Army** provides a dedicated homework room. This area provides a private, dedicated space that is conducive to study and completion of homework. In small facilities, the Army combines this with the Computer Room. The Navy and Marine Corps accommodate this function in the activity rooms and the Air Force accommodates this function in the Computer Room.
Min. Ceiling Ht.	2.44 m (8 ft.).
Finishes	**Walls.** Painted gypsum wallboard or vinyl wall covering. **Floor.** Carpet with vinyl or rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code.
Lighting	Provide 540 lux (50 fc) general ambient lighting.
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** Consider providing one outlet. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Consider providing at least two outlets. **Security.** Provide a vision panel in the door and wall.
Casework	None required.
Furnishings Fixtures & Equipment (FF&E)	Consider items such as the following: tables, chairs, desks, soft and padded furniture for reading, tack boards, and marker boards.
Special Requirements	If exterior windows are provided, equip with shading devices.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-7.3. GENERAL ACTIVITY ROOM

Description/ Usage	This shared activity room should be versatile and open to allow for a variety of indoor activities for up to 30 youth. As with all of the activity rooms, it is sized as a basic module to afford flexibility in use. This space allows youth to socialize during group games, hold club meetings, do homework, theater/drama, and receive instruction in topics like arts and crafts and the sciences. 
Min. Ceiling Ht.	3.05 m (10 ft.) clear.
Finishes	**Walls.** Gypsum wallboard—first 1.22 m (4 ft.) with a protective wall covering wainscot and paint above 1.22 m (4 ft.). **Floor.** Provide durable, low-maintenance hard surface flooring such as VCT (consider seamless or moisture-resistant flooring in wet/crafts areas). Consider area carpets or rugs. Vinyl or rubber base. . **Ceiling.** ACP.
Plumbing	Provide a sink with hot and cold water and a floor drain.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.
Fire Protection	Provide system per paragraph 3-5.3.
Power	As a minimum, provide duplex outlets at 2.44 m (8 ft.) on-center and provide one duplex outlet at each CATV outlet. Consider additional duplex outlets depending on intended usage. Outlets at the sink must be GFI and comply with all codes.
Lighting	Provide 540 Lux (50 ft. candles) in game/play areas. Consider providing dimmable lighting and down lights at individual activity areas. Coordinate fixture locations so lights are not obstructed or shadows cast.
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** Consider providing one outlet. **Navy** does not permit CATV in the General Activity Room. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Consider providing at least two outlets. **Security.** Do not create corners or “nooks” that are not visible from other areas of the room. Provide vision panels in interior doors and large windows in the interior walls to corridor and/or Commons.
Casework	Provide solid-surface countertop with base cabinets. Also consider providing wall storage cabinets for arts and craft supplies and projects.
Furnishings Fixtures & Equip. (FF&E)	Consider items such as the following depending on intended usage: tables, chairs, soft and padded furniture, bookshelves, large pillows, area rugs, television, video games, table games, tack board, dry-erase board, easels.
Special Requirements	Provide tackable surfaces on the walls. Provide exterior doors to outside activity area. **Army** requires exterior doors to be alarmed. The Navy does not require exterior doors. Provide a dedicated storage closet (included in the space program) with hanging rods and/or shelves. Consider providing a folding room partition. The **Navy** does not recommend folding partitions.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	Room. Storage Closet.

TABLE 4-7.4. SPECIAL ACTIVITY ROOM

Description/ Usage	This shared activity room is designed to be versatile and open to allow for a variety of indoor activities. As with all of the activity rooms, it is sized as a basic module to afford flexibility in use. The primary difference between this room and the General Activity Room is that it is designed for more active functions such as dance, yoga, or martial arts instruction. However, this room is not intended to accommodate team sports.
Min. Ceiling Ht.	3.05 m (10 ft.) clear.
Finishes	**Walls.** Painted concrete masonry unit (CMU) wall or impact-resistant gypsum wallboard (GWB) or high-density polyethylene (HDPE). **Navy** and **Air Force** do not permit CMU in these spaces. **Floor.** Varies depending on intended functions, but may include hard-wood dance floor, athletic flooring, etc. **Ceiling.** ACP.
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum. Consider the active functions with regard to air changes and humidity control.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code.
Lighting	540 lux (50 fc).
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Consider providing at least two outlets. **Security.** Do not create corners or “nooks” that are not visible from other areas of the room.
Casework	Varies depending on intended functions, but may include a segmented, height-adjustable dance (ballet) bar; full-height, shatter-proof mirrors; etc.
Furnishings Fixtures & Equipment (FF&E)	Varies depending on intended functions, but may include resilient athletic flooring, martial arts equipment, and other specialized equipment to suit the selected function.
Special Requirements	Include vision panels in interior doors and large windows in the interior walls. Provide exterior doors to outside activity area. **Army** requires exterior doors to be alarmed. The Navy does not require exterior doors. Provide a dedicated storage closet (included in the space program). Consider acoustical requirements for these active function rooms. Consider providing a folding room partition.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-7.5. OPTIONAL MUSIC/MULTIMEDIA ROOM

Description/ Usage	This optional room is smaller than the basic activity room module and is used for musical instrument instruction for one to two students or as a video and/or photography lab.
Min. Ceiling Ht.	2.44 m (8 ft.).
Finishes	**Walls.** Painted CMU or other material with consideration for acoustical separation from adjacent spaces. **Navy** and **Air Force** do not permit CMU in these spaces. **Floor.** VCT or Carpet with vinyl or rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code.
Lighting	540 Lux (50 ft. candles).
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Army** requires one line with two-way internal communication. **Data.** None required. **Security.** Provide a vision panel in the door.
Casework	None required.
Furnishings Fixtures & Equipment (FF&E)	May include chairs, music stands, etc.
Special Requirements	Integrate equipment storage spaces with the design of these rooms. Music rooms require acoustical separation from the remainder of the facility. Provide soundproof walls from floor to roof deck. Consider providing an acoustical vestibule at the entrance to this room or, at a minimum, a door with sound gaskets on all edges. Provide a vision panel in the door.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-7.6 OPTIONAL PARENT WAITING AREA

Description/ Usage	This optional space is in addition to the lobby waiting area and provides a comfortable area for family and friends to view youth participating in the individual programs. This area should have visual access at a minimum into the Special Activity Rooms. **Navy** does not permit this optional area.
Min. Ceiling Ht.	2.44 m (8 ft.).
Finishes	**Walls.** Painted gypsum wallboard or vinyl wall covering. **Floor.** Carpet with vinyl or rubber base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code.
Lighting	540 Lux (50 ft. candles).
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** None required. **PA/Audio.** Provide a speaker. **Telephone.** None required. **Data.** None required. **Security.** None required.
Casework	None required.
Furnishings Fixtures & Equipment (FF&E)	Soft padded furniture for seating/waiting area, tables, magazine-rack.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-8. SAC/YOUTH/TEEN TOILETS

Description/ Usage	See Table 3-1 for Service specific toilet requirements. Separate toilets for male and female youth. These toilets are not for use by adults. **Navy** Youth toilets are shared with the SAC youth, but not the teens while the center is occupied by pre-teens—see Table 4-9 for Navy Teen (unisex) toilet criteria.
Min. Ceiling Ht.	2.44 m (8 ft.) minimum.
Finishes	**Walls.** Epoxy or enamel painted, moisture-resistant gypsum wallboard with a ceramic tile wainscot. Provide full-height ceramic tile on wet walls; consider full-height ceramic tile on all walls. **Floor.** Ceramic tile. **Ceiling.** Painted, moisture-resistant gypsum board.
Plumbing	Provide water closets, urinals, and lavatories based on the applicable code for the calculated occupancy. To prevent scalding of youth, limit water temperature to 43 C (110 F). Provide a floor drain. Provide a keyed hose bibb. Consider providing a drinking fountain outside this room. Provide wall-hung water closets and urinals. The **Navy** requires floor-mounted urinals.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum. Provide at minimum 4 – 6 air changes per hour. Ventilate to the exterior per code.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code.
Lighting	540 lux (50 fc).
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** Ensure entrance can be audibly and visually monitored from Check-in.
Casework	Solid-surface countertop supported at both ends with either underhung or integral sink. Phenolic or solid composite toilet and urinal partitions secured at floor and ceiling.
Furnishings Fixtures & Equipment (FF&E)	Toilet accessories: toilet paper dispensers, paper towel dispenser with integrated trash receptacle, robe hooks, grab bars, and soap dispensers. Mirror.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-9. NAVY TEEN/STAFF/VISITOR TOILETS

Description/ Usage	**Navy** provides multiple (as needed) unisex toilets for use by Teens, Staff and visitors. Quantity of toilets is based on the applicable code for the calculated occupancy. The other Services do not use unisex toilets. See Table 3-1 for Service-specific toilet requirements.
Min. Ceiling Ht.	2.44 m (8 ft.) minimum.
Finishes	**Walls.** Epoxy or enamel painted, moisture-resistant gypsum wallboard with a ceramic tile wainscot. Provide full-height ceramic tile on wet walls; consider full-height ceramic tile on all walls. **Floor.** Ceramic tile. **Ceiling.** Painted, moisture-resistant gypsum board.
Plumbing	One wall-hung water closet and lavatory. Provide a floor drain.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum. Ventilate to the exterior per code.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code.
Lighting	540 lux (50 fc).
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** None required. **Security.** Lockable door.
Casework	Solid-surface countertop supported at both ends with either underhung or integral sink. A wall-hung lavatory is also acceptable. Wall-hung water closets.
Furnishings Fixtures & Equipment (FF&E)	Toilet accessories: toilet paper dispensers, paper towel dispenser with integrated trash receptacle, robe hooks, grab bars, and soap dispensers. Mirror.
Special Requirements	This room must be ADA-compliant.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-10.1. TEEN ROOM/LOUNGE

Description/ Usage	This space allows teens to socialize during group games as well as have access to more independent activities like computers or watching television in a home-like environment. Consider an irregular shaped room that can be zoned for different activities. However, do not create blind spots. This room must feel private but still connected to the rest of the center. Consider visual access from the Check-in. **Navy** requires visual access from Check-in.
Min. Ceiling Ht.	2.4 m (8 ft.) minimum with 3.66 m (12 ft.) recommended. Consider varying the ceiling heights and finishes to provide interest and a variety of scale. If a pool table is included, provide at least 3.35 m (11 ft.) over the table.
Finishes	**Walls.** Gypsum wallboard—first 1.22 m (4 ft.) with a protective wall covering wainscot and paint above 1.22 m (4 ft.). **Floor.** VCT, seamless vinyl, or carpet with vinyl or rubber base. Also see Special Requirements below. **Ceiling.** Primarily ACP with painted gypsum board used to help define other areas.
Plumbing	None required.
HVAC	20 C (68 F) minimum, 26 C (78 F) maximum.
Fire Protection	Provide system per paragraph 3-5.3.
Power	As a minimum, provide duplex outlets at 2.44 m (8 ft.) on-center. An area within the Teen Room/Lounge should provide duplex outlets at 1.22 m (4 ft.) on-center for video games and provide one duplex outlet at each TV cable outlet. Also provide outlets at counter height for portable electronic devices such as CD players and laptops. Provide power at data outlet locations.
Lighting	215 to 430 lux (20 to 40 fc) general ambient lighting. Provide a variety of accent lighting fixtures to create interest. Consider providing dimming in some areas.
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** Provide at least one outlet. **PA/Audio.** Provide a speaker. **Telephone.** Provide one line with internal two-way communication. **Data.** Provide at least two outlets. **Security.** Provide vision panels on all doors. Do not create corners or “nooks” that are not visible from other areas of the room.
Casework	Consider counter and base cabinets.
Furnishings Fixtures & Equip. (FF&E)	Tables, chairs, stools, soft and padded furniture, lamps, bookshelves, coffee table, television, stereo, CD player, computers, video games, table games (foosball, pool), and tack board.
Special Requirements	Provide tackable surfaces on the walls. Consider large windows in the interior walls, but avoid putting the Teens “on display” to other patrons. Interior windows work best in walls common with staff areas for supervision. Provide lockable exterior doors to patio. **Navy** requires that exterior doors are visible from Check-in. Provide a dedicated storage closet (included in the space program) with hanging rods and/or shelves. For **Navy** facilities, provide an eating area with hard-surfaced floor (consider stained concrete) and two- and four-top tables and chairs. Consider providing a separate pass-through from the Snack Bar into the Teen Room/Lounge.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-10.2. TEEN PATIO

Description/ Usage	This exterior space should work in conjunction with and be accessible from the Teen Room/Lounge. It needs to allow for privacy for teens from the other outdoor areas. It could benefit from being adjacent to the snack/vending/kitchen area. The **Navy** requires a separate, exterior entrance via the Teen Patio with visual control from Check-in.	
Min. Ceiling Ht.	Not Applicable.	
Finishes	**Walls.** Not Applicable. **Floor.** Brick or concrete pavers, wood, or exposed concrete for hardscape areas. Grass, mulch, or sand for softscape areas. **Ceiling.** Not Applicable.	
Plumbing	Keyed, tamper-resistant hose bibb.	
HVAC	None required.	
Fire Protection	A sprinkler system may be required if the space is covered. The system will need to be designed for the exterior conditions.	
Power	Provide several exterior grade convenience outlets.	
Lighting	Ground level, low lumen 55 lux (5 fc) decorative lighting. Provide security lighting on a timer for after-hours activation and on a switch for staff control. Consider lighting paths also.	
Communication	**CCTV.** None required. The **Army** provides outdoor camera coverage. **CATV/Internal Video.** None required. **PA/Audio.** Provide several speakers for adequate coverage. Speakers to be outdoor type. Consider outdoor noise levels when spacing speakers. **Telephone.** None required. **Data.** None required. **Security.** None required.	
Casework	None required.	
Furnishings Fixtures & Equipment (FF&E)	Benches and/or chairs, patio tables, BBQ grill. Waste receptacles (must meet antiterrorism criteria).	
Special Requirements	Consider providing a privacy fence and/or half-height brick or stone walls. Consider providing shade structures, if budget allows. Consider landscaping appropriate to an outdoor recreation area.	
For use during project execution by the appropriate Service agency		
Occupancy	Staff. Patrons/Youth.	
Min. net m^2 (ft^2)	Covered.	Open.

TABLE 4-11.1 MULTIPURPOSE ROOM

Description/ Usage	This room serves as a large activity room and will be used for skill building, sports, fitness activities, gymnastics, basketball, volleyball, theatrical plays, dances, in-line/roller skating, and other large area activities.
Min. Ceiling Ht.	7.62 m (25 ft.) clear height below structure and lights.
Finishes	**Walls.** CMU with glazed wall coating or heavy-duty epoxy up to 3.66 m (12 ft.). Above 3.66 m (12 ft.), use semi-gloss enamel and consider acoustic panels. **Floor.** Multipurpose, resilient, athletic flooring. **Ceiling.** Exposed, painted structure. Provide acoustical banners.
Plumbing	None required. Consider access to drinking fountains and bathrooms.
HVAC	18 C (65 F) minimum, 26 C (78 F) maximum; 15 cfm/person outside air, with CO_2 sensors or other type of energy conservation system; 10 air changes/hour.
Fire Protection	Provide system per paragraph 3-5.3. Provide protection for sprinkler heads, exit signs, manual pull stations, and other exposed components; minimize equipment that protrudes into activity space or raise it above 1.83 m (6 ft.) for safety considerations. Provide 1-hour fire separation from core areas of building.
Power	Provide outlets per code. Provide power for a scoreboard and a high, wall-mounted clock. Consider power requirements for other activities like stage sound and lighting.
Lighting	Metal halide, 540 lux (50 fc), with perimeter compact fluorescents multi-level switched for non-sport activities. Provide keyed light switches. Provide protection for all fixtures. Do not locate fixtures directly above basketball backboards.
Communication	**CCTV.** Provide at least one outlet in each divided space. **CATV/Internal Video.** None required. **PA/Audio.** Provide speakers with proper spacing. **Telephone.** Provide one line with internal two-way communication. **Data.** None required. **Security.** Provide large, shatter-resistant vision panels in the doors.
Casework	None required.
Furnishings Fixtures & Equip. (FF&E)	Protective wall mats, moveable stage, stage seating, scoring table and chairs.
Special Requirements	Provide 3.05 m (10 ft.) minimum safety distance between “out of bounds” line and nearest walls and bleachers. Acoustical control is required through the use of sound baffles, banners, acoustical materials, etc. **Built-in equipment:** Provide retractable basketball nets/backboards at two per half court or six per full court. Nets and backboards should be adjustable from 2.44 m to 3.05 m (8 to 10 ft.) for two opposite goals on the half court. Consider floor inserts for volleyball and gymnastics standards. Motor-operated, vertical-acting divider curtain with manual override. Electronic scoreboard—provide control for scoreboard and divider curtain on side of room opposite of bleachers (if bleachers are provided). Bleachers. Provide game lines on flooring for full- and half-court basketball and volleyball. Provide exterior double doors with removable latch post for equipment access.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-11.2 MULTIPURPOSE ROOM STORAGE/GEAR ISSUE

Description/ Usage	This area is used to store athletic equipment and tables and chairs for the center. It should be divided into two areas: one for sports equipment and one for tables and chairs. The sports equipment area should include space for the equipment monitor's desk.
Min. Ceiling Ht.	2.44 m (8 ft.). 3.5 m (10 ft.) is desirable.
Finishes	**Walls.** CMU or painted gypsum wall board. **Floor.** Sealed concrete. **Ceiling.** None required.
Plumbing	None required. Consider providing a connection for an icemaker and a floor drain.
HVAC	18 C (65 F) minimum, 29 C (85 F) maximum.
Fire Protection	Provide system per paragraph 3-5.3.
Power	Provide outlets per code. Provide two duplex outlets by the desk.
Lighting	215 lux (20 fc).
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** None required. **PA/Audio.** Provide speakers with proper spacing. **Telephone.** Provide one line with internal two-way communication. **Data.** None required. **Security.** None required.
Casework	None required.
Furnishings Fixtures & Equipment (FF&E)	Shelving and storage cabinets, one desk, one chair, and one file cabinet.
Special Requirements	Area must be accessible from both interior and exterior though lockable double doors with kick-plates. Consider providing "dutch" doors at interior for equipment issue. **Navy** does not permit dutch doors. Provide ramp at exterior door to facilitate equipment issue/delivery, if necessary. The area must be at least 2.44 m (8 ft.) wide.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

TABLE 4-11.3 SMALL MULTIPURPOSE ROOM

Description/ Usage	This space is optional for the Army and Navy and provides an active function room slotting in size between the Special Activity Room and the smallest Multipurpose Room option. It also generally has less sophisticated equipment than the Multipurpose Room. It is used for a variety of activities including four-square, dances, martial arts, movies, and dance classes.
Min. Ceiling Ht.	3.66 m (12 ft.). Generally, 4.88 m (16 ft.) is the maximum ceiling height, but consider the intended usage of the room.
Finishes	**Walls.** Impact-resistant painted gypsum wallboard. **Floor.** VCT or consider synthetic athletic flooring or rubber tile. **Ceiling.** Exposed, painted structure or ACP with hold-down clips.
Plumbing	None required.
HVAC	18 C (65 F) minimum, 26 C (78 F) maximum; 15 cfm/person outside air, with CO_2 sensors or other type of energy conservation system; 10 air changes/hour.
Fire Protection	Provide system per paragraph 3-5.3. Provide protection for sprinkler heads, exit signs, manual pull stations, and other exposed components; minimize equipment that protrudes into activity space or raise it above 1.83 m (6 ft.) for safety considerations. Provide 1-hour fire separation from core areas of building.
Power	Provide outlets per code.
Lighting	540 lux (50 fc), provide dual-level lighting for games and dances, fluorescent fixtures, multi-level switched, and dimmable compact fluorescent for multiple light levels. Provide protection for all fixtures.
Communication	**CCTV.** Provide at least one outlet. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** Provide one line with internal two-way communication. **Data.** None required. **Security.** None required.
Casework	None required.
Furnishings Fixtures & Equipment (FF&E)	None required.
Special Requirements	Provide at least one pair of doors to the interior of the building. Translucent wall panels or windows for natural lighting are desirable—provide suitable protection to windows from ball impacts. Provide good visual access into the room from public areas of the facility. **Acoustics:** Anticipated peak noise level is 70-80 dBA. Preferred sound criterion is 35-45 dBA. Maximum reverberation time is 1.5 seconds. STC 55 minimum at perimeter walls and ceiling.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Patrons/Youth.
Min. net m^2 (ft^2)	

APPENDIX A REFERENCES

GOVERNMENT PUBLICATIONS:

29 CFR 1910.1048, *Formaldehyde Standard*, U.S. Department of Labor, Occupational Safety and Health Administration, 200 Constitution Ave, NW, Washington, DC, 20210, http://www.osha.gov/

Air Force Interior Design Guide, U.S. Air Force Center for Environmental Excellence, HQ AFCEE, 3300 Sidney Brooks, Brooks City-Base, TX, 78235-5112, http://www.afcee.brooks.af.mil/afceehome.asp

Air Force Sustainable Facilities Guide, U.S. Air Force Center for Environmental Excellence, HQ AFCEE, 3300 Sidney Brooks, Brooks City-Base, TX, 78235-5112, http://www.afcee.brooks.af.mil/afceehome.asp

Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) (also 28 CFR Part 36), United States Access Board, 1331 F ST. NW, Suite 1000, Washington, DC, 20004-1111, (202)272-0080, TTY (202)272-0082, http://www.access-board.gov/adaag/html/addag.htm

Architectural Barriers Act (Public Law 90-780) *of 1968*, National Archives and Records Administration, 700 Pennsylvania Ave, NW, Washington, DC, 20408, (866)325-7208,

DG 1110-3-122, *Interior Design Guide*, U.S. Army Corps of Engineers, ATTN: CEIM-IM-PD, 2803 52nd Ave, Hyattsville, MD 20781-1102, http://www.usace.army.mil/usace-docs

DOD Instruction 6060.3, *School Age Care (SAC) Program*, Department of Defense, Washington Headquarters Service, Executive Services and Communication Directorate, Directives and Records Division, http://www.dtic.mil/whs/directives

DOD Instruction 6060.4, *Youth Programs (YPS)*, Department of Defense, Washington Headquarters Service, Executive Services and Communication Directorate, Directives and Records Division, http://www.dtic.mil/whs/directives

DOD School-age Program Inspection Checklist, Department of Defense, Washington Headquarters Service, Executive Services and Communication Directorate, Directives and Records Division, http://www.dtic.mil/whs/directives

Electric Current Abroad (1998), U.S. Department of Commerce, International Trade Administration, 14th & Constitution Ave, NW, Washington, DC, 20230, http://www.ita.doc.gov/

ETL 00-06, *Air Force Carpet Standard*, U.S. Air Force Civil Engineer Support Agency, HQ AFCESA/CES, 139 Barnes Drive, Suite 1, Tyndall AFB, FL, 32403-5319, http://www.afcesa.af.mil/

Handbook for Public Playground Safety, Consumer Product Safety Commission, 4330 East-West Highway, Bethesda MD 20814-4408, http://cpsc.gov/

NAVFACINST 11010.45D, *Comprehensive Regional Planning Instruction*, Naval Facilities Engineering Command, Washington Navy Yard, Washington, D.C., http://www.navfac.navy.mil/

OPNAVINST 11010.20F, *Facilities Projects Manual*, SECNAV/OPNAV Directives Control Office, N09B15, Washington Navy Yard, Bldg 36, 720 Kennedy Street, SE, RM 203, Washington Navy Yard, DC 20374, http://neds.nebt.daps.mil/isndirs.htm

P-80, *Facility Planning*, Naval Facilities Engineering Command - Atlantic, 6506 Hampton Blvd, Norfolk, VA 23505-1278, http://www.navfac.navy.mil/

UFC 1-200-01, *General Building Requirements*

UFC 3-120--01, *Air Force Sign Standard*

UFC 3-400-01, *Energy Conservation*

UFC 3-400-02, *Engineering Weather Data*

UFC 3-410-02N, *Heating, Ventilating, Air Conditioning, and Dehumidifying Systems, Naval Facilities Engineering Command*

UFC 3-420-01, *Plumbing Systems*

UFC 3-520-01, *Interior Electrical Systems*

UFC 3-530-01, *Interior and Exterior Lighting and Controls*

UFC 3-580-10, *Navy and Marine Corps Intranet (NMCI) Standard Construction Practices*

UFC 3-600-01, *Engineering Fire Protection*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

UFC 4-740-14, *Child Development Centers*

Uniform Federal Accessibility Standards (UFAS), (also FED-STD-795), United States Access Board, 1331 F ST. NW, Suite 1000, Washington, DC, 20004-1111, (202)272-0080, TTY (202)272-0082, http://www.access-board.gov/ifas/ufas-html/ufas.htm

USAF Landscape Guide, U.S. Air Force Center for Environmental Excellence, HQ AFCEE, 3300 Sidney Brooks, Brooks City-Base, TX, 78235-5112, http://www.afcee.brooks.af.mil/afceehome.asp

USC Title 10, Section 1794, *Military Child Care*, National Archives and Records Administration, 700 Pennsylvania Ave, NW, Washington, DC, 20408, (866)325-7208,

WHOLE BUILDING DESIGN GUIDE (http://www.wbdg.org/), National Institute of Building Sciences, 1090 Vermont Ave, NW, Suite 700, Washington, DC, 20005-4905, http://www.nibs.org/

Youth and School-age Care (SAC) Standards and Metrics Document, Navy Personnel Command, PERS-659, 5720 Integrity Drive, Millington, TN, 38055, http://www.mwr.navy.mil/

Youth Center Definitive Standard Design, U.S. Army Corps of Engineers, ATTN: CEIM-IM-PD, 2803 52nd Ave, Hyattsville, MD 20781-1102, http://www.usace.army.mil/usace-docs

NON-GOVERNMENT PUBLICATIONS:

AWI Quality Standards Illustrated, Current Edition, Architectural Woodwork Institute, 1952 Isaac Newton Square West, Reston, VA, 20190, (703)733-0600, http://www.awinet.org/

ASTM-F-1487, *Standard Consumer Safety Performance Specification for Playground Equipment for Public Use*, ASTM International, 100 Bar Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959, (610)832-9585, http://www.astm.org/

BOYS AND GIRLS CLUBS OF AMERICA WEBSITE (http://www.bgca.org/), Boys and girls Clubs of America, 1230 W. Peachtree St. NW, Atlanta, GA, 30309, (404)487-5700

CARPET AND RUG INSTITUTE WEBSITE (http://www.carpet-rug.com/), The Carpet and Rug Institute, 310 Holiday Ave, Dalton, GA, 30720, (706)278-3176

International Mechanical Code, International Code Council, Headquarters, 5203 Leesburg Pike, Suite 600, Falls Church, VA, 22041, http://www.iccsafe.org/

MARYLAND POISON CENTER WEBSITE (http://www.mdpoison.com/), Maryland Poison Center, University of Maryland School of Pharmacy, 20 N. Pine St., Baltimore, MD, 21201, (410)706-2151, http://www.pharmacy.umaryland.edu/

NAA Standards for Quality School-age Care, National AfterSchool Association (NAA), 1137 Washington St., Dorchester, MA, 02124, (617)298-5012, http://www.naaweb.org/

NFPA 70, *National Electric Code*, 2002, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA, 02169-7471, (617)770-3000, http://www.nfpa.org/

NFPA 72, *National Fire Alarm Code*, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA, 02169-7471, (617)770-3000, http://www.nfpa.org/

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA, 02169-7471, (617)770-3000, http://www.nfpa.org/

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA, 02169-7471, (617)770-3000, http://www.nfpa.org/

NFPA 101, *Life Safety Code*, National Fire Protection Association, 1 Batterymarch Park, Quincy, MA, 02169-7471, (617)770-3000, http://www.nfpa.org/

Park, Recreation, Open Space and Greenway Guidelines, National Recreation and Park Association, 22377 Belmont Ridge Road, Ashburn, VA 230148-4501, (703)858-0784, http://www.nrpa.org/

LEED™ *Green Building Rating System*, The United States Green Building Council, 1015 18th St, NW, Suite 805, Washington, DC, 20036, http://www.usgbc.org/

APPENDIX B SPACE PROGRAM DATA

B-1 SPACE PROGRAM DATA.

The data in Figures B-1 through B-5 are the bases for the Space Program Interactive Spreadsheet discussed in paragraph 2-2 and are provided here for reference only. Do not use these tables to program a Youth Center. The Interactive Spreadsheet combines this data in the correct manner and incorporates the necessary Service Exceptions—which may not be apparent from these Figures.

FIGURE B-1. SAC SPACE PROGRAM DATA

	Functional Component	Space Allocation Standard m^2	$ft.^2$	Standard	Single Room Standard No.	m^2	$ft.^2$						
Building	**Army/Air Force/Marine Corps SAC**												
	Activity Room	125.42	1,350	per room (2 ratio groups)	1	125.42	1350						
	Storage	5.57	60	per room	1	5.57	60						
	SAC toilets	4.18	45	per water closet/lav.	2	8.36	90						
	Total Building Net Area & Support					**139.35**	**1,500.00**						
	Circulation and Mechanical Building Factor @				**14%**	**19.51**	**210**						
	Total Building Gross Area & Support					**158.86**	**1,710**						
Building	**Navy SAC**												
	Activity Room	97.55	1,050	per room (2 ratio groups)	1	97.55	1050						
	Storage	2.79	30	per room	1	2.79	30						
	SAC toilets			per water closet/lav.									
	Total Building Net Area & Support					**100.33**	**1,080.00**						
	Circulation and Mechanical Building Factor @				**14%**	**14.05**	**151**						
	Total Building Gross Area & Support					**114.38**	**1,231**						
						One OAA		**Two OAA**			**Three OAA**		
Site	Outdoor Activity Area (OAA)	348.38	3,750	per OAA	1	348.38	3,750	2	696.75	7,500	3	1,045.13	11,250
	Storage for Outdoor Equip.	7.43	80	per room	1	7.43	80	1	7.43	80	2	14.86	160
	Total Site Support					**355.81**	**3,830.00**		**704.18**	**7,580.00**		**1,059.99**	**11,410.00**

FIGURE B-2.1. YOUTH SPACE PROGRAM DATA A (up to 90)

	Functional Component	Space Allocation Standard m^2	$ft.^2$	Standard	Up to 60 Youth No.	m^2	$ft.^2$	61 to 90 Youth No.	m^2	$ft.^2$
Building	Commons			sum of below + 10% factor		59.88	644.60		108.32	1166.00
	Game Area	32.52	350	per rec unit [3]	1	32.52	350	2	65.03	700
	Snack Bar					7.43	80		9.29	100
	Eating Area	1.11	12	per youth	8	8.92	96	15	16.72	180
	Snack Bar storage	1.86	20	per storage area	1	1.86	20	2	3.72	40
	Vending Area [1]	1.86	20	per machine	2	3.72	40	2	3.72	40
	Shared Spaces									
	General or Special Activity Room	97.55	1,050	per room	1	97.55	1050	2	195.09	2,100
	Activity Room Storage	5.57	60	per room	1	5.57	60	2	11.15	120
	Activity Room Storage (Navy)	2.79	30	per room	1	2.79	30	2	5.57	60
	Homework/Computer Room [2]	48.77	525	per room	1	48.77	525	1	48.77	525
	Youth Toilets	4.18	45	per water closet/lav.	2	8.36	90	4	16.72	180
	General Storage	7.43	80	per storage room	1	7.43	80	1	7.43	80
	Total Building Net Area & Support					**230**	**2,480**		**393**	**4,231**
	Circulation and Mechanical Building Factor @				**14%**	**32.25**	**347**	**14%**	**55.03**	**592**
	Total Building Gross Area & Support					**262.60**	**2,827**		**448.09**	**4,823**

[1] Navy does not permit Vending.

[2] Navy and Marine Corps provide a Computer Room and accommodate the homework function in the Activity Rooms. The Air Force combines the Homework function with the Computer Room. The Army provides a separate, dedicated Homework Room in the 61 to 90 Youth category.

[3] "Rec. Unit" equals the area of a standard gaming table (such a pool or foosball) and space around it that is required to play.

FIGURE B-2.2. YOUTH SPACE PROGRAM DATA B (91 to 155)

	Functional Component	Space Allocation Standard			91 to 135 Youth			136 to 155 Youth		
		m^2	$ft.^2$	Standard	No.	m^2	$ft.^2$	No.	m^2	$ft.^2$
Building	Commons			sum of below + 10% factor		164.53	1771.00		220.73	2376.00
	Game Area	32.52	350	per rec unit [3]	3	97.55	1,050	4	130.06	1,400
	Snack Bar					9.29	100		11.15	120
	Eating Area	1.11	12	per youth	30	33.44	360	45	50.17	540
	Snack Bar storage	1.86	20	per storage area	3	5.57	60	3	5.57	60
	Vending Area [1]	1.86	20	per machine	2	3.72	40	2	3.72	40
	Shared Spaces									
	General or Special Activity Room	97.55	1,050	per room	3	292.64	3,150	4	390.18	4,200
	Activity Room Storage	5.57	60	per room	3	16.72	180	4	22.30	240
	Activity Room Storage (Navy)	2.79	30	per room	3	8.36	90	4	11.15	120
	Homework/Computer Room [2]	48.77	525	per room	2	97.55	1,050	2	97.55	1,050
	Youth Toilets	4.18	45	per water closet/lav.	6	25.08	270	8	33.44	360
	General Storage	7.43	80	per storage room	2	14.86	160	2	14.86	160
	Total Building Net Area & Support					**620**	**6,671**		**790**	**8,506**
	Circulation and Mechanical Building Factor @				**14%**	**86.76**	**934**	**14%**	**110.63**	**1,191**
	Total Building Gross Area & Support					**706.50**	**7,605**		**900.84**	**9,697**

[1] Navy does not permit Vending.

[2] Navy and Marine Corps provide a Computer Room and accommodate the homework function in the Activity Rooms. The Air Force combines the Homework function with the Computer Room. The Army provides a separate, dedicated Homework Room.

[3] "Rec. Unit" equals the area of a standard gaming table (such a pool or foosball) and space around it that is required to play.

FIGURE B-3.1. TEEN SPACE PROGRAM DATA A (up to 30)

	Functional Component	Space Allocation Standard			Up to 15 Teens			16 to 30 Teens		
		m^2	$ft.^2$	Standard	No.	m^2	$ft.^2$	No.	m^2	$ft.^2$
Bldg	Teen Room/Lounge	3.25	35	per teen	15	48.77	525	30	97.55	1,050
	Storage	3.72	40	per room	1	3.72	40	1	3.72	40
	Total Building Net Area & Support					**52.49**	**565.00**		**101.26**	**1,090.00**
	Circulation and Mechanical Building Factor @				**14%**	**7.35**	**79**	**14%**	**14.18**	**153**
	Total Building Gross Area & Support					**59.84**	**644**		**115.44**	**1,243**
S	Teen Patio	185.80	2,000	per Patio	1	185.80	2,000	1	185.80	2,000
	Total Site Support					**185.80**	**2,000.00**		**185.80**	**2,000.00**

FIGURE B-3.2. TEEN SPACE PROGRAM DATA B (31 to 60)

	Functional Component	Space Allocation Standard			31 to 45 Teens			46 to 60 Teens		
		m^2	$ft.^2$	Standard	No.	m^2	$ft.^2$	No.	m^2	$ft.^2$
Bldg	Teen Room/Lounge	3.25	35	per teen	45	146.32	1,575	60	195.09	2,100
	Storage	3.72	40	per room	2	7.43	80	2	7.43	80
	Total Building Net Area & Support					**153.75**	**1,655.00**		**202.52**	**2,180.00**
	Circulation and Mechanical Building Factor @				**14%**	**21.52**	**232**	**14%**	**28.35**	**305**
	Total Building Gross Area & Support					**175.27**	**1,887**		**230.88**	**2,485**
S	Teen Patio	185.80	2,000	per Patio	2	371.60	4,000	2	371.60	4,000
	Total Site Support					**371.60**	**4,000.00**		**371.60**	**4,000.00**

FIGURE B-4.1. ADMINISTRATIVE SPACE PROGRAM DATA A (small and medium)

	Functional Component	Space Allocation Standard			Small Admin			Medium Admin		
		m^2	$ft.^2$	Standard	No.	m^2	$ft.^2$	No.	m^2	$ft.^2$
Building	Lobby	1.39	15	per person (per code)	15	20.90	225	30	41.81	450
Building	Control/Check-in					6.97	75		11.61	125
Building	Break/Staff Training Room	2.04	22	per staff member	10	20.44	220	16	32.70	352
Building	Copy/file Room	16.26	175	per room	1	16.26	175	1	16.26	175
Building	Storage	5.57	60	per storage room	1	5.57	60	1	5.57	60
Building	Communications Room	5.57	60	per room	1	5.57	60	1	5.57	60
Building	Staff/Vis. Toilets (M/F) [1]/Jan. closet	4.46	48	per room	2	8.92	96	2	8.92	96
	Total Building Net Area & Support					**84.63**	**911.00**		**122.44**	**1,318.00**
	Circulation and Mechanical Building Factor @				**22%**	**18.62**	**200**	**22%**	**26.94**	**290**
	Total Building Gross Area & Support					**103.25**	**1,111**		**149.38**	**1,608**
Site	Staff Parking	41.81	450	per space	12	501.66	5400	16	668.88	7,200
Site	Patron Parking	41.81	450	per space	8	334.44	3600	14	585.27	6,300
Site	Pick-up/Drop-off/Bus Lane	74.32	800	per area	1	74.32	800	1	74.32	800
Site	Service Drive/Trash	69.68	750	per area	1	69.68	750	1	69.68	750
Site	Bicycle Racks	14.86	160	per 10-bike Rack	1	14.86	160	1	14.86	160
	Total Site Support					**994.96**	**10,710**		**1,413.01**	**15,210**

Note: Offices and workstations are not shown here; they are calculated on the Space Program Interactive Spreadsheet discussed in Section 2-2

[1] Navy provides unisex toilets for staff, visitors, and teens.

FIGURE B-4.2. ADMINISTRATIVE SPACE PROGRAM DATA B (large and ex. large)

	Functional Component	Space Allocation Standard			Large Admin			Extra Large Admin		
		m^2	$ft.^2$	Standard	No.	m^2	$ft.^2$	No.	m^2	$ft.^2$
Building	Lobby	1.39	15	per person (per code)	40	55.74	600	50	69.68	750
Building	Control/Check-in					16.26	175		18.58	200
Building	Break/Staff Training Room	2.04	22	per staff member	20	40.88	440	24	49.05	528
Building	Copy/file Room	16.26	175	per room	1	16.26	175	1	16.26	175
Building	Storage	5.57	60	per storage room	1	5.57	60	1	5.57	60
Building	Communications Room	5.57	60	per room	1	5.57	60	1	5.57	60
Building	Staff/Vis. Toilets (M/F) [1]/Jan. closet	4.46	48	per room	2	8.92	96	2	8.92	96
	Total Building Net Area & Support					**149.20**	**1,606.00**		**173.63**	**1,869.00**
	Circulation and Mechanical Building Factor @				**22%**	**32.82**	**353**	**22%**	**38.20**	**411**
	Total Building Gross Area & Support					**182.02**	**1,959**		**211.83**	**2,280**
Site	Staff Parking	41.81	450	per space	20	836.10	9,000	26	1,086.93	11,700
Site	Patron Parking	41.81	450	per space	20	836.10	9,000	26	1,086.93	11,700
Site	Pick-up/Drop-off/Bus Lane	74.32	800	per area	1	74.32	800	1	74.32	800
Site	Service Drive/Trash	69.68	750	per area	2	139.35	1,500	2	139.35	1,500
Site	Bicycle Racks	14.86	160	per 10-bike Rack	2	29.73	320	2	29.73	320
	Total Site Support					**1,915.60**	**20,620**		**2,417.26**	**26,020**

Note: Offices and workstations are not shown here; they are calculated on the Space Program Interactive Spreadsheet discussed in Section 2-2

[1] Navy provides unisex toilets for staff, visitors, and teens.

FIGURE B-5.1. OTHER OR OPTIONAL SPACE PROGRAM DATA A

	Functional Component	Space Allocation Standard			Half Court w/o Bleachers			Half Court w/ Bleachers		
		m^2	$ft.^2$	Standard	No.	m^2	$ft.^2$	No.	m^2	$ft.^2$
Building	Multipurpose Room [1]					355.62	3828		416.94	4,488
	Equipment Storage	14.86	160	per storage room	1	14.86	160	1	14.86	160
	Circulation and Mechanical Building Factor @				**8%**	30	319		35	372
	Multipurpose Rm Subtotal					**400.12**	**4307.04**		**466.34**	**5019.84**
					Small Kitchen			**Large Kitchen**		
	Kitchen [2]					11.15	120		41.81	450
	Kitchen Storage (dry and cold)					7.43	80		16.72	180
	Circulation and Mechanical Building Factor @				**20%**	4	40		12	126
	Kitchen Subtotal					**22.30**	**240.00**		**70.23**	**756.00**
					Other/Optional Spaces			**Other/Optional Spaces**		
	Laundry [2] (incl. 20% bldg fac)	10.22	110	per room	1	10.22	70	1	10.22	70
	Parent Waiting [2] (incl. 20% bldg fac)	1.67	18	per person	10	16.72	180	10	16.72	180
	Music/MM Room (incl. 20% bldg fac)	6.69	72	per room	1	6.69	72	2	13.38	144
Site	Youth Outdoor Activity Area	11.61	125	per child	30	348.38	3750			
	Storage	7.43	80	per storage room	1	7.43	80			
	Youth Outdoor Activity Subtotal					**355.81**	**3830.00**			
	Open Outdoor Area	10,730	115,500	per area	1	10729.95	115500			

[1] In addition to the other Multipurpose Room size options, the Army and Navy offer an option for a Small Multipurpose Room at 232.25 m^2 (2500 $ft.^2$) plus 9.29 m^2 (100 $ft.^2$) of storage space.
[2] Navy does not normally permit the Kitchen, Laundry, or Additional Parent Waiting options.

FIGURE B-5.2. OTHER OR OPTIONAL SPACE PROGRAM DATA B

	Functional Component	Space Allocation Standard			Full Court w/ Bleachers			NCAA Full Court w/ Bleach		
		m^2	$ft.^2$	Standard	No.	m^2	$ft.^2$	No.	m^2	$ft.^2$
Building	Multipurpose Room [1]					706.04	7,600		776.64	8,360
	Equipment Storage	14.86	160	per storage room	2	29.73	320	2	29.73	320
	Circulation and Mechanical Building Factor @					59	634		65	694
	Multipurpose Rm Subtotal					**794.83**	**8553.60**		**870.88**	**9374.40**
					Other/Optional Spaces			**Other/Optional Spaces**		
	Laundry [2] (incl. 20% bldg fac)	10.22	110	per room	2	20.44	130	2	20.44	130
	Parent Waiting [2] (incl. 20% bldg fac)	1.67	18	per person	15	25.08	270	15	25.08	270
	Music/MM Room (incl. 20% bldg fac)	6.69	72	per room	3	20.07	216			

[1] Navy, Air Force, and Marine Corps do not permit the “NCAA Full Court with Bleachers” size option. In addition to the other Multipurpose Room size options, the Army and Navy offer an option for a Small Multipurpose Room at 232.25 m^2 (2500 $ft.^2$) plus 9.29 m^2 (100 $ft.^2$) of storage space.
[2] Navy does not normally permit the Kitchen or Additional Parent Waiting options.

APPENDIX C ILLUSTRATIVE DIAGRAMS

C-1 ILLUSTRATIVE DIAGRAMS.

The illustrative diagrams include Figures C-1 through C-3. They do not represent mandatory or even suggested layouts but are provided to expand on the Figure 2-3 Bubble Diagram and convey a *possible means* to accommodate the needed adjacencies. SE Note that Figure C-3 captures several critical Navy Service Exceptions and is the appropriate diagram for planning Navy facilities.

C-1.1 Figure C-1.

This diagram illustrates a potential layout with the Multipurpose Room located near the front of the facility. This layout precludes visitors from traveling through the Commons to get to events held in the Multipurpose Room. However, it does separate the Administrative Area from the check-in function, which is a desirable adjacency.

FIGURE C-1. ILLUSTRATIVE LAYOUT DIAGRAM A



1 = Check-in
* Commons includes the Game Area and the Eating Area.
† Kitchen is optional for all Services except Navy for which it is not permitted.

C-1.2 **Figure C-2**.

This diagram locates the Administrative Area adjacent to the Check-in.

FIGURE C-2. ILLUSTRATIVE LAYOUT DIAGRAM B



1 = Check-in
* Commons includes the Game Area and the Eating Area.
† Kitchen is optional for all Services except Navy for which it is not permitted.

C-1.3 **Figure C-3**.

As noted above, this diagram addresses several Navy concerns and desires, specifically the provision for a separate teen entrance through the patio and the snack bar located adjacent to the Teen room.

FIGURE C-3. ILLUSTRATIVE LAYOUT DIAGRAM C



1 = Check-in
* Commons includes the Game Area and the Eating Area.

APPENDIX D AIR FORCE FURNISHINGS, FIXTURES, AND EQUIPMENT SCHEDULE

D-1 AIR FORCE SCHEDULE OF FURNISHINGS, FIXTURES, AND EQUIPMENT.

Table D-1 provides a schedule of furnishings, fixtures, and equipment (FF&E) for Air Force Youth Centers.

TABLE D-1. AIR FORCE FF&E LIST FOR YOUTH CENTERS

Equipment Item	RP[1]	NRP[2]	Equipment Item	RP[1]	NRP[2]
Kitchen FF&E			**Admin/Staff/Support FF&E (cont'd)**		
Reach-in Refrigerator (not built-in)		X	Moveable Lockers		X
Reach-in Freezer (not built-in)		X	Lounge Seating & Tables		X
Built-in Refrigerator or Freezer	X		Built-in Counters/Cabinets/ Shelving	X	
Ice Machine	X		Moveable Cabinets & Shelving		X
Hand Sink	X		Cash Registers		X
Food Preparation & Pot Sinks	X		Fixed Tackboards	X	
Range		X	Interior & Exterior Signage	X	
Baking Oven/Convection Oven	X		Fire Extinguishers & Cabinets	X	
Microwave Oven		X	Built-in Display Cabinets	X	
Exhaust Hood w/Fire Suppression	X		Moveable Display Cabinets		X
Dishwasher and Booster Heater	X		Sound System Speakers & Wiring	X	
Dishwasher Hood	X		**Youth/School Age FF&E**		
Garbage Disposal	X		Desks/Tables/Chairs		X
Dishwasher Tables	X		Lounge Seating		X
Toaster		X	Built-in Counters/Cabinets/ Shelving	X	
Food Mixer/Processor		X	Moveable Cabinets & Shelving		X
Preparation Tables		X	Fixed Dry Erase Boards	X	
Food Carts		X	Moveable Dry Erase Boards		X
Built-in Counters/Shelving	X		Moveable Tackboards		X
Mobile or Moveable Shelving		X	Sinks	X	
Other Loose Equipment		X	Drinking Fountains	X	
Laundry/Janitor FF&E			Toilet Fixtures	X	
Clothes Washer & Dryer		X	Toilet Fixed Accessories	X	
Laundry Sink	X		Toilet Moveable Accessories		X
Built-in Counter & Shelving	X		Mirrors	X	
Moveable Counter & Shelving		X	Refrigerators		X
Janitor Mop Sink	X		Wall Clocks		X
Built-in Mop Rack	X		Games and Game Equipment		X

Admin/Staff/Support FF&E	Retractable Basketball Backstops	X	

TABLE D-1. AIR FORCE FF&E LIST FOR YOUTH CENTERS					
Equipment Item	**RP[1]**	**NRP[2]**	**Equipment Item**	**RP[1]**	**NRP[2]**
Desks & Chairs		X	Moveable Basketball Backstops		X
Systems Furniture		X	All Moveable Athletic Equipment		X
File Cabinets		X	Floor Mats		X
Computers/Printers/Scanners		X	Ballet Bar	X	
Telephone (instruments only)		X	Fixed Scoreboards	X	
Telephone (wiring/outlets)	X		Moveable Scoreboards		X
CCTV Circuiting, Cameras, Mon.	X		Fixed, Retractable Bleachers	X	
Fax Machines		X	Fixed Stage	X	
Copiers		X	Moveable Stage		X
CATV (television monitor only)		X	Theatrical Lighting	X	
CATV (cabling)	X		Fixed Wall Mats	X	
Intercom		X	Built-in Lockers	X	
Wall Clocks		X	Outdoor Handwashing Station	X	
Time Clocks		X	Outdoor Play Equipment	X	
Built-in or Fixed Lockers	X				

[1] RP = Real Property Installed Equipment (also “RPIE”). RPIE is purchased and installed with construction project funds.
[2] NRP = Non-Real Property Installed Equipment (also “Equipment”). “Equipment” is purchased with equipment funds and may be installed by the construction contractor or by the installation.
Note: Infrastructure to support all types of equipment, both RPIE and non-RPIE, should be included in the construction contract.

FC 4-740-14N
1 April 2014

FACILITIES CRITERIA (FC)

NAVY AND MARINE CORPS CHILD DEVELOPMENT CENTERS



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FACILITIES CRITERIA (FC)

NAVY AND MARINE CORPS
CHILD DEVELOPMENT CENTERS

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by \1\ ... /1/)

Change No.	Date	Location

This FC supersedes UFC 4-740-14, Design: Child Development Centers, dated 1 August 2002 and Final Draft UFC 4-740-14, Design: Child Development Centers, dated January 2009.

FOREWORD

Facilities Criteria (FC) provide functional requirements (i.e., defined by users and operational needs of a particular facility type) for specific DoD Component(s), and are intended for use with unified technical requirements published in DoD Unified Facilities Criteria (UFC). FC are applicable only to the DoD Component(s) indicated in the title, and do not represent unified DoD requirements. Differences in functional requirements between DoD Components may exist due to differences in policies and operational needs.

All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC (replace w/ FC), the SOFA, the HNFA, and the BIA, as applicable.

Because FC are coordinated with unified DoD technical requirements, they form an element of the DoD UFC system applicable to specific facility types. The UFC system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applicable to the Military Departments, Defense Agencies, and the DoD Field Activities. The UFC System also includes technical requirements and functional requirements for specific facility types, both published as UFC documents and FC documents.

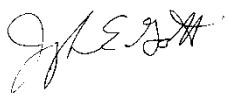
FC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet site listed below.

FC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/**.**

Refer to UFC 1-200-01, *General Building Requirements*, for implementation of new issuances on projects.

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FACILITIES CRITERIA (FC)
REVISION SUMMARY SHEET

Document: FC 4-740-14N, Navy and Marine Corps Child Development Centers
Superseding: UFC 4-740-14, Design: Child Development Centers, dated 1 August 2002 and Final Draft UFC 4-740-14, Design: Child Development Centers, dated January 2009.

Description of Changes: This FC separates the consolidated Tri-Service version and replaces the Final Draft Child Development Centers UFC version used by the Navy, into a Navy-only FC version for Child Development Center criteria.

Reasons for Changes: This FC contains the criteria for determining the appropriate size and complexity of Navy and Marine Corps Child Development Centers. It also provides non-Government standard resources that provide guidance in the design of these facilities.

Impact: The following improvements should result from this revision:

- This FC updates and clarifies the basic requirements for Navy and Marine Corps child development centers. This FC will reduce the initial cost of design and reduce costs associated with redesign of facilities that do not meet minimum standards.

- The improved performance-based criteria and coordination with the Navy's model RFP should reduce design-build proposals. Responders will be able to apply industry best-practices and more creativity to their proposals to reduce costs while still meeting the minimum technical design and construction standards outlined in Chapters 3, 4 and 5.

Non-unification Issues: There are unification issues:

- Table 2-1: Due to operational differences there are different quantities and types of offices and other spaces within the CDC's.
- 2-4.2.2: Navy only provides Multipurpose Rooms when climatic conditions warrant.
- Table 4-1: USMC allows carpet in corridors for noise abatement.
- Table 4-8: Navy does not permit ice makers due to the choking hazards.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

FC 4-740-14N provides requirements for evaluating and planning the site, determining programming requirements, establishing space distribution needs, determining building size, and designing all outdoor and indoor spaces for Navy and Marine Corps Child Development Center (CDC) facilities to support the child development program. Unless specifically indicated for only one of the 2 services, requirements in this FC apply to facilities for both Navy and Marine Corps. The information in this FC applies to the design of all new construction projects as well as renovation projects. Renovation projects should update existing facilities to meet the guidance and criteria within budgetary constraints. Further, this FC serves as an ongoing program management tool within the Navy and Marine Corps child development programs. This FC is not intended as a substitution during design for thorough review by individual Child Development Program Managers in each of the Services.

Chapter 1 provides an overview of the FC document, an overview of the facility, and the applicable regulatory authorities. Chapters 2 and 3 provide planning and design criteria that apply to the facility as a whole. Chapters 4 and 5 provide design criteria for the individual facility and site spaces and establish the baseline levels of features and finishes to be provided in those spaces. This FC also identifies desired or allowable design features. The objective of this FC is to promote centers that are child-oriented, developmentally appropriate, environmentally sensitive, safe, accessible and functional.

1-2 APPLICABILITY.

This FC applies to all military service elements and contractors involved in the planning, design, and construction of Navy and Marine Corps child development centers. Note: where one Service's criteria vary from the other Services' criteria, it is noted in the text as a **Service Exception.** If a Navy exception is noted, it does not apply to the Marine Corps unless specifically noted. Joint Bases should follow the Service criteria for the Supporting Component.

1-3 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *General Building Requirements*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this FC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-4 REFERENCES.

Appendix A contains a list of references used in this document. The publication date of the code or standard is not included in this document. In general, the latest available issuance of the reference is used.

1-5 GLOSSARY.

Appendix F contains acronyms, abbreviations, and terms.

1-6 USERS OF THE FACILITY.

The primary users of CDCs are as follows:

1-6.1 Children.

- Infants (6 weeks-12 months)
- Pre-toddlers (12 months-24 months)
- Toddlers (24 months-36 months)
- Preschool/Pre-K/Kindergarten Age (3-5 years)

1-6.2 Facility Staff.

- Program Administrators/ Directors
- Assistant Directors
- Training and Curriculum Specialists
- Group Leaders/Caregivers
- Family Child Care Director (USMC)/Child Development Home Directors (Navy)
- Receptionist or Operations Clerks/U.S. Department of Agriculture (USDA) Clerks/Monitors
- Cook and Food Service Staff
- Custodial Staff

1-6.3 Parents.

1-7 REGULATORY AUTHORITIES.

See Chapter 3, “General Design Criteria”, for references to the governing building and construction codes and statutes. The program regulatory authorities are included below.

1-7.1 Military Authorities.

The comprehensive authorities having jurisdiction for CDCs are the following:

1-7.1.1 Navy.

The following authorities must approve the acquisition methodology, the design team composition, site selection, facility requirements, the DD Form 1391, concept development, and the final design-build request for proposal (RFP) or final design:

- Commander of Naval Installations Command (CNIC) N926 Child and Youth Programs, and N944 Fleet and Family Readiness, Integrity Drive, Millington, TN 38055-6560.
- NAVFAC FAC/FEC

Planners must contact N926 and N944 during planning development and prior to final signature of the DD Form 1391.

1-7.1.2 Marine Corps.

The following authorities must approve the acquisition methodology, the design team composition, site selection, facility requirements, the DD Form 1391, concept development, and the final DB RFP or final design:

- HQMC, Marine Corps Installations Command (GF-4)
- HQMC, Marine and Family Programs Division (MFY-3)
- HQMC, Semper Fit and Exchange Services Division (MRD)

1-7.2 Occupancy Classification.

CDCs are classified as Day-Care Occupancy when applying NFPA 101, *Life Safety Code*, and I-4 when applying the *International Building Code* (IBC).

1-7.3 Certification.

The CDC must be certified by DoD and accredited by an external accrediting agency.

1-7.4 Additional Requirements.

See Chapter 5, “General Design Requirements” for additional certification requirements on the design of the outdoor activity area and the selection and installation of playground equipment.

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CHAPTER 2 PLANNING AND LAYOUT

2-1 SCOPE OF FACILITY.

The CDC accommodates a Department of Defense (DoD) child care program per Public Law 104-106, Section 568 of Title 10, United States Code, and Department of Defense Instruction (DoDI) 6060.2, *Child Development Programs.* The MCCA of 1989 (Pub.L.101-89) was recodified as the Military Family Act and Military Child Care Act, February 10, 1996.

2-1.1 Functional Program Areas.

Table 2-1 lists and describes the CDC functional program areas. They are broken down into four categories: core administration, staff support, facility support, and child activity areas.

Table 2-1. Program Areas

Functional Program Area	Description
Core Administration	
Entrance/Lobby	Includes vestibule, circulation from the vestibule to the reception desk, the circulation in front of the reception desk, and areas dedicated to waiting.
Public/Staff Toilet	ABA-compliant.
Reception/Work Area	Accommodates staff workers behind the reception counter and any circulation to adjacent office spaces and the isolation area, if applicable. Includes office equipment general work space.
Administration Offices	The required offices will vary both by Service and Installation. Refer to Chapter 2, “Administrative Offices”, for Service contacts and additional guidance. Include associated storage.
Director’s	Work, securable storage and conference space for the CDC director.
Assistant Director	Workspace for an assistant director; not included for every Service or facility.
Nurses Office	**Marine Corps**-only space. Provides a private room to isolate a sick child from the rest of the children until a parent can pick him or her up.
Training and Curriculum Specialist	Workspace for a specialist, space for staff training, and file storage. May be combined with other spaces.
Family Child Care (FCC)	**USMC program**. Workspace for program staff (one staff per 15 FCC providers, i.e., licensed or in the process of becoming licensed), one clerical, and file storage. May require additional space for an FCC lending program. May be located in the CDC or combined with other spaces.

Table 2-1. Program Areas

Functional Program Area	Description
Child Development Home (CDH)	**Navy program**. Workspace for program staff (one staff per 30 CDH providers, i.e., licensed or in the process of becoming licensed), one clerical, one resource, one referral (as required), and file storage. May require additional space for a CDH lending program. Not included for every facility.
Resource and Referral	Workspace with securable storage. May be located in the CDC or combined with other spaces.
Staff Support	
Break/Staff Room	Includes counter/cabinet space for microwave and small appliances, sink and refrigerator; tables and chairs and soft seating; and individual lockable storage, if applicable.
Training	Space to facilitate staff training. Space may accommodate computers for TACS/T&C's and staff to facilitate training/distant learning. Provide shelving or storage for resources and training supplies. Trainer may be co-located in training room or in separate office.
Central Storage	Storage of both bulk and individual items used throughout the facility.
Staff/Public Toilet	ABA-compliant, distributed throughout facility.
Facility Support	
Kitchen	Accommodates all food preparation, dishwashing, cart storage, dry goods storage, coolers and freezers, and cook work stations.
Janitorial	Accommodates janitorial supplies, equipment, and mop sink. Large and Extra Large facilities may have more than one room.
Laundry	Accommodates washers and dryers, a sink, work surface for folding, storage cabinet for detergents, and space for laundry carts or baskets.
Security and Monitoring Systems	Accomodates closed circuit TV video equipment, intrusion detection system, access control system, and exit notification system
Other Facility Support	Includes building circulation, construction, mechanical rooms, and electrical rooms (see Chapter 4 for more information). Generally calculated at a percentage of total building area, ranging from 25 to 30 percent.
Child Activity Areas	
Child Activity Rooms (CAR)	Accommodates developmental and routine activities, children's displays, eating, and all other child care activities in a self-contained environment. Each room accomodates two ratio groups, and includes storage and toileting areas.
Infants and Pre-toddlers	Accommodates two groups of infants
Toddlers and Preschoolers	Accommodates two groups of toddlers or one group of Preschoolers
Preschoolers/Pre-K/Kindergarten	Accommodates two groups of Preschoolers/Pre-K/K
Nursing Space	Accomodates mothers in a breastfeeding friendly environment.

Table 2-1. Program Areas

Functional Program Area	Description
Multipurpose room/Active Play	Optional. Service contacts provided in Chapter 1, Regulatory Authorities, must provide approval for inclusion of this space. Space to accommodate children for large group activities, wheel toy play, exercise, group games, or indoor play. This room may also support other activities such as parenting classes and staff training.
Outdoor Activity Areas	Supervised outdoor areas with direct access from the CAR. Outdoor activity play areas serve as extensions of classroom space and must be provided to support programming. Playground to be divided into individual separate areas to accommodate the different age groups occupying the facility. Playground equipment is arranged to ensure that children are visible and supervision is maintained.
Infants and Pre-toddlers	Separate, fenced areas with visual and audible connections to the other outdoor activity areas and limited play equipment. Infant and pretoddler areas may be combined or may be separate if required to maintain direct access from the CARs.
Toddlers	Separate, fenced area with visual and audible connections to the other outdoor activity areas and additional play equipment.
Preschool/Pre-K/Kindergarten	Separate, larger fenced area with visual and audible connections to the other outdoor activity areas, additional play equipment, and more structured activity areas.

2-2 FACILITY PLANNING.

Evaluate the total childcare requirements for the populations and missions of the individual Installation. Plan and budget for durable materials and details. A CDC is used intensely, and the design must be sensitive to the life cycle cost of materials.

2-2.1 Facility Classification.

Once the demand has been determined, classify the facility size as follows:

- Small. Less than 100 children
- Medium. 100 to 200 children
- Large. 201 to 300 children
- Extra Large. 301 children and up

No CDC will accommodate less than 48 children without approval from the Service contacts identified in Chapter 1, “Regulatory Authorities”.

2-2.2 Age Groups and Group Sizes.

Children are grouped according to age and different age group sizes vary. Group sizes are used to determine the number and type of Child Activity Rooms (CARs) in the CDC.

2-2.2.1 Ages Accepted.

Child Development Programs (CDP) according to DoDI 6060.02 states CDP is for children birth through 12 years; however, this FC addresses design of Child Development Centers for children from six weeks through five years of age.

2-2.2.2 Group Size and Caregiver-Child Ratio.

Table 2-2 provides the age groups, ratios of caregiver and children, and the group limits. These ratios exceed NFPA and require additional life safety features – see Chapter 3 Section titled "Fire Protection and Life Safety" for these additional requirements. In any individual center, actual age ranges between groups may overlap. In some centers, children may be grouped in mixed-age activity rooms. In these cases, use the design criteria for the youngest children in the group. Appendix B provides more information on the age groups and their developmental needs.

Table 2-2. Caregiver/Child Ratios

Group	Age Range	Adult/Child Ratio	Group Limit*
Infants	6 wks. to 12 mos.	1 to 4	8
Pre-Toddlers	12 mos. to 24 mos.	1 to 5	10
Toddlers	24 mos. to 36 mos.	1 to 7	14
Pre School/Pre-K/K Age	3 yrs. to 5 yrs.	1 to 12	24

* The group limit is the limit for children only.

2-2.3 Operational Considerations.

Some other programs accept children whose parents are not at home before and after school hours or who wish to place children in a care situation between school and family-gathering time. However, before and after school care programs usually occur somewhere other than a Child Development Center for DoD facilities. The three basic scheduling patterns are as follows:

- Full Day. Children attending for a full day, for example, as many as 12 hours.
- Part Day. Children attending part of a day, typically a half-day or less on a regular, scheduled basis.
- Hourly. Children attending for one hour or more on an infrequent or unscheduled basis.

2-3 SITE PLANNING.

2-3.1 Land Area Requirements.

Provide land area requirements as noted below. Ensure that the required antiterrorism set-back distances can be accommodated with any site selected. See UFC 2-000-05N, (P-80) *Facility Planning Criteria for Navy/Marine Corps Shore Installations* for land planning requirements.

2-3.2 Site Selection.

Select a site that meets the following criteria.

2-3.2.1 Noise Requirements.

Do not locate CDC's near airfields, industrial areas, or other areas with high noise levels. If noise levels at the CDC site exceed 70 dBA continuous, or 80 dBA intermittent, then comply with the acoustical criteria provided in Chapter 3, Exterior Design.

2-3.2.2 Natural Light.

Do not use locations without access to natural light for new CDCs.

2-3.2.3 Natural Environment.

Select a site with as many natural amenities as possible for a beneficial learning environment. These include the following: nontoxic plants and trees; non-dangerous animals; earth forms; rolling terrain; and natural protection from the sun, wind and rain. Develop a site plan that makes the most of the site's existing natural resources. Where possible, conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

2-3.2.4 Site Elevation.

Do not select a site that is near the installation's lowest elevation. Do not select a site near marsh areas, as mosquitos, flies, and other insects should be separated from CDC Outdoor Play environments.

2-3.2.5 Visibility.

Locate CDCs in areas of high visibility to deter crime and vandalism, e.g., locate amidst community facilities, housing, and parks.

2-3.2.6 Hazards.

Do not locate CDCs near the following hazards or nuisances:

- Fuel or other HAZMAT storage buildings
- Service stations

- Maintenance shops, including woodworking and painting areas
- Laundry facilities
- Large kitchen/food preparation facilities
- Aircraft runways
- Railroads
- Security areas
- Any facility producing odors, smoke, dust or pollution
- Unsafe buildings
- Explosives
- Radiation
- Utility substations and overhead power lines

2-3.2.7 Vehicular Traffic.

Avoid locations near busy streets and intersections. If this is not possible, provide mitigation measures, such as bollards, to increase safety at pedestrian areas and playgrounds.

Prepare a site traffic impact study to determine the traffic patterns and the peak demand for parking. Large and Extra Large CDC's will have a significant impact on peak traffic patterns. The circulation and parking demand includes the turnover for the hourly care program and the part-day care program. See Chapter 3, "Parking/Vehicular Circulation", for specific requirements.

2-3.2.8 Soil Testing.

Before selecting the site for the center and its playground, test the soil for the presence of dangerous contaminants. Also, check previous uses of the site. Investigate proposed playground locations adjacent to old structures, which may be painted with lead paint or contain other hazards. Check with the Environmental Installation Restoration Program and the Underground Storage Tank Program. Continue to monitor the site, at the direction of the environmental safety staff, to ensure that it does not become subsequently contaminated, especially by lead. This is particularly a concern in urban areas or where there is a heavy concentration of automobiles or industrial facilities.

2-3.2.9 Domestic Water Testing.

Test domestic water for levels of lead both during the site selection process and again after project completion, and mitigate as necessary.

2-3.3 Site Layout.

2-3.3.1 Internal Traffic Flow.

Site the CDC so the building is clearly visible to cars and pedestrians coming to the facility. Separate service and delivery access from the public and children's areas. Eliminate the potential for conflict between moving vehicles and children. See Chapter 3, “Exit Requirements”, for additional requirements.

2-3.3.2 Outdoor Areas.

Design the outdoor activity area to be directly accessible from the CARs. When planning the outdoor activity area, consider prevailing weather patterns that may affect children's comfort. For example, locate, as necessary in some geographical areas, the outdoor areas on the south side of the building where they will be protected from northerly winds. See Chapter 5 for more information.

2-4 SPACE REQUIREMENTS.

2-4.1 Introduction.

This FC states area requirements in terms of Net Floor Area (NFA) or Gross Floor Area (GFA). NFA is the net usable area of spaces, excluding the area required for building construction and mechanical and electrical equipment. GFA is the total building footprint measured to the exterior side of the exterior wall. Space requirements for individual spaces are expressed as NFA. GFA is determined, where appropriate, by adding to NFA totals an estimated area for building construction (including wall thickness, ventilation space, etc.) and mechanical/electrical equipment rooms.

2-4.2 Space Programs.

Sample space programs for the four CDC size classifications are illustrated in Tables 2-3 to 2-6. They are grouped according to the four functional program areas.

For Navy and USMC CDCs, an interactive spreadsheet is available to help develop a space program for a specific project. It is completed by first selecting the appropriate facility size classification. This generates a partial space program per Tables 2-3 through 2-6 of this FC. The programmer then must select the facility options and enter the quantity of age-specific CARs. The Child Development Center Space Program spreadsheet is available as a downloadable Microsoft© Excel© file from the Whole Building Design Guide Website (www.wbdg.org) under the NAVFAC Design-Build Master page, Design Guidance, located at http://www.wbdg.org/ndbm/design_guidance.php.

2-4.2.1 Core Administration, Staff Support and Facility Support.

The space programs illustrated in Tables 2-3 to 2-5 are purely sample programs and are not intended to establish fixed design programs for CDC planning teams. Determine the actual total space program for CDC Core Administrative functions, Staff

Support functions, and Facility Support functions by considering the anticipated number of children accommodated by the facility and the specific space and design criteria provided in this FC.

2-4.2.2 Child Activity and Multipurpose Rooms.

- The space requirements for CARs in Table 2-6 are mandatory and must not be changed. Determine the total number of activity rooms for specific age groups based on the number and ages of children to be accommodated per Chapter 2, “Facility Planning”.
- Provide a Nursing Room in close proximity to the Infant/Pre-toddler wing of the facility and visible to staff for monitoring.
- Verify the need for a multipurpose room with the Service contacts provided in Chapter 1, Regulatory Authorities. **Service Exception: Navy** contacts will determine when climatic conditions warrant the requirement for a multi-purpose room. As a general rule, only those Navy bases with extreme (heat, cold, rain) climates should consider programming a Multi-purpose room.

Table 2-3. Sample Program Space Requirements for Core Administration

Functional Spaces	Standard CDC Areas			
	Small	Medium	Large	Extra Large
	ft.^{2} (m^2)	ft.^{2} (m^2)	ft.^{2} (m^2)	ft.^{2} (m^2)
Entrance/Lobby. Includes vestibule, circulation space from the vestibule to the reception desk, the circulation space in front of the reception desk, and all areas dedicated to waiting.	120 (11.2)	180 (16.7)	400 (37.2)	450 (41.8)
Reception/Work Area. Generally includes space required for staff workers behind the reception counter and any circulation space leading to adjacent office space, to the isolation room and to the toilet. It does not include any space for general public. Includes the net space required to enclose any office equipment such as printers, faxes, copiers, computers, and video recording equipment, if any. It also includes general office work space (work tables or work surfaces).	280 (26.0)	380 (35.3)	520 (48.3)	520 (48.3)
Administration Offices. The required offices will vary both by Service and by Installation. Refer to Chapter 2, "Administrative Offices", for Service contact names and more information. These ranges are rough estimates.	400 to 600 (37.2 to 55.7)	450 to 650 (41.8 to 60.4)	550 to 750 (51.1 to 69.7)	800 to 1,000 (74.3 to 92.9)
Nurses Office. Marine Corps-only area for isolating and observing a sick child.	80 (7.4)	80 (7.4)	160 (14.9)	160 (14.9)
Nursing Room/Space. Area for mothers (1-2) to have privacy in breast-feeding friendly environment. Includes space for soft seating, sinks, table, counter and diaper changing table. Extra Large requires 2 rooms.	60 (5.6)	60 (5.6)	60 (5.6)	100 (9.3)

Table 2-4. Sample Program Space Requirements for Staff Support

Functional Spaces	Standard CDC Areas			
	Small	Medium	Large	Extra Large
	ft.^{2} (m^2)	ft.^{2} (m^2)	ft.^{2} (m^2)	ft.^{2} (m^2)
Break/Staff Room. Includes space for counter/cabinet space for microwave, sink and refrigerator, space for tables and chairs for staff. Provide closet or lockers for coats and jackets.	180 (16.7)	220 (20.4)	300 (27.9)	380 (35.3)
Training Room. Includes space for a conference room, resource bookshelves, and 2 workstations for computer-based training. Sized to accommodate 30% of staff.	280 (26.0)	380 (35.3)	480 (44.6)	580 (53.9)
Central Storage. Generally includes any space required for storage of both bulk and individual items for use within the CARs and in the office area. Includes space to store any equipment such as Audio/Visual equipment that is rotated in the CARs or used in training.	100 (9.3)	130 (12.1)	150 (13.9)	180 (16.7)
Staff/Public Toilet. This area must be sized based upon building code requirements (occupant load/occupancy) and must be ABA compliant.	120 (11.2)	200 (18.6)	280 (26.0)	360 (33.4)

Table 2-5. Sample Program Space Requirements for Facility Support

Functional Spaces	Standard CDC Areas			
	Small	Medium	Large	Extra Large
	ft.^{2} (m^2)	ft.^{2} (m^2)	ft.^{2} (m^2)	ft.^{2} (m^2)
Kitchen. Includes space for all food preparation and dishwashing, as well as cart storage, dry goods storage, coolers and freezers, and work station for cooks. Note: areas include walk-in freezers and refrigerators for medium CDC's and larger, sized for weekly deliveries	700 (65.0)	1,000 (92.9)	1200 (111.5)	1400 (130.1)
Janitorial. Includes all floor space required for storing janitorial supplies and equipment. Includes a mop sink. Large and Extra Large facilities may have more than one room	60 (5.6)	60 (5.6)	80 (7.4)	80 (7.4)
Bye-Bye Buggy Storage. Alcoves in the vicinity of the infants and pre-toddlers rooms for storage of bye-bye buggies.	25 (2.3)	50 (4.7)	75 (7.0)	100 (9.3)
Video Surveillance Room. Includes video equipment and electronic storage components for surveillance system.	60 (5.6)	60 (5.6)	60 (5.6)	60 (5.6)
Laundry. Includes area required for washers and dryers, one dryer more than the number of washers and a sink and work surface for folding.	80 (7.4)	110 (10.2)	130 (12.1)	220 (20.4)
Other Facility Support. Generally calculated at a percentage of total building area, this includes building construction, circulation/corridors, public restrooms, mechanical rooms, and electrical rooms (see Chapter 3, "Services", for more information). A rough percentage of total building area for these items would range from 25 to 30 percent; however, these spaces are inherently variable as a result of installation unique requirements. Consult with mechanical engineer and CDC Program Manager when programming these spaces.				

Table 2-6. Child Activity Room Space Requirements

Age Group(s) Accommodated	Room Area	
	m^2	$ft.^2$
Infants and Pre-toddlers. This room can accommodate two groups of infants (eight children total) or two groups of pre-toddlers (10 children total).	**78.97**	**850**
Toddlers and Preschoolers. This room can accommodate two groups of toddlers (14 children total) or one group of Preschoolers (12 children total).	**88.3**	**950**
Preschoolers/Pre-K/Kindergarten. This room can accommodate two groups of Preschoolers/Pre-K/K (24 children total).	**133.8**	**1440**
Multi-purpose Room (Optional) for Small and Medium CDC's. Space to accommodate children for large group activities, wheel toy play, exercise, group games, or indoor play. Space includes storage and a toilet. This room may also support other activities such as parenting classes and staff training.	**111.5**	**1,200**
Multi-purpose Room (Optional) for Large and Extra-Large CDC's.	**204.4**	**2,200**
Note: While the rooms are set-up to accommodate more than one age group in terms of space and facilities, usually two age groups will never share a room. See Chapter 2, "Child Activity Rooms" for more detailed breakdown of Child Activity Room spaces.		

2-4.3 Administrative Offices.

2-4.3.1 Quantity and Type.

The quantity and type of administrative offices are Service and facility specific. At a minimum, two offices are provided: One for the CDC director and one shared office. The shared office would accommodate the training and curriculum specialist and the FCC/CDH program (see Chapter 2, "Functional Program Areas", for a description of these programs). Larger facilities and programs will provide separate and even multiple training/curriculum and FCC/CDH offices, as well as an assistant director's office.

Additional design criteria for these offices are provided in Chapter 4. Do not program CDC office space types and sizes without first consulting with the Service contacts identified in Chapter 1, "Regulatory Authorities".

2-4.3.2 Typical Sizes.

- Director's Office. Small at 100 $ft.^2$ (9.3 m^2) minimum; medium at 120 $ft.^2$ (11.2 m^2); and large and extra large at 140 $ft.^2$ (13 m^2).
- Training and Curriculum Specialist. One to two offices at 100 $ft.^2$ (9.3 m^2) minimum.
- FCC/CDH Office. Variable by program and size.
- Resource and Referral Office. If provided as a separate office, 100 $ft.^2$ (9.3 m^2) minimum.

2-4.4 Child Activity Rooms.

Each CAR includes required subspaces. These subspaces and their space requirements are identified in Table 2-7. One of these subspaces is uninterrupted activity space (UAS). UAS is defined as space used exclusively for activity, excluding diaper changing, food preparation, toilets, storage areas, installed millwork, door swings, and dedicated circulation space. Dedicated circulation space is built into the area for each of the subspaces. Sizes shown are net areas.

Table 2-7. Child Activity Room Space Requirement Breakdown

Age Group(s) Accommodated	Room Area	
	m^2	$ft.^2$
Infants and Pre-toddlers. This room can accommodate two groups of infants (eight children total) or two groups of pre-toddlers (10 children total).	**78.97**	**850**
Uninterrupted activity space	48.31	520
One child toilet	2.79	30
Children's hand washing station	1.39	15
Adult sink with counter	4.65	50
Diapering station, including sink and storage	4.65	50
Crib area	9.29	100
Cubby storage	2.32	25
General storage closet	5.57	60
Toddlers and Preschoolers. This room can accommodate two groups of toddlers (14 children total) or one group of Preschoolers (12 children total).	**88.3**	**950**
Uninterrupted activity space	58.53	630
Two child toilets	4.65	50
Two children's hand washing stations	2.79	30
Children’s art sink	1.39	15
Adult sink with counter	4.65	50
Diapering station, including sink and storage	4.65	50
Cubby storage	6.04	65
General storage closet	5.57	60
Preschoolers/Pre-Kindergarten/Kindergarten. This room can accommodate two groups of Preschoolers/Pre-K/K (24 children total).	**133.8**	**1,440**
Uninterrupted activity space	100.3	1,080
Two toilets	4.65	50
Two children's hand washing stations	2.79	30
Children’s art sink	1.39	15
Adult sink with counter	4.65	50
Diapering station, including sink and storage	4.65	50
Cubby storage	9.75	105
General storage closet	5.57	60

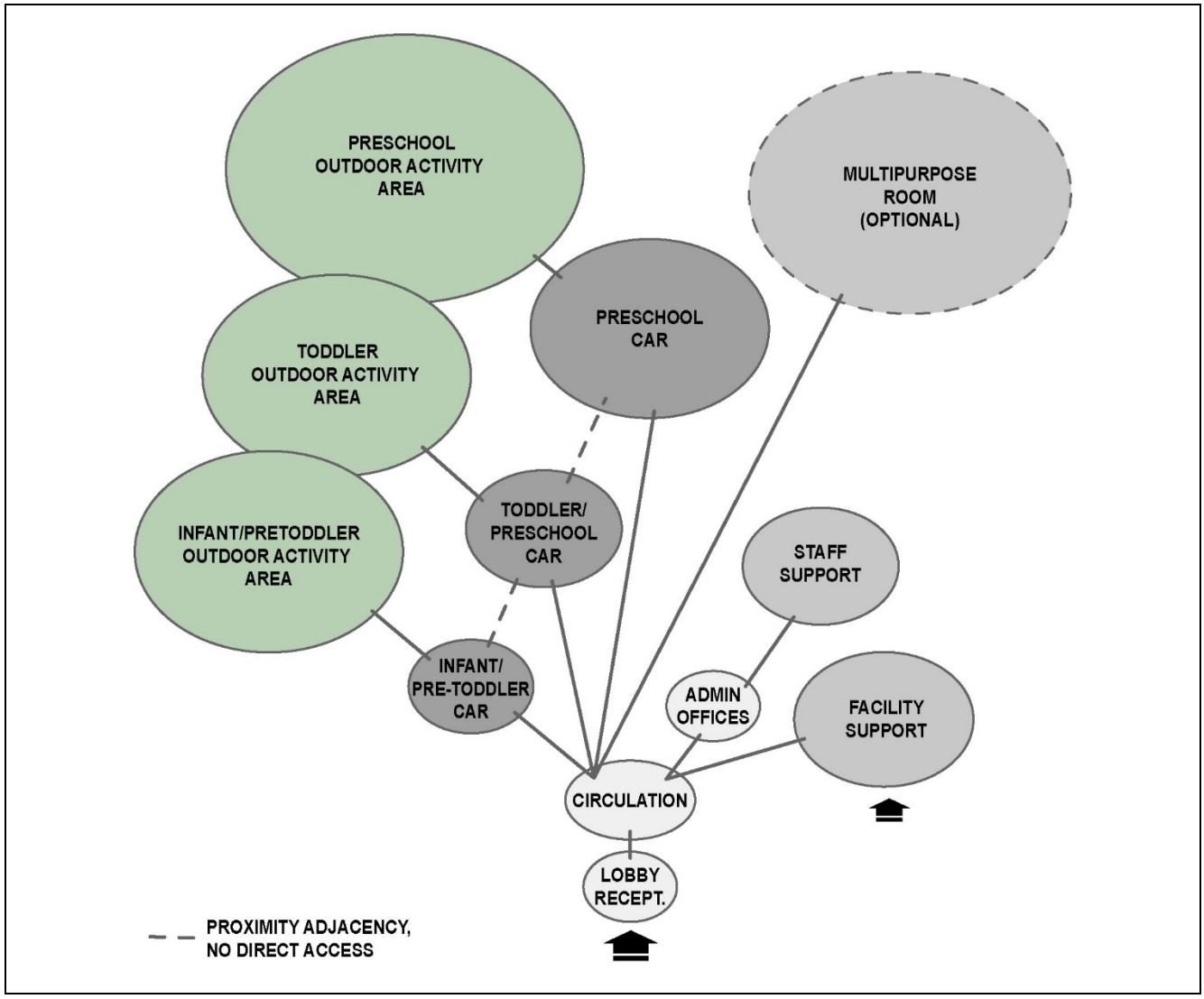
2-5 ORGANIZATION AND LAYOUT.

2-5.1 General Adjacencies.

2-5.1.1 Bubble diagram.

Figure 2-1, Functional Relationship Bubble Diagram, provides the general required adjacencies. The multipurpose room is optional and will only be provided at the discretion of the contacts provided in Chapter 1, Regulatory Authorities.

Figure 2-1. Functional Relationship Bubble Diagram



2-5.1.2 Noise Level Zoning.

Zone the building in terms of noise levels so that activity rooms and/or spaces are grouped together and separated by distance and/or barriers from quiet rooms and/or spaces.

2-5.2 Non-standalone CDC External Adjacencies.

Locate CDCs on a first floor, at-grade level permitting exit discharge directly outside the building. CDCs are not permitted in basements. CDCs must not be located in a mixed occupancy with high hazard or storage occupancies. In any permitted mixed occupancy, CDCs must be separated from other occupancies by a minimum of 1-hour rated construction. In mixed occupancies, the CDC and CDC outdoor areas must be separated from the other occupants; no access is allowed from upper fire exits or through the space to others' spaces.

Site selection must be approved prior to submission of DD Form 1391 by the contacts identified in Chapter 1, "Regulatory Authorities".

2-5.3 Child Activity Room Adjacencies.

2-5.3.1 Building and Site Adjacencies.

Organize and group CARs by age group (infant, pre-toddler, toddler, and preschool/Pre-K/K). Arrange age groups nearest the next age group to simplify and possibly consolidate playground areas. In small centers, design to allow for future expansion and addition of CARs.

Locate CARs along the exterior perimeter of the building to provide direct egress from each activity room to an age-appropriate playground and to maximize natural light admission. Provide direct access to the central circulation system and locate close to common use spaces. Locate the infant/pre-toddler rooms closest to the reception/lobby area because the child is usually carried to the room, along with diaper bags and other supplies.

2-5.3.2 Internal Adjacencies.

Internal room adjacencies are driven by the following key factors:

- **Visibility.** Do not create blind spots within the room. The caregivers should be able to see all areas of the room. Toilets positioned to provide semi-privacy from corridor and entry to CAR.
- **Sanitation.** Physically separate the adult sink and counter (where food preparation takes place) from the child hand washing/toilets and diaper changing.

2-6 ADDITIONS/ALTERATIONS/RENOVATIONS TO EXISTING FACILITIES.

Modernize existing facilities according to the design criteria established in this FC. The objective of all modernization projects is to meet new construction standards to the maximum extent possible within the programmed criteria.

2-6.1 Program.

For CDCs that will be located in existing, modernized facilities, the CAR size and distribution must follow the criteria given in Chapter 2, “Space Requirements”, and Chapter 4. Adapt the standard CDC activity areas to accommodate the existing structure. However, send all proposed modifications to the standard criteria to the contacts defined in Chapter 1, Regulatory Authorities.

2-6.2 Design.

When modifying an existing building, analyze its potential with regard to location, site services, architecture, structure, internal environmental systems, and functional adaptability. Enhance its architectural character in accordance with the local base architectural compatibility standards.

CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL.

UFC 1-200-01 provides applicability of model building codes and government criteria. UFC 1-200-01 identifies, through references, key unified facility criteria and requirements including accessibility, antiterrorism, security, sustainability, safety, discipline specific, and building systems. The facility-specific design requirements in this FC are to be used in addition to or to modify UFC 1-200-01 and the referenced UFCs and government criteria.

3-1.1 Authorized Building Program.

A DD1391 funding document is developed for all new construction projects which establishes the project requirements and authorized building size. The designer can use the functional diagrams contained herein to create the logical flow and individual space allocations for approved functions within the facility, however the design must not exceed the square footage allowances of the DD1391 or add functions in the facility if the functions are not authorized in the validated DD1391.

3-1.2 Accessibility.

The specifications in DoD, “ABA (Architectural Barriers Act) Accessibility Standard” contain alternate specifications based on children's dimensions and anthropometrics for ages 3 and up (preschool age). This FC contains alternate specifications for infants, pre-toddlers, and toddlers for drinking fountains/bubblers, water closets, toilet stalls, lavatories, sinks, and fixed or built-in seating and tables. All spaces, including toilets for preschool age and older, janitor’s closet, and storage rooms must be ABA compliant. Also note the following guidelines for children for the purpose of the CDC facility design:

- Infants, pre-toddlers, and toddlers are not considered to be self-mobile wheelchair users; they are assisted and transferred by caregivers.
- Preschool-age children are considered to be self-mobile wheelchair users.

3-2 STRUCTURAL FOUNDATION INSULATION.

In addition to the criteria established in UFC 1-200-01, the following requirements are specific to CDC’s. Since children spend a great deal of time on the floor, both temperature control and avoidance of drafts are very important. Maximize insulation of floors, including perimeter insulation of floor slabs, as required by project location.

3-3 ARCHITECTURE.

Refer to UFC 1-200-01 and comply with stated and cross referenced requirements for Architecture. Also comply with the following CDC- specific requirements.

3-3.1 Stories.

Unless approved by the Service regulatory authorities, newly constructed CDCs must be single-story structures.

3-3.2 Exterior Design.

3-3.2.1 Architectural Style and Scale.

Design CDCs to reflect a residential, non-institutional character to meet installation Architectural standards. For example, small-scale finish materials, such as bricks, are preferable to large pre-cast panels. The dimension of brick is more congruent with the size of a child and his or her home experience. Minimize the use of irregular geometry in the overall building design that results in any wall angle other than 90° in the offices, CARs, or service areas.

For new CDCs, contain the facility in one building. For annexes to existing buildings, they may be joined by an enclosed and covered walkway.

3-3.2.2 Entrance.

The perimeter of the building and outdoor activity areas must have only one primary means of public access and egress. Control all other service and emergency egress points, with access limited to authorized individuals. Design the entry approach to be visible by inside staff. Incorporate a point of reference or landmark that serves as a welcome and a transition. Visually separate the primary entrance from other entrances and service areas. If budget allows, provide a covered main entry that connects to a covered walkway to short-term parking to protect arriving children and parents from inclement weather.

In cold climates, provide a canopy or recess at required egress doors to ensure that doors can completely open without obstruction from snow and ice.

3-3.2.3 Roof.

The preferred roof is a gable or hip with minimal level changes or projections. Roof overhangs assist with reducing glare in CARs and should be coordinated with shade structures in the outdoor activity areas. See Chapter 5, “Shade”, for more information on outdoor activity area shade structures.

3-3.2.4 Windows and Doors.

Windows and doors must replicate a residential style and scale. Locate windows so that children have visual access to the outside. Locate vision panels in doors so that small children at floor level can be seen and potential injury avoided. Recess or locate casement and other projecting types of windows to preclude dangerous protrusions at child and adult heights. For warm climate locations, give due diligence to material and color selection for exterior windows and doors that children may touch.

Natural lighting is essential in CDCs. Provide throughout to the highest degree possible. If budget permits, provide natural lighting coming from multiple directions.

3-3.2.4.1 General Window Criteria.

Construct, adapt or adjust all windows in areas used by children under 5 years of age to limit the exit opening accessible to children to less than 3.5 in. (90 mm), or be otherwise protected by guards that do not block outdoor light. Screen all openings used for ventilation. Use insulated glass for exterior window glazing. Provide light control and energy conservation features on all exterior windows, either by exterior or interior methods. In new construction, include exterior overhangs, low E-type glass, or both.

For exterior window sills accessible to children, avoid sharp edges and corners.

Adhere to the following safety glass standards:

- Consumer Product Safety Commission, 16 CFR, Part 1201, *Safety Standard for Architectural Glazing*.
- ANSI Z97.1, *Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test*.

3-3.2.4.2 Child Activity Room Window Criteria.

Provide child activity rooms with glass exterior walls from a maximum sill height of 11 in. (280 mm) above finished floor. Place the sill bottom on the finished floor for infant/pre-toddler rooms. Do not place sill heights between 3 and 10 in. (75 and 255 mm).

Comply with the following criteria:

- All exterior windows must be operable. A minimum of 25 percent of each window must be operable. Operable portion of the windows must be no lower than 48 in. (1220 mm) above finished floor. Windows must have an operating mechanism at a maximum height that meets ABA requirements and have draft deflectors, screens, and safety locks.
- Locate or recess casement and other projecting types of windows or awnings to preclude dangerous protrusions at child and adult heights at both the interior and exterior.
- Any glass lower than 36 in. (915 mm) above the finished floor must be tempered safety glass. Wire glass is not permitted.
- Sills must be of durable material such as solid surface materials or plastic laminate. Horizontal and vertical sill edges and corners must be rounded with a radius of .25-in. (6-mm) and must project no more than .75 in. (20 mm) from the wall.
- If window seats are provided, they must be between 10 and 12 in. (250 and 305 mm) above the finished floor and a minimum of 12 in. (305 mm) deep. Edges and corners of window seats must be rounded with a radius of .25-in. (6-mm).

- Use overhangs or tinted glass to prevent glare in CARs. Avoid excessive or heavy tinting.
- If protruding 2 in. (50 mm) or more, do not locate horizontal window muntins (horizontal mullions) between 12 in. to 43 in. (305 mm and 1100 mm) above the finished floor because they could be used as climbing support.
- If interior shades are used for daylighting control, use shade with 5% perforation opening, color to be medium to dark value, and child safety cords. Shades must not extend below 48 in. (1220 mm) AFF in CARs.

3-3.2.5 Exterior Acoustics.

Ensure windows and doors provide the following acoustical treatments:

- Use acoustically laminate glass with a Sound Transmission Coefficient (STC) rating of 35 to 45 for all window and door glazing.
- Use high-quality commercial doors with a minimum STC rating of 30 for exterior doors.

3-3.3 Interior Design.

Refer to UFC 1-200-01 and comply with stated and cross referenced requirements for Interior Design, with the following additions and exceptions for CDC's. Designer of record must coordinate with Service's regulatory authorities for current Interior Design processes, procedures and selections.

Design the interior spaces to dispel an institutional feeling, and use residential-style layouts, scales, and finishes. Ensure the interior design package is compatible throughout the facility and supportive of functional requirements. Ensure collaboration between interior designer, architect, and appropriate engineering discipline personnel.

3-3.3.1 Interior Construction.

3-3.3.1.1 Corridors.

Circulation corridors serving child activity rooms must be a minimum of 6.5 ft. (1980 mm) wide and a maximum of 8 ft. (2440 mm) wide.

3-3.3.1.2 Interior Glass.

All interior glass must be tempered safety glass and mirrors must be constructed with shatter-resistant materials.

3-3.3.1.3 Doors.

Provide vision panels at adult and child viewing heights in all doors, including closets and storage rooms, except school-age or adult toilets. Vision panels must be a minimum of 6 $ft.^2$ (.56 m^2) and placed so a person opening the door can see if children are sitting or standing in front of the door. Provide a full-height vision panel in all closet,

storage, and janitor closet room doors. Full-height panels must be 4 in. to 8 in. (100 mm to 200 mm) wide, located a minimum of 6 in (150 mm) from the lock-side of the door, and extend vertically from 6 in. (150 mm) from the top of the door to 12 in. (305 mm) from the bottom of the door.

Comply with the following additional door criteria and the door hardware schedule in Table 3-1:

- Dutch doors are not permitted.
- Sliding glass doors are only allowed at the main entry as the interior door of the vestibule. Ensure the doors meet ABA, antiterrorism requirements, and the Life Safety Code requirements for emergency and non-powered operation.
- Install finger-pinch protection devices on both push and pull sides of door hinges wherever doors are accessible to children.
- Cover the hand contact and splash areas of doors and walls with a finish that is easily cleaned. Enamel paint is acceptable.
- All locking doors must be openable from the inside without a key and with a single motion (emergency passage).

Table 3-1. Hardware Schedule

Hardware	Main Entry/ Exits**	Admin Areas	CAR Exterior Doors	CAR Interior Doors	Laundry, Janitor, Building Storage	Kitchen Exterior Door	Kitchen Interior Door	Outdoor Storage	Nursing Room Door	Corridor Door (Exit Only)+
Passage latch-set				✓						
Storage lock-set					✓			✓		
Office lock-set		✓							✓	
Panic hardware/ exterior lock cylinders	✓		✓			✓				✓
Door self-closer	✓	✓		✓	✓					✓
Door self-closer w/ integral hold-open*			✓			✓				
Automatic door closer							✓			
Door stops		✓	✓	✓	✓				✓	✓
Kick-plates	✓		✓	✓	✓	✓	✓			✓
Pinch guards/hinge cups	✓		✓	✓				✓	✓	

*Magnetic hold open must be connected to building fire alarm system
**Refer to Chapter 3, “Exit Requirements” for secondary exit requirements
+Corridor Doors, used as secondary exits, must be alarmed to Front Desk

3-3.3.1.4 Casework and Counters.

Casework, counters, and cabinets must be of high-quality and durable construction. Specify Architectural Woodwork Institute (AWI) Premium or Custom for finishes per *AWI Quality Standards Illustrated*. Casework, cabinet doors, and drawer faces should be provided as veneer panel core. Doors, drawers, and casework faces should be plastic laminate at a minimum. Countertops are to be solid surface/solid composite plastics only. Specify .75-in. (20-mm) minimum thickness for plywood, plywood backing, and solid wood panels.

All counters throughout the facility must have rounded safety corners with a .5-in. (12-mm) radius.

3-3.3.2 Interior Finishes.

See Chapter 4 for finish requirements in individual spaces.

3-3.3.2.1 Color and Texture.

Choose light to medium hues for large background areas and walls used for display. Do not use bright colors on walls, floors, and carpets/rugs in large quantities. Do not provide entire walls of graphics and designs that would compete with children's work or display materials. Do not use cartoon or fairy tale characters. Warm hues are preferred.

Do not use abrasive finishes such as stucco, knock-down finishes or high-relief tiles.

3-3.3.2.2 Soft Floor Coverings.

Carpet tile is allowed in Admin areas. Comply with the following for all carpet and area rugs in other areas:

- Do not select carpet with large patterned designs, for example, games or alphabets.
- Backings must be anti-microbial of synthetic or inorganic material. For carpets, use direct glue type with an attached cushion/pad for additional life of the carpet and fall protection. Ensure adhesive or binding components of the carpet do not emit toxic fumes.
- Fibers must be stain and soil resistant 100 percent solution-dyed nylon. Minimum yarn face weight must be 28 ozs/SY (950 g/SM). Use heavy commercial wear classification carpet of level loop construction to minimize snagging.
- Ensure there are no tripping hazards at carpet transition. Area Rugs must be secured with a commercial-grade, two-sided carpet tape around the perimeter. Binding on rugs must be heavy duty .375 in. to 1 in, (9.5 to 25 mm) wide.

- Use carpets tested for Volatile Organic Compounds (VOCs) and that bear a Green Label from the Carpet and Rug Institute indicating that the carpet emissions are within the acceptable range.
- Use products containing less than 0.05 parts per million (ppm) of formaldehyde. Any product purchased with formaldehyde levels above 0.05 ppm must bear a label in accordance with 29 CFR 1910.1048.

3-3.3.3 Interior Acoustics.

Design the facility to provide a comfortable acoustical environment and provide comprehensive sound isolation and sound absorption measures for individual spaces as appropriate. Provide acoustical design to prevent sound from noisy spaces such as corridors, toilets, and mechanical rooms from having negative impact on the adjacent spaces. Limit the reverberation time to 0.6-0.8 seconds. Design for less than 0.6 seconds in smaller spaces. Limit the ambient noise level from mechanical systems, outside noises, and adjacent spaces to 30-40 dBA. Do not allow mechanical peak noise level to exceed 85 dBA. Comply with the following:

- Extend all interior partitions dividing occupied spaces to the roof deck above the suspended ceiling. Partitions can be single layer gypsum wallboard but must have cavity insulation and be completely caulked at the top and bottom of the partition.
- Design all systems to prevent cross-talk between rooms. All air transfer air ducts must be acoustically lined and contain a minimum of one 90 degree elbow. Provide sound attenuators as required. Coordinate requirements for air transfer ducts with the Mechanical Engineer.
- Do not place electrical outlet boxes back-to-back.

At a minimum, provide the required sound transmission coefficient (STC) ratings for common building spaces as identified in UFC 3-101-01, "*Architecture"*. The STC ratings for spaces unique to CDC's are identified in Chapter 4, "Functional Data Sheets". STC ratings stated are for partitions, not windows and doors. Utilize gypsum board wall "improvements" to increase the STC of gypsum board "Stud Type" partitions to achieve the project sound requirements. Unless indicated in Chapter 4, STC ratings do not need to be field verified.

3-3.3.4 Interior Signage.

Develop a comprehensive signage package that addresses both way-finding and definition of all spaces within the facility. Signage should reflect and complement the environment through colors, images and materials used.

3-3.3.5 Kitchen Design.

Design team must include a kitchen designer with 5 years of experience in design of similar facilities. This consultant's involvement will include, but not be limited to, developing specifications and schedules for all kitchen equipment including utility connection sizes and capacities for all applicable items, location of floor sinks and floor

drains, and kitchen hoods. Kitchen designer must be independent of equipment providers. See Appendix E of this document for a listing of kitchen equipment for each facility size.

3-4 SERVICES.

3-4.1 Plumbing.

Refer to UFC 1-200-01 and comply with stated and cross referenced requirements for plumbing. Also comply with the following CDC- specific requirements. All floor drain traps must be self priming.

3-4.2 Fire Protection and Life Safety.

Refer to UFC 1-200-01 and comply with stated and cross referenced requirements for fire protection and life safety. Also comply with UFC 3-600-01, *Fire Protection Engineering for Facilities*, and the following CDC-specific requirements. The DoD CDC fire protection and life safety requirements exceed the minimum standards of the NFPA codes because the DoD ratio of children to child caregiver is greater than permitted in the NFPA codes. The additional features required in DoD facilities compensate for the reduced number of child caregivers.

3-4.2.1 Exit Requirements.

Comply with the following:

- All corridors must terminate at an exterior exit. Dead ends are not permitted.
- All doors in the egress paths must be a minimum of 36 in. (915 mm) and provide a minimum clear width of 32 in. (813 mm). The door must open not less than 90°.
- Equip all doors from the facility to the outside with full-width push pad panic hardware that meets Accessibility requirements. The contact or pressing surface must extend the full width of the door. This is to prevent snagging on evacuation cribs.
- Provide a door direct to the outside from every CAR.
- Equip every door from a CAR to the outside with an automatic hold open device integral to the door or door closer. Flip down door stops are not permitted.
- Every door from a CAR will permit immediate reentry from the outside at all times when the facility is being used. This must be accomplished without toggling down the panic hardware.
- Design door thresholds and hardware to facilitate the exiting of an evacuation crib with up to four children pushed and/or pulled by a single adult.

- Secondary exit doors: All exterior doors other than the main entrance, the kitchen exterior entrance, and any door that opens to a fenced area must trigger a notification when opened to the reception desk to alert staff of unauthorized entry or exit.
- Exits must have a maximum drop of .25 in. (6 mm) and be equipped with ramps with all-weather non-slip surface for emergency evacuation of wheeled evacuation cribs and wheelchairs. Turns and bends in the ramps must be wider than the minimum. Any handrails must meet requirements for guardrails and protective barriers as set forth in the *CPSC Public Playground Safety Handbook*. Size of allowable handrail openings limited to 3 in. (75 mm) (as established in CPSC guidelines for Toddlers).

Provide a smooth paved-surfaced evacuation route to a safe gathering area not less than 75 ft. (23 m) from the facility for all exits and CARs. This route must not cross any emergency vehicle access path, parking area or street, but the paved evacuation path must connect to a public way and must not dead end in grassed areas. The evacuation route must be a minimum of 60 in. (1524 mm) wide; turns and bends in the route must be wider to account for the turning radius of the evacuation cribs and wheelchairs. These routes and safe gathering area must comply with ABA requirements of an accessible route, and with the lighting requirements for exterior pedestrian walkways per UFC 3-530-01, “Design: Interior and Exterior Lighting and Controls”. Additionally, the evacuation route must provide landings at 75 horizontal foot (22.9 horizontal meter) intervals. Each egress gate must provide a minimum of 44 in. (1020 mm) clear width with panic hardware in the outdoor activity area fences. The safe gathering area needs to provide protection for children from adjacent hazards via fencing (such as storm drainage facilities) or other acceptable means as determined by the Regulatory Authority identified in Chapter 1.

3-4.2.2 Additional Exiting Requirements for Extreme Cold Weather Locations.

Extreme cold weather locations are those with more than 50 hours per year with a dry-bulb temperature below 5°F (–15° C) between the hours of 0900 and 1600. (Weather data for DoD is maintained by the Air Force Combat Climatology Center and may be accessed for all DoD locations at https://notus2.afccc.af.mil/SCISPublic/). The file can be searched by installation or city name. Temperature data is found in the Table, Dry-Bulb Temperature Hours for an Average Year and is presented first by month and annual summary. From the summary under the column 0900 to 1600, total the hours. For example, the numbers in parenthesis are the hours in that temperature range for the following bases: Bangor, ME (40); Elmendorf AFB, AK (151); Minot, ND (244); Offutt AFB, NE (41); and Andrews AFB, MD (0). Weather data is also available at http://www.afccc.af.mil/ using the “Other Domain” link to submit a service request for the weather data. If a location meets the criteria for an "extreme cold weather location," comply with the following:

- Provide a two-hour area separation wall dividing the facility child activity areas roughly in half on either side of the wall. Locate the core

administrative/support areas totally in one area or the other. Provide for horizontal exiting from one fire area to the other.

- Design corridor/room doors in the two-hour area separation wall to recess into the wall providing a smooth continuous wall surface. Install magnetic latches to hold door open, which release when the fire evacuation signal sounds. Install swinging doors that swing in opposite directions.
- Install magnetic latches to hold open other doors in the two-hour area separation wall that release when the fire evacuation signal sounds.
- Seal and fire stop all penetrations of the two-hour separation wall for conduit, piping, HVAC and electric service to maintain the fire rating of the wall.

3-4.2.3 Emergency Lighting.

Incorporate the emergency lighting into the normally provided lighting fixtures including the lighting in laundry rooms.

3-4.2.4 Fire Separation.

Provide a one-hour fire resistive fire barrier around the laundry room.

3-4.2.5 Fire Suppression Systems.

Provide complete automatic sprinkler systems in accordance with UFC 3-600-01 and NFPA 13. Comply with the following criteria:

- Provide wet pipe sprinkler system. Dry pipe sprinkler system may be used for those portions of the facility subject to freezing. Anti-freeze and pre-action systems are not permitted.
- Use quick response-type sprinkler heads in wet pipe sprinkler systems.
- Discharge inspectors' test connections to a safe, outside location onto a hard surface outside of areas where children play or congregate. Indicate location on drawings.
- Make fire department connection (FDC) accessible without entering or transiting a children's play area or crossing a discharge path. Provide the FDC on the street side of the building within 150 ft. (45m) of a fire hydrant outside of a fenced area and arranged so that the hose lines can readily and conveniently be attached without interference from any near-by object.
- Provide a wet chemical hood duct and cooking surface fire extinguishing system according to NFPA 96.

3-4.2.6 Fire Detection, Alarm System and Mass Notification System.

Provide systems in accordance with UFC 3-600-01 and comply with the following criteria:

- Locate the control panels in environmentally controlled locations in the facility.
- Use fully addressable Class B control panels with addressable detectors, supervisory sensors, and pull stations.
- Provide a pre-recorded voice notification of fire and other emergencies using a female voice. Provide an alerting tone consisting of a chime sound before each pre-recorded message. In facilities that are exempted from providing mass notification, provide fire alarm audible notification throughout the facility using an uncoded chime sound. Provide appliances to make the chime sound that are listed for "fire alarm service, private mode (45 dBA at 10 ft. (3.1m))". Provide this level in all interior areas of the building except where required to meet the louder output sound level required by NFPA 72 for mechanical rooms and other service areas subject to high levels of ambient noise.
- Provide smoke detection in all areas including closets over 20 $ft.^2$ (1.86 m^2) except the kitchen and spaces that are not climate controlled, such as the attic, walk-in coolers, and the mechanical equipment room.
- For those facilities using multiple, physically separated buildings/structures but one shared reception area, fire alarm and mass notification systems must be interconnected so that all facility occupants receive notification alarms and signals originating in any building/structure.

3-4.2.7 Carbon Monoxide Detection System.

Provide a protected premises carbon monoxide detection system in accordance with NFPA 720 for each building provided with fuel burning appliances. The carbon monoxide system must include the following required features:

- Automatic carbon monoxide alarm signal initiation.
- Notification of carbon monoxide alarms to building occupants using the audible and visual appliances of the mass notification system.
- Transmission of carbon monoxide alarms to the Base Fire Department as a supervisory signal in accordance with NFPA 72.
- Transmission of carbon monoxide detection system trouble and supervisory signals to the Base Fire Department in accordance with NFPA 72.
- Combination-type carbon monoxide detection systems that are integrated in operation with the building mass notification system and fire alarm system, and that meet the requirements of NFPA 72 for combination systems.

- Class B initiating device circuits, notification appliance circuits, and signaling line circuits.
- Install carbon monoxide detectors in accordance with the manufacturer's published instructions on the ceiling in the same room as all permanently installed fuel-burning appliances. Also provide at least one carbon monoxide detector centrally located within each area served by a separate air handler.

3-4.3 Electrical Design.

In addition to the criteria established in UFC 1-200-01 and the references therein, comply with the following CDC-specific requirements:

3-4.3.1 General Requirements.

Provide wall duplex receptacles at a maximum of 8 ft. (2.44 m) on center. Provide at least one duplex outlet on walls less than 9 ft. (2.74 m) long. All receptacles must be listed Tamper-Resistant (removable caps or plugs are not acceptable).

3-4.3.2 Lighting.

For the overall design approach, adapt the appropriate sections of UFC 3-530-01. To meet applicable energy codes and utilize daylight havesting, dimming may be necessary. However, lights cannot completely shut off during operating hours. Provide automatic controls to maintain minimum light levels throughout the facility and prevent lights from completely turning off during occupied hours. See Chapter 4, "Functional Data Sheets", for additional specific light level and control requirements.

Designers must coordinate with activity to verify that specifications as written are sufficient to ensure operational controls are appropriate for a CDC and lighting systems do not shut off during operating hours.

3-4.3.3 Optional Standby Power Connection.

Provide a standby generator hook-up and interior manual transfer switch to power the entire facility load. Ensure availability of a hard surface area adjacent to the building service entrance to accommodate the generator. Ensure that this surface is outside of the outdoor activity area and does not impact other child-occupied areas or pathways.

3-4.3.4 Intercom System.

Provide two way communication between child activity rooms to master station and other areas in the facility. The room devices must have two capabilities - communication must function hands-free as a one-touch control and allow for communication from anywhere in the room without using a headset or handset; also, handset functionality must be provided. "Hands-free" does not include a headset with a microphone. The master station in the reception area must include a handset and a hands-free function. The master station must have an "all call" capability. If intercom and telephone

capabilities are combined, coordinate programming with activity for operational controls of system (e.g., rooms in which calls outside building are prohibited).

3-4.3.5 Electronic Security Systems (ESS).

Design the ESS in accordance with UFC 4-021-02, *Electronic Security Systems*.

3-4.3.5.1 Intrusion Detection System (IDS)

The IDS components to be funded by construction funds and included in all projects include:

- A duress alarm (panic button) at the receptionist desk that reports to installation security dispatch.
- Point sensors on exit-only corridor doors that alarm at the front desk to indicate the potential that a child has exited the building.

Additional features for the IDS may be required by installation command and will be funded by the installation.

3-4.3.5.2 Access Control Systems

Provide card reader with keypads at entry to building.

3-4.3.5.3 Closed Circuit Television (CCTV)

Provide a complete and usable digital CCTV system, including all equipment, for child monitoring. See Chapter 4, “Functional Data Sheets” for monitor and camera locations.

3-5 HVAC.

3-5.1 General

Refer to UFC 1-200-01*s* and comply with stated and cross referenced requirements for HVAC. Also comply with UFC 3-401-01, *Mechanical Engineering* and 3-410-01, *Heating, Ventilating, and Air Conditioning Systems.* In addition, the following requirements are specific to CDC’s:

- All Child Development Centers (CDC’s) must be provided with mechanical heating and cooling as required to maintain space temperature and humidity levels listed below and in the tables in Chapter 4. All return air must be ducted to unit from each space. Plenum return systems will not be acceptable. Coordinate interior acoustic requirements for air transfer ducts with the Architect.
- Temperature for all regularly occupied areas to be adjustable between 68°F to 73°F (20°C to 22.8°C) in winter and 72°F to 77°F (22.2°C to 25°C) in summer.

- Relative Humidity will not exceed 50% RH in any space with mechanical cooling.

3-5.2 Kitchen.

Provide listed ventilation hoods over all cooking and warming appliances.

3-5.3 Laundry.

All dryer exhaust ducting must be metal. Use only solid metal ducting to transition through the fire barrier.

3-6 FURNISHINGS.

3-6.1 General.

Comply with following for furnishings in areas accessible to children:

- Furnishings must have rounded corners or edges with a .5-in. (12-mm) radius.
- Furnishings must not splinter or have toxic surfaces.
- Furnishings that are 36 in. (915 mm) or higher must be secured to prevent tipping.
- Furnishings less than 36 in. (915 mm) in height must be easily moved by staff to help define activity areas (e.g., storage units, display space units, bookcases, puppet stages) and circulation paths.
- Choose furnishings and equipment that meet all applicable codes and standards and are age appropriate.

3-6.2 Tables and Chairs.

Specify comfortable, cleanable upholstered adult seating in the infant/pretoddler CARs to provide a place where caregivers can nurture children. Child-scaled seating includes cleanable upholstered or exposed frame seating. To avoid suffocation, do not use beanbags, cushions and pillows for infants. Scale tables and chairs to the child. A minimum of one table per CAR must be height adjustable with appropriate knee clearance for children in wheel-chairs, 24 in. (600 mm) above the finished floor by 24 in. (600 mm) deep by 30 in. (750 mm) wide. Provide so top surface height is a maximum of 2 in. (50 mm) higher than knee clearance. See Appendix B, Designing for Children, for more information on anthropometric dimensions.

3-7 EXTERIOR SIGNAGE.

Identify the CDC as a "Child Development Center." Ensure that signage complies with Installation requirements. The installation or community name or graphical location of the facility may be used for public identification purposes (i.e. "____ Base Child

Development Center"). Do not use terms such as "Nursery," "Child Care Center," or "Preschool" to designate a CDC. Unique names must be approved by Program Management and Regulatory Authorities designated in Chapter 1 of this document. Sign placement and type are site-specific, but signs must be strategically located, adequately lit, and of sufficient size to permit proper viewing by individuals approaching the facility.

3-8 SITE DESIGN.

3-8.1 Grading and Drainage.

Ensure that all areas have positive drainage. This is especially critical in outdoor play areas. If possible, accommodate both the building and outdoor activity areas without extensive grading and potential damage to the existing drainage run-off patterns. Water must be drained away from all play areas to ensure the areas are useable as quickly as possible after rain. Drop inlets and catch basins are not allowed within outdoor activity areas.

3-8.1.1 Minimum Slopes.

Position drainage slopes away from the building at a minimum slope rate of 1:20, except in areas designated for the physically handicapped. Do not exceed a slope rate of 1:3 for banks for transition from one area to another. Use a minimum slope of 1:50 for grass areas.

3-8.1.2 Hydrologic Regime.

Rather than creating a large retention basin that could be a hazard, control storm water at the source by the use of micro-scale features that are distributed throughout the site. Locate retention or detention basins as far away as possible from the outdoor activity areas.

3-8.1.3 Downspouts.

Locate above-grade downspouts outside the outdoor activity areas and away from areas where children congregate. If this is not possible, connect downspouts to an underground drainage system. Design any elements of the downspouts or the drainage system located in the outdoor activity area to be free of sharp edges. Protect underground drainage systems from clogging. Provide a subsurface drainage system under all safety surfacing systems (including synthetic surfacing).

3-8.2 Walkways.

Connect the building to the public sidewalk system and to parking with pedestrian sidewalks. Comply with the following:

- The sidewalks must be a minimum of 5 ft. (1525 mm) wide.
- All access ways must utilize ramps or be on grade.

- Provide sidewalks immediately in front of or beside any designated parking areas to minimize the need for a child to walk behind a parked car to gain access to the building.
- Pedestrian approaches to the building must not pass through any outdoor activity areas.
- Where possible, provide views of the outdoor activity areas from the main walk from the parking lot to the building entrance, considering a child's height and perspective.

3-8.3 Parking/Vehicular Circulation.

Design the parking and vehicular circulation to meet UFC 3-201-01, *Civil Engineering.* Also comply with the additional criteria and exceptions in this section. For planning purposes, pavement area must allow for circulation, parking, and drives, plus space for the drop-off. Gravel surfacing is not permitted.

The layout of the parking lot and traffic circulation must consider the safety of the children when entering and departing the facility. Parking lots must be designed such that children are not required to walk behind parked vehicles as they walk from the parking lot to the building. Do not use parallel parking. If the parking lot design requires crosswalks, these must be painted and identified with signage in appropriate locations to ensure the safety of the patrons. All sidewalks must be ADA compliant.

For safety, separate vehicular and pedestrian circulation. Provide parking and vehicular access for six different functions:

3-8.3.1 Bus Drop-Off/Pick-Up.

Not all CDC programs use buses. If required, locate the bus drop-off/pick-up directly adjacent to the main building entrance. Provide safe points of facility access for children and adults that are separate from the main vehicular circulation. Bus drop-off/pick-up must be configured such that the right (door) side of the bus will always face the main facility entry.

3-8.3.2 Parent and Visitor Parking.

Parents are required to walk the child inside the facility for drop-off and to meet the child inside the facility for pick-up. This drives the need for a significant quantity of parent parking. Provide one space per 12 children accommodated by the facility. Support an increase in the parking allocation for patrons with the required site traffic impact study (see Chapter 2, “Site Selection”). Accommodate easy return to parking areas for circling. Provide a one-way traffic pattern with angled parking to improve traffic flow and limit back-up and turning maneuvers. Locate parent parking as close to the CDC entrance as possible while meeting required antiterrorism stand-off distances. Maximize the parking on the building-side of the drive to reduce the conflict between vehicles and children. Compact parking spaces (less than 9 ft. (2.7 m) wide) are not permitted in the parent and visitor lot. Strive to locate area drains and drainage inlets

away from paths where strollers will travel or parents and children will walk. Where signage is provided, use posts with no sharp edges.

3-8.3.3 Staff Parking.

Separate staff parking from parent/visitor parking. Locate staff parking near the building with a view to the entry. Provide parking spaces for the maximum number of staff on duty at one time. Staff parking can be configured for 90-degree parking.

3-8.3.4 Service Access.

Verify the size of required service vehicles and dumpster pad prior to planning and designing the service access areas. Plan service drive to allow ease of access to kitchen. Provide a back-up spur for dead-end and service drives which exceed 100 ft. (30.5 m) in length. Screen or separate the service area from public use or traffic areas with fences, depressions, berms, and landscaping. Ensure proper drainage if depressions are used. Provide physical barriers to separate outdoor child areas from all service areas. Service access must not cross outdoor activity areas.

Locate access near the serviced areas and consolidate service access when site and building layout allows. Provide a service vehicle apron. Four basic functions require service access:

- Occasional supply deliveries (furniture, laundry, books, toys).
- Regular food deliveries to the storage and kitchen area.
- Mechanical room related service (fuel deliveries, maintenance equipment).
- Regular garbage pick-up.

3-8.3.5 Emergency Vehicle Access.

Coordinate emergency vehicle access with the Installation fire protection. Personnel emergency egress routes/exit discharge paths must not cross any vehicle access roads.

3-8.3.6 Maintenance Vehicle Access.

Coordinate maintenance vehicle access with the Installation engineer's office.

3-8.4 Utilities.

Transformers, mechanical equipment, and other above-grade utilities must not be located within the outdoor activity area and must be inaccessible to children. This includes storm drainage inlets, utility clean outs, valve covers, and manhole covers. These items must be securable and accessible to only the installation’s engineering staff.

3-8.5 Radon.

Evaluate and mitigate Radon. See Appendix B for more information.

3-8.6 Perimeter Fencing.

There is no policy-based requirement for a perimeter fince. Coordinate the need for a perimeter fence with security personnel. If a perimeter fence is determined to be a project requirement, the fencing must be ornamental. Also provide perimeter fencing for CDCs located in “high traffic” areas. Comply with UFC 4-022-03*, Security Fences and Gates*, for perimeter fencing requirements. See Chapter 5 for requirements of fencing around Outdoor Activity Areas.

3-9 LANDSCAPING.

Landscaping is a critical component of a CDC and must be coordinated with the outdoor activity area design. Landscaping must reflect the local geographical environment, and selected plants must be easy to maintain and enhance the visual quality of the facility, including the entrance way, in all seasons. Use indigenous species to the greatest extent possible. Comply with UFC 3-201-02, *Landscape Architecture*, and the local Installation landscape standards.

Three critical components of CDC landscaping require attention beyond that of most other facility types: Child safety, child learning opportunities, and durability.

3-9.1 Child Safety.

Plants with thorns are not permitted. Poisonous or toxic plants are not permitted. Plants that produce fruits, nuts, or seeds that represent choking hazards, regardless of toxicity, are not permitted. Verify the selected and existing plant material for meeting these requirements—the submittal section of specifications require written verification by the nursery contractor that plants with thorns, poisonous plants, toxic plants, or fruit bearing plants are not planted in the outdoor activity area. A non-comprehensive list of common non-poisonous and poisonous plants is included in Appendix C of this document. For a comprehensive list of poisonous plants, refer to *Peterson Field Guides: A Field Guide to Venomous Animals & Poisonous Plants*.

Any fertilizers, herbicides and pesticides used in the outdoor activity area must be approved for use in child care environments by the Armed Forces Pest Management Board.

3-9.2 Child Learning Opportunities.

Provide a variety of plants with seasonal change, color, texture, fragrance, and interpretive value in the outdoor activity area to accommodate the programming requirements to provide learning opportunities for children. Gardens are permitted in outdoor activity areas for pre-school age children provided all plants are non-poisonous, and all fertilizers, herbicides and pesticides are approved for use in child care environments.

Preserve natural landscape features, including existing topography, trees and vegetation. Supplement the natural features as needed to provide opportunities for children to explore different aspects of nature. Ensure that natural features such as hills

and nature areas are accessible. Integrating plants into the entire play area is preferred over isolated nature areas. All areas of the outdoor activity area must be visibly accessible to adult supervisors.

While a maximum slope rate of 1:3 for site grading is allowed, a 1:2 slope is allowed for berms that incorporate hill slides in outdoor activity areas.

3-9.3 Durability.

Always use local, durable, native species to the greatest extent possible to help ensure survivability. Children's play will inflict additional wear and damage to plants, especially in playgrounds; provide plantings that are resilient and of adequate size to withstand daily play.

3-9.4 Irrigation.

When utilized, provide an irrigation system with sprinkler heads that do not present tripping or other safety hazards in the outdoor activity areas. Exposed or accessible elements of the sprinkler system must not have openings between .375 in. (9 mm) and 1 in. (25 mm) in size. Locate controls for the irrigation system in the mechanical room. Locate back-flow preventers, risers, and valves outside the outdoor activity area. An irrigation system for the landscaped areas will be determined on a case-by-case basis for the specific installation, project budget, and sustainable design principles. The only non-potable water allowed for irrigation systems in outdoor activity areas is rainwater.

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CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-1 INTRODUCTION.

This chapter identifies the specific design needs for each functional area as outlined in the space program. Tables 4-1 through 4-13 provide this data in a standard Functional Data Sheet format.

The interior construction specialties, equipment and furnishings criteria provided in these tables are broken down as follows:

4-1.1 Casework/Built-in Equipment.

This includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window treatments, laundry machines, and retractable overhead screens.

4-1.2 Furnishings, Fixtures, and Equipment (FF&E).

For the purposes of this FC, FF&E is broken down into Type 1 and Type 2. The FF&E types are distinguished as follows:

- Type 1. This includes contractor-furnished, contractor-installed loose items such as desks, tables, chairs, and bookshelves.
- Type 2. This includes all government-furnished, government-installed items, which are typically limited to office equipment such as computers, printers, copiers, and projectors (if mounted, projector mount would be built-in). Also, toys and accessories for the Child Activity Rooms are included in this FF&E Type.

4-2 ADMINISTRATIVE, STAFF SUPPORT, AND FACILITY SUPPORT.

Tables 4-1 through 4-9, and 4-13 are the functional data sheets for the administrative, staff support and facility support spaces.

Table 4-1. Entrance/Lobby/Corridors

Description/ Usage	The lobby serves as the primary entrance to the facility for parents, children and visitors, and it connects all the primary circulation pathways of the facility. Parents will escort children to the activity rooms. A waiting area is included.
Ceiling Ht.	10 ft. (3.05 m) minimum; 12 ft. (3.7 m) maximum.
Windows/Doors	Provide windows and doors per Chapter 3, Windows and Doors. Provide an entry vestibule at the main entrance. Exterior doors must accommodate adult- and child-height views from both sides. Sliding glass doors are only allowed as the interior door of the vestibule and must be automated. The exterior door of the vestibule must be an automated hinged door. If the sliding doors are used, plainly mark the doors at both adult and child levels to prevent someone walking through the door by accident.
Finishes	**Walls.** Lobby & Corridors. Provide a low-maintenance, durable finish with a wainscot. Consider high performance architectural latex coated (MPI no. 140) gypsum wallboard.

Table 4-1. Entrance/Lobby/Corridors

	Floor. Lobby. Provide a low-maintenance, durable, moisture and slip-resistant finish suitable for this high traffic area. Options include resilient flooring, sheet vinyl, stained concrete, stone, or terrazzo. Provide a recessed walk-off mat/area at the entrance door. Provide a base that matches the flooring or a resilient base. Corridors. Resilient flooring. **Service Exception:** USMC allows carpet. **Ceiling.** Lobby. Painted gypsum wallboard or acoustical ceiling panels (ACP). Corridors. ACP
Plumbing	Corridors: Provide an electric water cooler near the lobby and public toilets.
HVAC	Provide system per Chapter 3, "HVAC".
Fire Protection and Life Safety	Provide system per Chapter 3, "Fire Protection and Life Safety". Provide either a graphic or alphanumeric annunciator at the front desk or main entrance vestibule.
Power	Provide power per Chapter 3, "Electrical". Coordinate all powered equipment locations with the program personnel identified in Chapter 1, Regulatory Authorities, and place outlets accordingly to eliminate the need for extension cords. For safety of the children, the top of the electrical outlet boxes must be 54 in. (1370 mm) above finished floor. Outlets provided above countertops must be located no less than 18 in. (455 mm) from the edge of the countertop. .
Lighting	Provide system per Chapter 3, "Electrical".
Communication	**CCTV.** Provide outlets to cover the entrance and the interior. All monitors must be viewable from the entrance and lobby. **CATV/Internal Video.** Provide a CATV outlet. **Intercom.** None required. **Telephone.** Provide an outlet in the waiting area. **Data.** Provide an outlet in the waiting area.
Security System	Ensure visibility of the entrance from the reception/work area. Any additional security equipment must have a non-threatening appearance.
Acoustics	Design space to comply with Chapter 3, "Interior Acoustics".
Casework/ Built-in Equipment	Lobby. Provide a means to display facility information and children's artwork. Corridors. Provide a means to display children's artwork. Provide a parent-teacher board at the entry to each of the CARs. Provide CCTV cameras per the outlet count and monitors.
Type 1 FF&E	Waiting area includes durable, easy-to-clean, and moisture-resistant furniture; tables; magazine and brochure rack; wall art; and a wall clock.
Type 2 FF&E	
Special Req.	Include an area within or near the waiting area to store child safety seats and strollers. Provide a grated snow-trap for northern tier bases. Provide a means to visually reduce the length of the longer corridors, e.g. varied wall, ceiling and floor finishes, patterns, and design. If possible, allow children in the lobby/waiting area to see into some of the activity rooms.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-2. Reception/Work Area

Description/ Usage	The reception desk is the focal point of information exchange within the building and is the check-in/out location for patrons. It is also the working surface for the receptionist/desk attendant. The work area includes shared office equipment and general work space.
Ceiling Ht.	9 ft. (2.74 m) minimum. 12 ft. (3.7m) maximum.
Windows/Doors	None required.
Finishes	**Walls.** Provide high performance architectural latex coated (MPI no. 140) gypsum wallboard. **Floor.** In front of counter: Provide a low-maintenance, durable, moisture and slip-resistant finish suitable for this high traffic area. Options include resilient flooring, sheet vinyl, linoleum sheet, vinyl plank flooring, stained concrete, stone, or terrazzo. Provide a base that matches the flooring or a resilient base. Behind counter and work area: Can match the lobby, or resilient flooring and carpet are also permitted for all Services. Provide resilient base. **Ceiling.** Match lobby ceiling. Consider using the ceiling to define and separate this area from the Lobby, i.e., a dropped gypsum board soffit over the reception desk and gypsum board false beams.
Plumbing	None required.
HVAC	Provide system per Chapter 3, “HVAC”. Locate HVAC shutdown switch here.
Fire Protection and Life Safety	Provide system per Chapter 3, “Fire Protection and Life Safety”. Provide LOC.
Power	Provide power per Chapter 3, “Electrical”. In addition, perform a power requirement survey as this area’s power requirements are extremely site- and locale-specific.
Lighting	Provide system per Chapter 3, “Lighting”. Provide emergency lighting to illuminate the desk area to a minimum of 1 ft. candle (10 lux).
Communication	**CCTV.** All monitors must be viewable from this area. Also see Special Requirements. **CATV/Internal Video.** None required. **Intercom.** Provide the master controls for the facility internal two-way system. **Telephone.** Provide outlets for the required number of phones and facsimile machines. **Data.** Provide outlets for the required equipment.
Security System	If a security system is provided, place the controls and a duress alarm accessible to the receptionist/desk attendant.
Acoustics	Design space to comply with Chapter 3, “Interior Acoustics”.
Casework/ Built-in Equipment	Provide a 24-in- (610-mm-) deep dual-height transaction counter that accommodates a minimum of one person in a wheelchair, a minimum of three standing adult patrons for small facilities and six standing adult patrons at large and extra large facilities. Ensure that a child can see the receptionist/desk attendant behind the counter, and vice versa. The counter must be dual height for standing transactions, seated office functions. The counter must be a durable solid surface material such as granite, concrete, or solid plastic—laminate is not permitted. Modesty panels and apron must also be of durable materials. Consider providing wall and base cabinets and an equipment counter. Provide CCTV monitors – verify size with Regulatory Authorities identified in Chapter 1.
Type 1 FF&E	Reception desk chairs and patron stools.
Type 2 FF&E	Point of sale equipment. Office equipment, including computers, printers, copiers, scanner, and facsimile machine.

Table 4-2. Reception/Work Area

Special Req.	The receptionist/desk attendant must have direct line-of-sight visual control over the main entrance and the CCTV monitors. Place the monitors so the seated attendant does not have to turn more than 30° to 45°from his or her normal working position to view the monitors. Coordinate the location of the monitors and the overall design of the area, including the lobby, with the monitor equipment selection to ensure appropriate viewing angles and distance. If the distance from the receptionist position to the monitor exceeds 6 ft (1830 mm), a separate monitor is required in close proximity to the receptionist.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-3 Administrative Offices

Description/ Usage	The required offices will vary both by Service and Installation. Refer to Chapter 1, "Scope of Facility", and Chapter 2, "Space Program", for additional guidance. Locate offices as close to lobby/reception area as possible.
Ceiling Ht.	9 ft. (2.74 m) minimum.
Windows/Doors	Provide windows and doors per Chapter 3, "Windows and Doors and Interior Construction". If possible, locate offices on exterior wall and provide windows for natural light admission.
Finishes	**Walls.** Provide high performance architectural latex coated (MPI no. 140) gypsum wall board. **Floor.** Carpet with resilient base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC".
Fire Protection and Life Safety	Provide system per Chapter 3, "Fire Protection and Life Safety".
Power	Provide power per Chapter 3, "Electrical".
Lighting	Provide system per Chapter 3, "Electrical".
Communication	**CCTV.** Provide an outlet for a single CCTV monitor in the director's office. **CATV/Internal Video:** None required. **Intercom.** Provide a system remote in each enclosed space. **Telephone.** Provide one line per staff plus one additional line for fax and copier. **Data.** Provide one outlet per staff plus one outlet for each piece of equipment such as printers, copiers, and scanners.
Security System	None required.
Acoustics	Design space to comply with Chapter 3, "Interior Acoustics", and provide partition construction with a minimum STC rating of 45.
Casework/ Built-in Equipment	Provide coat hooks. Provide CCTV monitor in Director's Office only. Provide dry-erase boards in select offices and workstations.
Type 1 FF&E	Private Offices: desk, credenza, filing cabinet, desk chair, and two side chairs. Workstations: desk chair and side chair for open offices. Workstation systems furniture must provide adequate space for filing and overhead storage. The training and curriculum office requires one (1) lockable, four-drawer lateral file cabinet for each office/workstation.
Type 2 FF&E	Office equipment, including computers, printers, copiers, scanner, and facsimile machine.
Special Requirements	Provide direct line of sight from the director's office to the lobby/reception. If possible, provide direct line of sight from the FCC/CDH office to the lobby reception. The training and curriculum specialist office must be buffered visually and acoustically from the public areas and the CARs. The following offices require a 6 $ft.^2$ (0.56 m^2) lockable storage closet: Director, Administrator, and Resource and Referral.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-4. Break/Staff Room

Description/ Usage	This space is used for staff breaks, meals and storage of belongings. It should be located adjacent to the staff/public toilet and the training and curriculum office, and it should be buffered visually and acoustically from the public areas and CARs.
Ceiling Ht.	9 ft. (2.74 m) minimum.
Windows/Doors	Provide windows and doors per Chapter 3, "Windows and Doors and Interior Construction".
Finishes	**Walls.** Provide high performance architectural latex coated (MPI no. 140) gypsum wall board. **Floor.** Carpet or durable resilient flooring with resilient base. Provide resilient flooring at sink area. **Ceiling.** ACP.
Plumbing	Provide a sink and a water line for connection to refrigerator ice maker.
HVAC	Provide system per Chapter 3, "HVAC".
Fire Protection and Life Safety	Provide system per Chapter 3, "Fire Protection and Life Safety".
Power	Provide system per Chapter 3, "Electrical".
Lighting	Provide system per Chapter 3, "Electrical".
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet. **Intercom.** Provide a system remote. **Telephone.** Provide one line. **Data.** Provide a dedicated outlet for the time clock and at least one additional outlet.
Security System	None required.
Acoustics	Design space to comply with Chapter 3, "Interior Acoustics".
Casework/ Built-in Equipment	Provide solid-surface countertops with lockable wall and base cabinets. Provide 24-in- (610-mm-) deep Z-shaped lockers for staff. Provide bulletin board with tack surface.
Type 1 FF&E	Tables, chairs, microwave, refrigerator, coffee machine, television, wall clock, and time clock.
Type 2 FF&E	Telephone.
Special Requirements	If possible, locate break room on exterior wall and provide windows for natural light admission.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-5. Training Room

Description/ Usage	The training room provides space for staff work, development of program materials, and utilization for staff training library and resources. Also includes two computer workstations for computer-based training. It should be located adjacent to the staff/public toilet and the training and curriculum office, and it should be buffered visually and acoustically from the public areas and CARs.
Ceiling Ht.	9 ft. (2.74 m) minimum.
Windows/Doors	Provide windows and doors per Chapter 3, "Windows and Doors and Interior Construction".
Finishes	**Walls.** Provide high performance architectural latex coated (MPI no. 140) gypsum wall board. **Floor.** Carpet with resilient base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC".
Fire Protection and Life Safety	Provide system per Chapter 3, "Fire Protection and Life Safety".
Power	Provide system per Chapter 3, "Electrical". For safety of the children, the top of the electrical outlet boxes must be 54 in. (1370 mm) above finished floor.
Lighting	Provide system per Chapter 3, "Electrical".
Communication	**CCTV.** None required. **CATV/Internal Video.** Provide one outlet. **Intercom.** Provide system remote. **Telephone.** Provide one line. **Data.** Provide outlets as required for equipment.
Security System	None required.
Acoustics	Design space to comply with Chapter 3, "Interior Acoustics", and provide partition construction with a minimum STC rating of 45.
Casework/ Built-in Equipment	Countertop with wall and base cabinets. Provide a storage closet for training materials and AV cart. Provide an electrically operated retractable screen, a built-in ceiling projector mount with network connection, bulletin board with tack surface, and dry-erase board.
Type 1 FF&E	Provide TV, VCR, and DVD player. Provide conference/work tables and chairs for 30 percent of staff in all facilities.
Type 2 FF&E	Computer projector, printers, and interactive dry-erase board.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-6. Central Storage

Description/ Usage	The separate central storage room provides space for shared program materials, audiovisual equipment, and other resource materials. It is located near staff/administrative areas.
Ceiling Ht.	9 ft. (2.74 m) minimum.
Windows/Doors	Provide doors per Chapter 3, "Doors".
Finishes	**Walls.** Provide high performance architectural latex coated (MPI no. 140) gypsum wall board. **Floor.** Resilient flooring with resilient base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per Chapter 3, "HVAC".
Fire Protection and Life Safety	Provide system per Chapter 3, "Fire Protection and Life Safety".
Power	Provide system per Chapter 3, "Electrical".
Lighting	Provide system per Chapter 3, "Electrical".
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **Intercom.** Provide system remote. **Telephone.** Provide one line. **Data.** Provide one outlet.
Security System	None required.
Acoustics	Design space to comply with Chapter 3, "Interior Acoustics".
Casework/ Built-in Equipment	Provide a combination of low open shelving, drawers, cabinets with doors, hooks that do not present a hazard, adult-height shelves, and wall-hung cabinets. Maintain an 18 in. (455 mm) clearance below the lowest point of the sprinkler heads.
Type 1 FF&E	None required.
Type 2 FF&E	Provide cart for multi-roll 48 in. (1220 mm) wide classroom paper. Provide baskets, boxes, chests, storage bags, buckets, crates and bins.
Special Requirements	Provide space for and access to multi-roll classroom paper cart.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-7. Staff/Public Toilets/Janitor's Closet

Description/ Usage	ABA-compliant facilities located near the lobby and staff areas. In small CDCs, combine public and staff toilets. In medium, large and extra large facilities, provide separate public and staff toilets. Minimum requirements are as follows: Small CDCs - two unisex staff/public toilets. Medium CDCs - one unisex public and two unisex staff toilets. Large and Extra Large CDCs - one unisex public and three unisex staff toilets.
Ceiling Ht.	9 ft. (2.74 m) minimum.
Windows/Doors	Provide doors per Chapter 3, Doors. Any staff or public toilet that is not directly visible from the reception desk must require keyed entry or cipher lock.
Finishes	**Walls.** Epoxy painted, mold-resistant gypsum wall board with a ceramic tile wainscot. Consider full ceramic tile walls with integral patterns. Use a dark-colored epoxy grout. Janitor's closet: Epoxy painted, mold-resistant gypsum wall board **Floor.** Porcelain tile with integral patterns. Use a dark-colored epoxy grout. Janitor's closet: sealed concrete. **Ceiling.** Epoxy painted, water-resistant gypsum board. None needed for janitor's closet.
Plumbing	Provide floor-mounted water closets and wall-hung lavatories. Provide a floor drain with trap primer in each room.
HVAC	Provide system per Chapter 3, "HVAC".
Fire Protection and Life Safety	Provide system per Chapter 3, "Fire Protection and Life Safety".
Power	Provide system per Chapter 3, "Electrical". For safety of the children, the top of the electrical outlet boxes must be 54 in. (1370 mm) above finished floor.
Lighting	Provide system per Chapter 3, "Electrical". The lights in the janitor's closet must be controlled automatically to remain on during facility operating hours.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **Intercom.** None required. **Telephone.** None required. **Data.** None required.
Security System	None required.
Acoustics	Design space to comply with Chapter 3, "Interior Acoustics".
Casework/ Built-in Equipment	Solid-surface countertop with either underhung or integral sink. Mirror. Toilet accessories: toilet paper dispensers, paper towel dispenser with integral trash receptacle, robe hooks, grab bars, sanitary napkin disposal, seat cover dispensers, and soap dispensers. Fold-down diaper changing table/station.
Type 1 FF&E	Provide lockable cabinets for cleaning supplies and maintenance cart for Janitor's Closet.
Type 2 FF&E	None required.
Special Req.	Provide a Janitor's closet associated with or in proximity of these toilets. This closet includes a floor mop sink with hot and cold water and a hose connection, a floor drain, and storage for pails, mops, vacuums, and related cleaning supplies and equipment. Include an outward-swinging, lockable door with a vision panel per Chapter 3, "Interior Construction" that can be opened from the inside without a key.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-8. Kitchen

Description/ Usage	CDC kitchens support food preparation, food and supply storage, delivery of snacks or meals to CARs, sanitation (washing of dishes, utensils, pots, pans, etc.), and storage of food service equipment, flatware, and dishes. Locate kitchen adjacent to an exterior wall and the service area. It requires a direct service entrance from the outside that does not cross any outdoor areas. Provide direct pathways from the kitchen to the CARs that do not pass through the lobby or other functional areas for food cart transport.
Ceiling Ht.	9 ft. (2.74 m) minimum.
Windows/Doors	Provide windows and doors per Chapter 3, "Windows and Doors and Interior Construction".
Finishes	**Walls.** Epoxy painted mold-resistant gypsum wall board. Food prep areas will have ceramic tile with dark-colored epoxy grout or stainless steel wall finish. The walls must be impact resistant up to 48 in. (1220 mm) from finished floor; consider using FRP panels. **Floor.** Quarry tile with epoxy grout or liquid applied flooring designed for commercial kitchens. **Ceiling.** High humidity-rated, ceramic-faced ACP.
Plumbing	Provide hand-washing sinks at each entrance; a two-compartment food preparation sink; a three-compartment, deep dishwashing sink with a gooseneck faucet. Provide a hot water booster to 180°F (82°C) to the dishwashing sink and to the heavy-duty, commercial-grade dishwasher. Provide a floor drain. **Service Exception:** Navy does not permit ice makers. CDC kitchens will typically use grease interceptors in lieu of central grease traps to service individual equipment. Locate them to be easily accessible for cleaning, be located outside of food preparation areas, and not project above the floor in open walkways or work areas. Exposed covers must be rust-proof and skid resistant. If central grease traps are provided, locate them outside the building in a service area inaccessible to children.
HVAC	Provide system per Chapter 3, "HVAC".
Fire Protection and Life Safety	Provide system per Chapter 3, "Fire Protection and Life Safety". Provide a fully recessed extinguisher cabinet with a Class K fire extinguisher.
Power	Provide system per Chapter 3, "Electrical". In addition, perform a power requirement survey as this area's power requirements are extremely site- and locale-specific. Provide a dedicated electrical circuit for the cold storage.
Lighting	Provide system per Chapter 3, "Electrical".
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **Intercom.** Provide a system remote. **Telephone.** Coordinate with activity if telephone is allowed. **Data.** Provide one outlet.
Security System	None required.
Acoustics	Design space to comply with Chapter 3, "Interior Acoustics".
Casework/ Built-in Equipment	Provide minimum 24-in- (610 mm-) deep stainless steel countertop and metal cabinets and wire shelves for food, utensil, equipment and supply storage. See Appendix D for sample equipment lists.

Type 1 FF&E	See Appendix D for sample equipment lists. Provide one stainless steel food cart for every CAR and space in the kitchen to store them. Provide a small office area with desk, chair, and file storage for food and supply orders. Provide fire extinguisher.
Type 2 FF&E	See Appendix D for sample equipment lists. Computer, printer, and phone for office area.
Special Requirements	Provide air curtains or air locks on the exterior doors. Provide lockable storage for dry food storage. Deep-fat fryers are not permittedSee Appendix E for sample layouts. Comply with *USDA Program Aid Food Service Equipment Guide for Child Care Institutions.* Include a food service specialist on the design team that is a member of the Foodservice Consultant Society.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-9. Laundry.

Description/ Usage	The laundry room must be accessible only to adults. Locate it near the infant/pre-toddler CARs and an exterior wall. Room configuration and equipment must meet ABA requirements.
Ceiling Ht.	9 ft. (2.74 m) minimum.
Windows/Doors	Provide windows and doors per Chapter 3, Windows and Doors and Interior Construction.
Finishes	**Walls.** Epoxy painted CMU or water-resistant gypsum wallboard. Provide rub rails and metal/high-impact plastic corner guards. **Floor.** Sealed concrete, or seamless vinyl. **Ceiling.** Epoxy painted gypsum wallboard ceilings that comply with ASTM C1396/C1396M, Section 12, *Gypsum Ceiling Board.*
Plumbing	Provide connections to each of the washing machines and one single-compartment laundry tub, minimum size 22 in. D by 24 in. W by 13 in. (550 mm D by 600 mm W by 325 mm) depth of tub. Provide floor drains. Provide recessed plumbing cabinets for each utility connection to the machines.
HVAC	Provide system per Chapter 3. In addition, provide a minimum of six air changes per hour with all dryers running, a maximum of 50% relative humidity, and negative pressure. Each dryer must be vented directly and independently to the outside. Do not vent the dryer exhaust near a building entrance or into an outdoor play area. Provide ventilation in accordance with ANSI/ASHRAE 62.1 requirements for "Laundry Rooms, Central".
Fire Protection and Life Safety	Provide system per Chapter 3, "Fire Protection and Life Safety". Provide one-hour rated construction and 45-minute-rated door with self closer and rated vision panel—see Special Requirements. Provide a smoke detector.
Power	Provide system per Chapter 3, "Electrical". If washers and dryers are hard-wired (non-plug connected), provide wall-mounted safety disconnect switch within sight of the equipment it controls.
Lighting	Provide system per Chapter 3, "Electrical".
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **Intercom.** Provide system remote. **Telephone.** None required. **Data.** None required.
Security System	None required.
Acoustics	Design space to comply with Chapter 3, "Interior Acoustics", and provide partition construction with a minimum STC rating of 50.
Casework/ Built-in Equipment	Provide a built-in folding table and shelves for storage. Provide a spacer between the dryers and the wall to preclude the dryer vent from become compressed due to dryer movement.
Type 1 FF&E	Provide large, heavy-duty, front-loading residential washers and dryers: • Small. One washer and two dryers. • Medium. Two washers and three dryers. • Large and Extra Large. Two washers and three dryers. Covered containers for soiled laundry.
Type 2 FF&E	None required.

Special Req.	Achieve the one-hour rating with rated wall assemblies that extend to roof deck. Provide easy access to rear of dryers to allow easy maintenance and cleaning of vents (see HVAC). Coordinate door openings and dimensions with room layout and equipment sizes, e.g., laundry carts, washers, dryers. Provide acoustical measures to control the noise/vibration of the washers and dryers. The laundry room should not be visible from the lobby area.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

4-3 CHILD ACTIVITY AREAS.

Tables 4-10 through 4-10.4 provide the criteria for the CARs and their subspaces. Table 4-11 provides the criteria for the optional multipurpose room. Criteria for the outdoor activity areas are provided in Chapter 5.

The child interest centers described in Table 4-10.4 are the required subareas of the activity space within the CAR. They are defined primarily through operational considerations, such as furniture placement, but it will be helpful for the designer to understand the types of activities that will take place in these rooms. Not every CAR will include all these subspaces.

Table 4-10. Child Activity Rooms

Description/ Usage	Provides age-appropriate child activity areas and functional support spaces in a self-contained environment. These rooms are sized per Chapter 2, "Child Activity Rooms". Activities include developmental, play, eating, sleeping, and all other activities pertaining to a child's care. See special requirements for age-specific design considerations. See Tables 4-10.1 through 4-10.3 for subspaces of the CARs.
Ceiling Ht.	8 ft. (2.44 m) minimum; 9 ft. (2.74 m) maximum.
Windows/Doors	Provide windows and doors per Chapter 3, Windows and Doors and Interior Construction. **Provide** full-lite doors at all CARs. Provide interior windows from activity rooms to corridors at 42 in. (1070 mm) above finished floor, a minimum of 36 in. (915 mm) high, and a minimum of 15 $ft.^2$ (1.39 m^2) total window area (no horizontal members blocking view of either adults or children). Do not use folding or sliding doors. Provide finger guards on the hinge edge of both the interior and exterior sides of all activity room doors up to 48 in. (1220 mm) minimum above finished floor. Plastic accordion-style finger guards are not allowed. In cold climates, provide a vestibule at the exterior exit. One vestibule can serve two rooms. If a vestibule is provided, comply with Chapter 3, but use a non-latching type interior door with a hydraulic door closer and integral hold-open device and only install panic egress hardware on the exterior door. Exterior doors must be designed to open and allow easy maneuverability of the evacuation cribs onto the paved egress path.

Table 4-10. Child Activity Rooms

Finishes	**Walls.** Provide high performance architectural latexcoated (MPI no. 140) dual-layer gypsum board with outside layer of lower 4 feet of wall being impact resistant. Provide continuous vinyl bumper rail at the selected crib/equipment heights. Provide heavy vinyl bumpers on all corners. **Floor.** Seamless rubber, sheet vinyl or linoleum sheet with resilient base. See Tables 4-10.1 through 4-10.4 for flooring requirements for specific subspaces. **Ceiling.** ACP.
Plumbing	See Tables 4-10.1 through 4-10.3 for subspace plumbing requirements.
HVAC	Provide system per Chapter 3. In addition, maintain 35 to 50% humidity and maintain 68°F (20°C) minimum and 78°F (26°C) maximum. Use general ventilation rates per ANSI/ASHRAE 62.1, "Education Facilities, Daycare (through age 4)." See Tables 4-10.1 through 4-10.3 for ventilation rates of subareas. Provide DDC temperature sensor mounted in wall recess at 12 in. (305 mm) above finished floor for monitoring only. Provide uniform air velocities of no more than 30 ft. (9.14 m) per minute 12 in. (305 mm) from the floor in all child activity spaces, unless otherwise noted. For safety of the children, provide individual room control and locate thermostats 54 in. (1370 mm) above the floor. Incorporate night and weekend setback capability. Use room thermostats that adjust accordingly to maintain the appropriate temperature as measured by the DDC sensor. Locate or protect heating surfaces to ensure children cannot come in contact with surfaces above 110°F (43°C). Do not specify equipment that interrupts continuous and flat wall space at child levels that could accommodate perimeter activity areas. In climate zones 5 through 8 provide a supplemental, under-floor, hydronic radiant heating system in infant and pre-toddler CARs. Radiant floors must have in slab temperature sensors. Provide under floor slab R-10 insulation for climate zones 3 through 7 and R-15 insulation for climate zone 8.
Fire Protection and Life Safety	Provide system per Chapter 3, Fire Protection and Life Safety. Do not provide exit signs in the room. Provide a manual pull station at the exterior door.
Power	Provide system per Chapter 3, Electrical. Coordinate all powered equipment locations with the program personnel identified in Chapter 1, Regulatory Authorities, and place outlets accordingly to eliminate the need for extension cords. For safety of the children, the top of the electrical outlet boxes must be 54 in. (1370 mm) above finished floor. In infant and pretoddler CARs, coordinate the location of cribs with the personnel identified in Chapter 1, Regulatory Authorities, and do not locate outlets within reach of children in cribs. This may require deviations from the frequency and height of outlet criteria noted above and must be carefully coordinated with program personnel.
Lighting	Provide system per Chapter 3, Electrical. Provide lighting with automatic controls and multi-level switching. Maintain a minimum of 1 fc (10 lux) at all times to accommodate child observation requirements but do not exceed 5 fc (50 lux) for sleeping. Normal operating light levels are 20 fc (200 lux) general ambient and 30-40 fc (300-400 lux) task lighting at the counters. Provide emergency lighting to illuminate the entire room floor area to a minimum of 1 ft. candle (10 lux).
Communication	**CCTV.** Provide a minimum of two outlets and ensure full coverage. **CATV/Internal Video.** Provide one outlet. **Intercom.** Provide hands-free capability and system remote with a handset for private conversations. **Telephone.** None permitted. **Data.** Provide outlets as required for equipment.
Security System	None required.

Table 4-10. Child Activity Rooms

Acoustics	Design space to comply with Chapter 3, Interior Acoustics, and provide partition construction with a minimum STC rating of 50. The CAR's anticipated peak noise level is 70-80 dBA. The preferred sound level is 35-40 dBA, maintained for at least 80 percent of the time.
Casework/ Built-in Equipment	**Cubby Storage Area.** Provide pre-manufactured, compartmentalized, open-front cubbies with top shelf, anchored to the floor and/or wall. Provide an individual cubby for each child. Provide 36 in. (915 mm) of clear space directly in front of cubbies. • Infant/Pre-toddler. Provide 10 individual 12-in.-wide, 18-in.-high, and 15-in.-deep (305-mm x 455-mm x 380-mm) cubbie compartments. Cubby units must have solid raised base for floor applications. • Toddler/Preschooler. Provide 14 individual 12-in.-wide, 42-in.-high, and 15-in.-deep (305-mm x 1,220-mm x 380-mm) cubbie compartments. Provide two safety hooks in each cubbie. Provide a 10-in-high (255-mm) bench for child use. • Preschooler/Pre-K/K. Provide 24 individual 12-in.-wide, 42-in.-high, and 15-in.-deep (305-mm x 1,220-mm x 380-mm) cubbie compartments. Provide two safety hooks in each cubbie. Provide a 10-in-high (255-mm) bench for child use. **Other.** Provide magnetic locks to any storage cabinets within a child's reach that allow a child to open the door from the inside. • Infant/Pre-toddler. Provide a minimum of 60 in. (1525 mm) linear length of 1- to 1.2-in.- (25- to 30-mm-) diameter grab bars with rounded corners at 18 in. (455 mm) above finished floor level to aid infants to pull to standing position. Provide a shatter-resistant child safety glass mirror with safety edges. Locate the bottom edge at finished floor and the top at a minimum of 30 in. (760 mm) above finished floor. Laundry equipment is not permitted in the CARs. Provide a parent-teacher board at the entry to each of the CARs. Provide CCTV cameras, with a minimum of two, to ensure full coverage of all areas within room.
Type 1 FF&E	See Appendix D for more information on FF&E. **Infant/Pre-toddler.** Cribs used for sleeping and emergency evacuation. Cribs must be of durable construction, be narrow enough to pass through a door with a 32 in. (813 mm) clear opening, and have sturdy caster wheels approximately 4 in. (100 mm) in diameter. The evacuation crib must be able to support and transport a minimum of four 18-month-old children weighing a total of 120 lbs. (55 kg).
Type 2 FF&E	See Appendix D for more information on user-provided FF&E.
Special Requirements	**Room Design.** The ideal room width to length ratio is 3:2. Do not create blind spots in the room and ensure that caregivers have full visual access over all areas of the room without the use of mirrors to achieve full visual access. Color-coding can be used to differentiate spaces for each age group or activity room. **Interior construction.** Construct a partitioned, lockable general storage closet sized per Chapter 2, Child Activity Rooms, that can be opened from the inside without the key. The closet door must have a vision panel per Chapter 3, Interior Construction. Provide adjustable shelving in the closet; leave open floor space for stacked cot storage. Demountable and retractable partitions are not permitted in the CAR. **Infant/Pre-toddler.** Cribs must be directly observable by caregivers. Indicate location on plans of all major equipment using dotted lines to ensure proper fit and clearances. **Toddler/Preschooler.** Provide wider pathways to and within uninterrupted activity space to accommodate increased mobility. **Preschooler/Pre-K/K.** The uninterrupted activity space must be a large, open, flexible area that allows unrestricted movement.

Table 4-10. Child Activity Rooms

For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-10.1. CAR Toilets

Description/ Usage	Provides age-appropriate toilet for children only. Where information is not provided in this table, use the criteria in the child activity room table.
Finishes	**Walls.** Provide high performance architectural latex coated (MPI no. 140) paint on mold-resistant gypsum wall board with an FRP wainscot. **Floor.** Seamless rubber sheet goods with the edges turned up the walls a minimum of 6 in. (150 mm) to form an integral coved base. **Ceiling.** ACP.
Plumbing	Sinks must have single-action, pre-mixing, automatic shut-off controls mounted within 14 in. (355 mm) of the leading edge of the lavatory. Provide a floor drain. **Infant/Pre-toddler.** Provide one child water closet with a rim height of 10 in (250 mm) and flush controls 20 to 30 in. (510 to 760 mm) above finished floor. Provide one child hand-washing sink, 18 - 20 in. deep, mounted at 22 in. (550 mm) above finished floor with 19 in. (480 mm) clearance for knee space. **Toddler/Preschooler.** Provide a minimum of two child water closets with a rim height of 11 in (280 mm) and flush controls 20 to 30 in. (510 to 760 mm) above finished floor. Provide two child hand-washing sinks, 18 - 20 in. deep mounted at 22 in. (560 mm) above finished floor with 19 in. (480 mm) clearance for knee space. **Preschooler/Pre-K/K.** Provide a minimum of two child water closets with a rim height of 12 in (280 mm) and flush controls 20 to 30 in. (510 to 760 mm) above finished floor. Provide two child hand-washing sinks, 18 - 20 in. deep mounted at 22 in. (560 mm) above finished floor with 19 in. (480 mm) clearance for knee space.
HVAC	Provide 200 cfm (94 L/s) exhaust over the general toilet area. Exhaust to operate continuously when lights are on in the CAR.
Casework and Built-in Equipment	Provide toilet-tissue dispenser at each water closet at 14 in (355 mm) above finished floor and within reach of a child on the water closet. Provide a hands-free paper towel dispenser without serrated edges at each lavatory. Provide a shatter-resistant mirror over the sink with the bottom edge no higher than 29 in (740 mm) above finished floor. Also provide an additional full-height shatter-resistant child safety glass mirror with safety edges and the bottom edge no higher than 18 in (455 mm) above finished floor. **Toddler/Preschooler.** Provide partitions between the water closets with the bottom of the partition at 9 in (230 mm) above finished floor and the top of the partition no higher than 36 in (915 mm). **Preschooler/Pre-K/K.** Provide partitions between the water closets with the bottom of the partition at 6 in (150 mm) above finished floor and the top of the partition no higher than 42 in (1065 mm). If a school-age care program is combined with a CDC, see Chapter 2, Facility Planning, for additional requirements.
Type 1 FF&E	None required.
Type 2 FF&E	None required.
Special Requirements	The water closets must not be visible from the door and corridor windows and must be screened from the rest of the room with partial height partitions constructed to 42” AFF, but no door. Design to accommodate easy supervision and the amount of congestion that can occur in the toilet, especially before meal times. **L**avatories must be located in the same space as the water closet, but open and visible to the rest of the room.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-10.2. CAR Diaper Changing Area

Description/ Usage	Provides diapering station and diaper storage in every CAR. Caregivers must have a clear view of the room while standing at the changing table. Where information is not provided in this table, use the criteria in the child activity room table.
Finishes	**Walls.** Provide high performance architectural latexcoated (MPI no. 140) dual-layer gypsum board. Provide heavy vinyl bumpers on all corners. Provide an impervious wall finish on walls directly adjacent to the changing counter that will withstand continuous cleaning. If low walls are used, provide a solid surface cap at the required height of 42" AFF. **Floor.** Seamless sheet vinyl with an integral cove base. **Ceiling.** ACP.
Plumbing	Provide one deep, underhung sink with a swivel goose neck faucet, hands-free operation with a 30 second shut-off with use of foot, automatic, or wrist blade controls. Decision for faucet control type to be made by facility operator. Provide a dedicated shut-off valve.
HVAC	Provide a minimum of 150 cfm exhaust grille directly over the diaper changing area, served by a central exhaust system that operates continuously during facility operating hours.
Power	Do not provide any receptacles in this area.
Casework/ Built-in Equipment	Provide a 34-in.-high, 24-in.-deep (865 x 610 mm) solid-surface changing counter with integral storage underneath and integral, retractable steps that lock in place. Changing counter surface must be a minimum of 36 in. (915 mm) long for the infant/pre-toddler CAR and a minimum of 48 in. (1220 mm) long for the toddler and preschooler CARs. Provide a safety lip on either side of the changing surface area that extends 3 in. (75 mm) above the surface of the mat (mats are typically 1 in. (25 mm) thick). Lip must be constructed of same material as counter. This changing surface must be directly adjacent to the sink and allow for individual to reach sink when standing at the changing area. Provide hands-free paper towel (cone-type), soap, glove, and plastic bag dispensers within reach of the caregiver at the table. Provide 10 compartmentalized cabinets 9-in.-wide, 9-in.-high, and 12-in.-deep (230 x 230 x 305 mm) for storage of diapers and products. Ensure that cabinets do not inhibit the child from standing on the changing surface.
Type 1 FF&E	Two foot-operated, covered containers within reach of the caregiver standing at the changing table: one for soiled disposable diapers and one for laundry. The diaper container must be waterproof, washable, and have an airtight lid.
Type 2 FF&E	None required.
Special Requirements	Provide magnetic locks to any storage cabinets within a child's reach that allow a child to open from the inside.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-10.3. CAR Adult Sink with Counter

Description/ Usage	Provides space to store and heat individual bottles and food in every CAR. This area must be physically separated from the Diaper Changing Area. Where information is not provided in this table, use the criteria in the child activity room table.
Finishes	**Walls.** Provide high performance architectural latexcoated (MPI no. 140) dual-layer gypsum board. Provide heavy vinyl bumpers on all corners. **Floor.** Seamless sheet vinyl with resilient base. **Ceiling.** ACP.
Plumbing	Provide one sink with a single-lever faucet and a dedicated shut-off valve.
Power	Provide a duplex outlet for the refrigerator. Provide a counter-height GFCI duplex receptacle at least 2 ft. (610 mm) from the edge of the sink for appliances.
Casework/ Built-in Equipment	Provide a 34-in.-high, 96-in.-long (865 x 2440 mm) solid-surface counter with base cabinets, the integral sink, and a 4-in. (100-mm) high, integral backsplash. The cabinets must have heavy-duty hinges, non-protruding handles/pulls/hardware, and easily-cleanable surfaces. Provide one lockable cabinet. If upper cabinets are provided, ensure the caregiver will have visual access of the room while standing at the food preparation area. Base cabinet doors and drawers must have recessed finger pulls. In infant and pre-toddler rooms, provide a 5 $ft.^3$ (.23 m^3) minimum, under-counter ADA-compliant refrigerator.
Type 1 FF&E	See Appendix D for FF&E.
Type 2 FF&E	None required.
Special Requirements	Physically separate this area from the diaper changing area to meet sanitation requirements. Do not locate this area under any sanitary or drain lines running through the ceiling. Provide magnetic locks to any storage cabinets within a child's reach that allow a child inside to open from the inside.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-10.4. Child Interest Centers

Space	Description/Functions	Design Considerations
Blocks	Out-of-way area for children to build with and to store blocks and other props.	Typically located in a corner with soft-surface flooring.
Dramatic play	Area geared for creative and imaginative play activities.	Typically includes soft-surface flooring and wall mirrors.
Toys and games	Area for table-top and floor toy and game play.	Typically double functions as eating area with child-size tables and chairs and hard-surface flooring.
Art	Area for visual art activities	Typically double functions as eating area with child-size tables, chairs, and easels and hard-surface flooring. Provide means to display artwork and locate near a sink.
Library	Area for reading, writing, story telling, and storage of books and writing supplies.	Typically includes soft-surface flooring, comfortable seating, and bookshelves.
Discovery	Area for preschool children to participate in various investigation activities.	Hard-surface flooring with sensory tubs and nature collection storage.
Sand and water	Area for small-scale indoor sand and water play.	Hard-surface flooring with sand and water tubs. Locate near a sink.
Music and movement	Area for music and movement activities, including both recorded and child-generated music.	Typically includes soft-surface flooring and storage for music player, music, and instruments.
Cooking	Area for preschool children to participate in simple food preparation activities.	Hard-surface flooring with storage space for a mobile cooking cart. Locate near a sink.
Computers	Area for preschool children to access computers.	Typically includes soft-surface flooring with child-size desks and chairs.

Table 4-11. Multipurpose Room

Description/ Usage	This **optional** space accommodates children 24 months to 6 years of age for large group activities, wheel toy play, exercise, group games, or indoor play in extremely hot or cold climates. This room can also support other activities such as parenting classes and staff training. Service contacts provided in Chapter 1, Regulatory Authorities, must provide approval for inclusion of this space.
Ceiling Ht.	10 ft. (3.1 m) minimum and 12 ft. (3.7 m) maximum.
Windows/Doors	Provide windows and doors as in the CARs per Chapter 3, Windows and Doors and Interior Construction. Provide an interior window from the multipurpose room to the corridor at 42 in. (1070 mm) above finished floor, a minimum of 36 in. (915 mm) high, and a minimum of 10 $ft.^2$ (.93 m^2) total window area (no horizontal members blocking view of either adults or children). Do not use folding or sliding doors. Provide finger guards on the hinge edge of both the interior and exterior sides of all activity room doors up to 48 in. (1220 mm) minimum above finished floor. Plastic accordion-style finger guards are not allowed.
Finishes	**Walls.** Provide high performance architectural latexcoated (MPI no. 140) dual-layer gypsum board. Provide heavy vinyl bumpers on all corners. **Floor.** Seamless sheet vinyl with resilient base. **Ceiling.** ACP.
Plumbing	None required.
HVAC	Provide system per Chapter 3, HVAC. In addition, maintain 35 to 50% humidity, and maintain 68°F (20°C) minimum and 78°F (26°C) maximum. Exhaust rates must match child activity areas. Provide DDC temperature sensor mounted in wall recess at 12 in. (305 mm) above finished floor for monitoring only. Provide uniform air velocities of no more than 30 ft. (9.14 m) per minute 12 in. (305 mm) from the floor in all child activity spaces, unless otherwise noted. For safety of the children, provide individual room control and locate thermostats 54 in. (1370 mm) above the floor. Incorporate night and weekend setback capability. Use room thermostats that adjust accordingly to maintain the appropriate temperature as measured by the DDC sensor. Locate or protect heating surfaces to ensure children cannot come in contact with surfaces above 110°F (43°C). In climate zones 5 through 8 provide a supplemental, under-floor, hydronic radiant heating system in infant and pre-toddler CARs. Radiant floors must have in slab temperature sensors. Provide under floor slab R-10 insulation for climate zones 3 through 7 and R-15 insulation for climate zone 8.
Fire Protection and Life Safety	Provide system per Chapter 3, “Fire Protection and Life Safety”.
Power	Provide system per Chapter 3, “Electrical”. Coordinate all powered equipment locations with the program personnel identified in Chapter 1, Regulatory Authorities, and place outlets accordingly to eliminate the need for extension cords. For safety of the children, the top of the electrical outlet boxes must be 54 in. (1370 mm) above finished floor.
Lighting	Provide system per Chapter 3, Electrical. Provide emergency lighting to illuminate the entire room floor area to a minimum of 1 ft. candle (10 lux).

Table 4-11. Multipurpose Room

Communication	**CCTV.** Provide outlets required for full coverage **CATV/Internal Video.** Provide one outlet. **Intercom.** Provide system remote with a handset for private conversations. **Telephone.** None required. **Data.** Provide outlets as required for equipment.
Security System	None required.
Acoustics	Design space to comply with Chapter 3, “Interior Acoustics”, and provide partition construction with a minimum STC rating of 50.
Casework/ Built-in Equipment	Provide a lockable storage closet that can be opened from the inside without a key. Provide CCTV cameras, with a minimum of two, to ensure full coverage of all areas within room.
Type 1 FF&E	None required.
Type 2 FF&E	None required.
Special Requirements	Provide natural light from non-breakable skylights or a clerestory. Demountable and retractable partitions are not permitted in the multipurpose room.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-12. Nursing Room

Description/ Usage	This space provides privacy for a mother to nurse her child. Locate near the infant and pre-toddler rooms.
Ceiling Ht.	8 ft. (3.1 m) minimum and 10 ft. (3.7 m) maximum.
Windows/Doors	Provide windows and doors per Chapter 3, "Windows and Doors and Interior Construction". Windows and doors require privacy while in use.
Finishes	**Walls**. Painted gypsum wall board. **Floor**. Seamless sheet vinyl with resilient base. **Ceiling**. ACP.
Plumbing	Provide integral sink as described in "Casework/Built-in Equipment".
HVAC	Provide system per Chapter 3, "HVAC".
Fire Protection and Life Safety	Provide system per Chapter 3, "Fire Protection and Life Safety".
Power	Provide system per Chapter 3, "Electrical". Provide a quad outlet over counter.
Lighting	Provide system per Chapter 3, "Electrical". Lights remain on during operating hours with dimming capability.
Communication	**CCTV**. None required. **CATV/Internal Video**. None required. **Intercom**. Provide system remote with a handset for private conversations. **Telephone**. None required. **Data**. None required
Security System	None required.
Acoustics	Design space to comply with Chapter 3, "Interior Acoustics".
Casework/ Built-in Equipment	Provide a diaper changing counter with integral storage underneath for the infants/pre-toddlers as described in Table 4-10.2, CAR Diaper Changing Area. Also provide a counter with base cabinets and an integral sink as described in Table 4-10.3, CAR Adult Sink with Counter.
Type 1 FF&E	None required.
Type 2 FF&E	None required.
Special Requirements	None required
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

Table 4-13 Nurses Office

Description/ Usage	This **Marine Corps**-only space provides a private room to isolate a sick child from the rest of the children until a parent can pick him or her up. Locate in the Administration area.
Ceiling Ht.	9 ft. (2.74 m) minimum.
Windows/Doors	Provide windows and doors per Chapter 3, "Windows and Doors and Interior Construction".
Finishes	**Walls.** Epoxy painted gypsum wall board. **Floor.** Sheet vinyl with integral base. **Ceiling.** ACP.
Plumbing	Provide sink.
HVAC	Provide system per Chapter 3, "HVAC". Use ventilation rates per ANSI/ASHRAE 62.1, "Education Facilities, Daycare Sickroom."
Fire Protection and Life Safety	Provide system per Chapter 3, "Fire Protection and Life Safety".
Power	Provide power per Chapter 3, "Electrical". For safety of the children, the top of the electrical outlet boxes shall be 54 in. (1370 mm) above finished floor.
Lighting	Provide system per Chapter 3, "Electrical". The lights shall be controlled automatically to remain on during facility operating hours.
Communication	**CCTV.** None required. **CATV/Internal Video:** None required. **Intercom.** Provide a system remote. **Telephone.** Provide one line. **Data.** Provide one data outlet.
Security System	None required.
Acoustics	Design space to comply with Chapter 3, "Interior Acoustics".
Casework/ Built-in Equipment	
Type 1 FF&E	Provide desk with lockable file drawers, 2 chairs, lockable file cabinet and lockable medicine cabinet.
Type 2 FF&E	
Special Requirements	Provide floor space for a cot.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Customers.
Min. net m^2 (ft^2)	

CHAPTER 5 OUTDOOR ACTIVITY AREAS

5-1 INTRODUCTION/PURPOSE.

The Outdoor Activity Area provides outdoor play activities for all age groups. It supports a program of activities and, as such, is an extension of the interior activity room space.

Design the play environment to allow a wide range of movement; stimulate the senses; offer novelty, variety and challenge; and be safe and comfortable. Ensure novelty by incorporating both simple and complex features. Incorporate textures such as sand, water, grass, flowers, trees, and smooth rocks (and other artifacts of nature) within the natural environment. Incorporate manufactured textures of wood, metal and plastic as well as elements that respond when acted upon within the play environment. Design the play environment to be open to many interpretations and uses in order for the child to exercise his or her power to manipulate it. Do not design the environment to impart preconceived notions of how to act or respond to the surroundings. With appropriate supervision, children will actively manipulate, transform, dismantle, and re-create the environment in order to learn about the makeup of the world.

5-2 PLANNING CRITERIA.

5-2.1 Size.

Provide a minimum of 130 $ft.^2$ (12.1 m^2) per child for 50% of each age group's capacity. Larger outdoor activity areas can be provided if approved by the regulatory authorities in Chapter 1.

5-2.2 Grade.

Provide a minimum slope of 1 percent for all paved areas and 2 percent of all grassed areas. The maximum slope is 5 percent throughout the entire outdoor activity area.

5-2.3 Layout.

Do not create blind spots or hidden areas within the playgrounds. Ensure design accommodates adult visual supervision of children at play, and avoid creating areas where unsupervised mischief or child abuse can occur. Ensure depth of outdoor areas allow for providing emergency exit pathways, play and shade structures.

5-2.3.1 Utilize Existing Features.

Preserve natural landscape features, including existing topography, trees, and vegetation, and supplement as needed to provide a varied natural environment. Ensure that natural features such as hills and nature areas are accessible to everyone and that plants and vegetation are non-toxic and don't have seeds or other elements that could be choked on. Trees that drop nuts or species subject to high deadfall limbs are not permitted. Integrate plants into the entire play area rather than provide isolated nature areas.

5-2.3.2 Utilities.

The only utilities permitted in the outdoor activity area are those actively supporting the outdoor activity area. Do not locate mechanical equipment, transformers, storm drains, and manholes in the outdoor activity area.

5-2.3.3 Drainage.

Provide proper drainage on the site and under the playground equipment to permit use of the outdoor activity area after inclement weather. See Chapter 3, “Site Design”, for additional grading and drainage criteria.

5-2.3.4 Adjacencies.

Design outdoor play areas to directly adjoin the CDC building. Locate age-specific play areas immediately adjacent to the age-appropriate CARs. Locate play areas in view of the CARs they serve.

5-2.3.5 Access and Exiting.

Provide a minimum of two access points: One from the CAR into the outdoor activity area, and one from the outdoor activity area to the outside site. Design the outside site access point to allow the retrieval of play equipment (i.e., balls). Additionally, provide an accessible pathway between the age specific outdoor activity areas that is surfaced in a maintenance free material. Design to accommodate the movement of maintenance equipment into the play area and allow an emergency exit. Pave the main entrance pathway from the outside site into the activity areas.

5-2.3.6 Climate Considerations.

Accommodate the prevailing weather patterns that can affect children's comfort. For example, if sited in an area with prevalent northerly winds, locate the play areas on the south side of the building. Provide natural wind breaks (trees) for extra protection from the elements.

5-3 GENERAL DESIGN CRITERIA.

Design the outdoor play area to support a program of activities and be conducive to creative play. To the degree that climate permits, design the outdoor activity area to accommodate many indoor activities—it is an extension of the interior activity room space. The play program encourages children to interact with the environment, each other, and the caregivers either in free play or through planned and structured activities. A certified playground safety inspector that has current certification from the National Playground Safety Institute that is not affiliated to an equipment manufacturer must design the outdoor activity area or review and approve the final design.

Integrate play areas, to the greatest extent possible, into the overall design of the center. Ideally, design the indoor and outdoor spaces simultaneously so that a proper link can be made to join the two spaces. The outdoor activity area is divided into age-

specific areas that correspond to the facility child activity rooms. General design criteria that apply to all ages and portions of the outdoor activity area are provided below.

5-3.1 Accessibility.

It is the policy of DoD to integrate children with special needs into the outdoor play environment with their appropriate group. To accomplish this, provide a diversity of play opportunities and equal opportunity for all children regardless of ability. Discuss accessibility needs with the CDC staff before starting the design, and note the following information.

5-3.1.1 Accessibility Pathways.

Provide an accessible pathway throughout the play area. Provide a safety-surfaced path for a wheelchair to approach, but not roll onto, manufactured play equipment. Do not provide access ramps that allow trike access onto equipment. The optimum solution is to provide an accessible surface up to the equipment and provide transfer platforms to help the child onto the equipment. Design play structures and play areas to be accessible. Provide specially designed decks and railings for transfer out of wheelchairs and onto equipment.

5-3.1.2 Access to Use Zone Surfacing.

Meet zone criteria for surfacing, but also design for wheelchairs to allow accessibility where possible. Use zone criteria take priority over equipment accessibility.

5-3.1.3 Sensory Rich Materials.

Provide a variety of materials to stimulate and entertain children, including those who are visually impaired, hearing impaired or who have other special needs.

5-3.1.4 Special Requirements.

For requirements to accommodate children who are severely handicapped in the child development program, consult with the contacts provided in Chapter 1, “Regulatory Authorities”.

5-3.2 Exterior Storage.

Provide enclosed, weather-tight, vandal-proof and lockable storage in each age-specific outdoor activity area. Storage size must be 100 $ft.^2$ (9.3 m^2) per infant/pre-toddler and toddler play area, and 150 $ft.^2$ (13.9 m^2) of storage space per pre-school play area. Comply with the following:

- Locate storage to be readily accessible to the age-specific activity area and so it does not create any blind spots in any portion of the Outdoor Activity Area.
- Connect the storage to the activity areas with ABA-accessible hard-surface pathways.

- Detached facilities require ventilation only.
- The floors must be concrete sloped to the door for drainage.
- Interior clear height must be a minimum of 7 ft. (2135 mm).
- Provide heavy-duty adjustable shelving, 2’ deep, able to support 100 pounds per linear foot.
- Provide doors 4 ft. to 6 ft. (1220 mm to 1830 mm) wide with a 5 SF vision panel. Doors must swing outward, include finger guards, and be equipped with vandal-proof hardware and keyed locks that can be opened from the inside without a key.
- Where possible, locate any storage unit not physically attached to the building with the storage unit door to be in-line with the playground fence and set the rest of the storage unit outside of the playground.

5-3.3 Fencing.

At a minimum, enclose the perimeter of the entire outdoor activity area with a 5 ft. (1520 mm) high fence. Add or position planting or landscape features to preclude an adult from reaching over the fence. Facility planners must submit site plans to the contacts identified in Chapter 1, “Regulatory Authorities”, to determine if a taller fence or solid wall is required. When the outdoor activity area is adjacent to hazards, busy roadways, or is in a high security risk neighborhood, enclose the perimeter of the entire outdoor activity area with an 8 ft. (2440 mm) high fence.

Enclose each age-specific area within the perimeter with a 3 ft. to 5 ft. (915 mm to 1520 mm) high fence or provide buffer areas between age-specific areas where appropriate Buffer areas can be created by using landscape elements to divide the children from one area to another. Provide passage gates between age-specific areas.

Comply with the following in the design of the fences.

- The fence design must be compatible with the architecture of the CDC and be more than simply utilitarian. Provide a combination of fencing materials to avoid an institutional effect. Black or dark green vinyl-coated chain link is the preferred fence material. Exposed galvanized wire is not permitted. Do not make fences out of wood.
- Use bollards, raised planters, or other devices to protect play areas located next to driveways or roads where cars could swerve into the play area.
- Fences must have smooth caps, be selvage knuckled, with no finials or sharp picket tops. The fencing components must not expose sharp points or edges that could cut or puncture children's skin. All fastening devices used for fence construction must be turned sideways or must not project perpendicular to the fence surface beyond .125 in. (3.2 mm). Finials or sharp picket tops are permitted only on the 8 ft. (2440 mm) high perimeter fences.

- The fence bottom must either be secured to a bottom rail or be buried a minimum of 3 in. (75 mm) below grade.
- Fencing gaps between vertical elements, such as at gates and at connecting points to the building, must be no more than 3.0 in. (75 mm).
- No openings in the fence must be between .375 in. (9 mm) and 1 in. (25mm) in size as pinch protection.
- Additional information on entrapment dimensions is provided in *CPSC Public Playground Safety Handbook*.
- Coordinate gate sizes to accommodate the evacuation cribs (See Chapter 4, “Child Activity Rooms”).
- Perimeter emergency egress gates must only be operable from the interior side with panic hardware, have adult-controlled securing devices to prevent child operation, and pinch/crush protection on the hinges. In addition, design the gate to preclude operation by an adult reaching over the fence from the exterior side as a child-abuse prevention measure.
- Provide at least one access gate that is 10 ft. to 12 ft. (3050 mm to 3650 mm) wide for emergency or service vehicles.
- Ensure that fences do not impede caregiver supervision of children.
- Design fences to discourage climbing. Do not use horizontal slats or horizontal rails. Design walls or structures used for barriers to discourage climbing. Design fences to be capable of withstanding code specific force applied horizontally.

5-3.4 Shade.

Shade is a requirement for the CDC to receive DoD certification. Provide each age-specific activity area with a structure or structures to provide shelter from the sun and inclement weather. At a minimum, provide whichever is greater: 10 percent shaded area per each age-specific area or a minimum of 15 $ft.^2$ (1.4 m^2) per child for the maximum number of children occupying the areas at any one time (see Chapter 5, “Planning Criteria”). At a minimum, 50 percent of each play area must be exposed to direct sunlight during the morning and afternoon use periods.

Shade structures include exterior screened rooms, park shelters, awnings, porches, gazebos, and umbrellas. Supplement structures with trees and other natural landscaping. All structures must provide a minimum shaded area of 6 ft. (1830 mm) in any direction. The degree and orientation of shade will depend on local climatic conditions. Transitional areas such as a patio, deck or platform that serve as a link between interior and exterior spaces are an effective means to provide shade. All shade structures must comply with the criteria provided in Chapter 5, “Equipment Requirements”. Shade structures must conform to architectural and design guidelines of the installation.

5-3.5 Equipment Requirements.

Playground equipment must be included in the MILCON construction to provide a complete and usable facility.

5-3.5.1 Industry Standards.

Playground equipment and shade structures must comply with the minimum standards put forth in the guidelines listed below. In some cases, this FC may include more stringent requirements than those listed. In those cases, follow the criteria identified in this FC. Use the most recent editions of the following publications:

- The Consumer Product Safety Commission (CPSC) *Public Playground Safety Handbook*. (Although the CPSC provides guidelines for unsupervised public play settings for children two years and older, the CDC playground must safely accommodate supervised children as young as 6 weeks of age.)
- ASTM F1292, *Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment*.
- ASTM F1487, *Standard Consumer Safety Performance Specification for Playground Equipment for Public Use*.
- ASTM F1951, *Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment*.
- ASTM F2373, *Standard Consumer Safety Performance Specification for Public Use Play Equipment for Children 6 Months through 23 Months*.
- Accessibility. See additional information in Chapter 3, “Accessibility”.

5-3.5.2 Additional DoD Standards.

Show all use zones for play equipment on the site plan to ensure there is no conflict between play activities on the ground and swinging or jumping from the equipment. Do not overlap use zones. The minimum height above ground surface requiring a use zone is 20 in. (500 mm). As a minimum, design the infant crawl space, to include a 4 ft. (1.2 m) distance outside the infant crawl curb, as a use zone.

If young school-age children are using the playground, different use zone criteria apply.

5-3.5.2.1 Selection Criteria.

- **Range.** Provide a sufficient range of equipment to accommodate every type of play—exercise, dramatic, construction, organized games, social—engaged in by the age group served.
- **Novelty.** Select interesting play equipment with both simple and complex features. Group play equipment together to provide a sequence of play opportunities rather than providing single, large, fixed-in-place structures.

Provide for both solitary and social play. Select equipment that can be modified.

- **Flexibility.** Use composite units or super-structures that stimulate a wide range of motor functions. Provide equipment that can be used equally well by one child or by several children simultaneously. Do not select items designed to look like animal forms or other recognizable objects. Use dramatic play props that are adaptable to a range of make-believe roles or themes.
- **Challenge.** Provide equipment that provides clear, graduated stages of accomplishment, e.g., variable-height steps or climbing equipment with landings at different heights.
- **Scale.** Size equipment to match the age and development of child users.
- **Aesthetics.** Design children's playgrounds for aesthetics as well as function. Select equipment colors and styles that are appealing to children and compatible with the facility exterior. Integrate equipment with natural vegetation and landforms.

5-3.5.2.2 Installation Criteria.

The equipment purchasing agreement must include a requirement for the manufacturer to inspect the equipment after installation and confirm in writing that installation conforms to manufacturer's instructions and to CPSC and ASTM Guidelines. Also provide a contractual agreement for a skilled, certified, independent playground safety consultant that has current certification from the National Playground Safety Institute to inspect the entire playground after the installation is completed. Have experienced playground installers conduct or supervise installation.

5-3.5.2.3 Exclusions.

Do not use the following items in the outdoor activity areas, regardless of CPSC or ASTM approval:

- Animal swings, metal and otherwise.
- Wood equipment. Wood equipment is not permitted due to maintenance concerns, unless pre-manufactured and approved by the Service authorities.
- Metal slides. Metal slide surfaces are not allowed.
- Merry-go-rounds.
- Hard-seat swings.
- Trampolines.
- See-saws.
- Zip lines.

5-3.5.2.4 Exceptions and Modifications.

Observe the following exceptions and/or modifications to previous DoD policy or CPSC Handbook and ASTM requirements when selecting equipment for CDC outdoor activity areas:

- Spring toys are allowed if meeting CPSC Handbook and ASTM standards. However, this equipment is discouraged due its limited potential for creative play.
- Tunnels and tunnel slides require view panels. Specify only on preschool playgrounds.
- Use climbing structures that allow for free fall.
- Balance beam criteria vary by age group. Specify the CPSC Handbook standard for balance beams only on preschool playgrounds. For toddler playgrounds, the maximum height for a balance beam is 6 in. (150 mm).

5-3.6 Surfaces.

Use a variety of surface materials, with varying finishes, patterns, textures, and colors to stimulate interest and increase play opportunities. The outdoor activity area has four categories of surface areas with specific requirements: use zones, wheeled toy pathways, other hard surface areas, and general. Transitions between each category of surface areas must not exceed a 2 in. (50 mm) differential in elevation.

5-3.6.1 Use Zones.

Use zones are the areas under and around playground equipment and are defined by ASTM F1487. A required submittal is the commercial playground safety surface manufacturer's warranty and liability in the specifications and transfer to the Using Service. Include a written verification by the manufacturer that the playground safety surface meets the requirements of the CPSC Handbook and ASTM in the submittal section of the specifications.

The Services prefer poured-in-place resilient safety surfaces. Approval from the using Service is required for any other use zone surface material. Do not use the following surface materials:

- Engineered and natural wood fiber.
- Engineered loose rubber and ground tires.
- Any materials that are subject to compaction, ingestion, flammability, and wind dispersion.

5-3.6.2 Wheeled Toy Pathways.

Acceptable materials include concrete and stone and masonry pavers. The edge of pathways must be tapered for transitions and must not create trip hazards. Joints must be not wider than .5 in. (12 mm) because they may cause toys to tip. Adjacent grading

and/or sod installation must be within .75 in. (19 mm) of the pathway surface height and must allow for settlement to minimize replacement. Comply with the following when designing the wheeled toy pathways:

- **Modular paving.** Use non-grouted interlocking type pavers on sand placed over a continuous concrete setting bed. Install brick, stone or other non-interlocking type paving in grout over a continuous concrete setting bed. Do not install non-interlocking paving on sand in play areas, as the modular units may settle unevenly, resulting in a hazardous irregular surface. Where winter freezing is common and where poor soils occur, use a gravel base under concrete and reinforce to prevent cracking and deterioration. Integrally colored pavers are encouraged to create visual interest.
- **Concrete.** Add color additives or surface finishes to improve the appearance of concrete and reduce glare. Avoid smooth steel trowel finishes, which can become slippery when wet. Where winter freezing is common and where poor soils occur, use a gravel base under concrete and reinforce to prevent cracking and deterioration. Cast-in-place concrete over a well-compacted sub-grade is the most durable, maintenance-free paving material for hard surface areas.

5-3.6.3 Other Hard Surface Areas.

These areas include sidewalks, seating areas, patios, and areas for hard-surface games. Use a variety of surface configurations and materials for these areas. Specify compaction during construction. Sidewalks, seating areas, and patios must be concrete or stone and masonry pavers. Use brick and other types of modular paving for sidewalks to reduce the scale of these environments. The edge of sidewalks must be tapered for transitions and must not create trip hazards. Hard-surface game areas must be concrete.

5-3.6.4 General.

This encompasses any portion of the outdoor activity area not included in the other three defined areas. Use surfaces of grass or other natural landscaping. Use grass primarily in open, active play areas, passive play areas, and areas with low traffic levels. Do not use grass where wear and maintenance will become a problem. Locate grass in sunny areas where it will dry out quickly after rain. Artificial turf is not recommended for use as a playground surface; it can be abrasive and convey an unnatural impression. See Chapter 3, Landscaping, for more information on non-paved areas.

5-3.7 Plumbing.

Protect all outdoor water sources from freezing with an underground shut off valve.

5-3.7.1 Drinking Water.

Drinking water is typically provided via a portable cooler and single-use cups managed by the caregiver. However, if budget permits, provide a minimum of one outdoor

drinking fountain with mouth guard and angled jet in each activity area serving children older than 18 months. Provide outdoor fountains with frost-free operation and design to minimize clogging from sand or dirt. Use an appropriate height for the age group served, but do not exceed 24 in. (610 mm).

5-3.7.2 Hose Bibbs.

Provide a minimum of one hose bibb in each play area. Install hose bibbs in a recessed wall box to prevent impact injury. Provide hose bibbs with a frost-free water source and locate directly accessible to outside playgrounds.

5-3.7.3 Misters.

In hot, dry climates and if budget allows, provide misters. Connect misters to the potable water system and provide code-compliant back-flow prevention devices.

5-3.7.4 Irrigation System.

See Chapter 3, “Irrigation”, for system criteria.

5-3.8 Electrical.

Provide an outlet on the exterior of the building in each child outdoor play environment located at 54” above finished grade.

5-4 AGE-SPECIFIC AREA DESIGN CRITERIA.

5-4.1 Infant and Pre-toddler.

Separate but do not isolate this activity area from the other age groups. Provide a low fence, hill or other natural feature to separate crawling infants from more active toddlers, but allow easy transition between these areas. The separation must provide visual and audible connections but limit physical contact. Pre-toddlers can use either the infant area or the toddler area depending upon their level of development.

5-4.1.1 Storage.

Provide an individual 100 $ft.^2$ (9.3 m^2) of storage per room in accordance with Chapter 5, “General Design Criteria”.

5-4.1.2 Shade.

Shade is particularly important for infants and pre-toddlers. See Chapter 5, “General Design Criteria”, for additional information on shade.

5-4.1.3 Play Areas and Equipment.

Provide small steps, slopes, ground beams, climbing ramps, slight barriers and slides. If swings are provided, use belt-type baby seats with restraints.

5-4.1.4 Surfaces.

Access paths from the CDC must be concrete and double function as emergency egress paths. Modular paving must not be used in this activity area. Play area surfaces must consist of soft, resilient materials that protect crawling children and provide a comfortable surface on which to sit.

5-4.1.5 Exclusions.

Avoid excessive heights, abrupt surface level changes, and rough surfaces. The following items are not permitted in the infant/pre-toddler activity area:

- Treated wood
- Wood chips
- Pea gravel
- Pools of water

5-4.2 Toddlers.

This activity area must accommodate children playing alone, playing in pairs, and playing in small groups.

5-4.2.1 Storage.

Provide an individual 100 ft.^{2} (9.3 m^2) of storage per room in accordance with Chapter 5, General Design Criteria.

5-4.2.2 Play Areas and Equipment.

Provide the following play areas and equipment in this activity area:

- Wheeled toy path.
- Sand play area. Provide a sandbox with a retaining border that does not pose a tripping hazard, allows drainage, and will accommodate sand 18 in. to 24 in. (460 mm to 610 mm) deep. Locate the box so it is protected from the wind. Locate the box away from the entrance to the building and the drinking fountain to help alleviate concerns of tracking sand inside and clogging the fountain drain. Locate near storage. Provide raised troughs for wheelchair accessibility. If the sand area is less than 100 ft.^{2} (9.3 m^2), provide a cover. In cool, wet climates, locate sand areas in sunny locations and provide a sub-surface drain line system whenever possible to reduce dry out time. In hot, dry climates, provide shade over large sand areas to reduce heat and glare problems.
- Dramatic play area.
- Swings, space permitting. Provide 50 percent bucket-type swings and 50 percent single axis swings

- Multi-purpose area.
- Climbing equipment. Simple, versatile equipment is more appropriate for toddlers than scaled down versions of older children's play structures.
- Semi-enclosed spaces such as small play houses or climb-through tunnels. Climb-through tunnels must include vision panels.
- Small slides.

5-4.2.3 Exclusions.

Avoid excessive heights, abrupt surface level changes, and rough surfaces. The following items are not permitted in the toddler activity area:

- Treated wood
- Wood chips
- Pea gravel
- Pools of water

5-4.3 Preschoolers/Pre-K/Kindergarten.

The Preschool/Pre-K/Kindergarten activity area is larger than that required for infants and toddlers and requires more space for running and larger, more complex equipment.

5-4.3.1 Accessibility.

Preschoolers/Pre-K/K are self-mobile wheelchair users. Design this activity area to provide maximum accessibility.

5-4.3.2 Storage.

Provide an individual 150 $ft.^2$ (13.9 m^2) of storage per room in accordance with Chapter 5, General Design Criteria.

5-4.3.3 Play Areas and Equipment.

Provide the following play areas and equipment in this activity area:

- Wheeled toy path.
- Dramatic play area. Provide a larger, open-ended play superstructure offering many activities, but include elements such as playhouses, stages and props. Position these elements within the play area to allow the dramatic play to spill out and flow into other spaces. Place dramatic play materials and equipment in close proximity to each other and to wheeled vehicle paths.
- Construction area. Provide space for children to build freeform items and structures. Locate near storage for access to building materials, including blocks, wood boards, PVC pipe, paint, carpentry tools, ropes, and balls.

- Multi-purpose area.
- Swings. Locate swings along the perimeter of playground areas and provide adequate safety areas around swings to prevent conflicts with other activities. Use a flexible material for swing seats, such as the rubber belt-type, to avoid impact injuries. Hard seat swings are not allowed. Design swing top rails to not exceed 8 ft. (2.4 m) for children under four years old.
- Ball play area.
- Quiet activity space.
- Garden.
- Composite structure for climbing.
- Sand and water play. These areas should be adjacent to one another. Provide raised troughs for wheelchair accessibility to sand play area.
- Covered porch area. For use of musical devices, painting materials, chalkboards.

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APPENDIX A REFERENCES

AMERICAN NATIONAL STANDARDS INSTITUTE

http://ansi.org/

ANSI Z97.1, *Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test*

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS

http://www.ashrae.org

ANSI/ASHRAE 62.1, *Ventilation for Acceptable Indoor Air Quality*

ARCHITECTURAL WOODWORK INSTITUTE

http://www.awinet.org

AWI Quality Standards Illustrated

ASTM INTERNATIONAL

http://www.astm.org

ASTM C1396//C1396M, Standard Specification for Gypsum Board, Section 12, Gypsum Ceiling Board

ASTM F1292, *Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment*

ASTM F1487, *Standard Consumer Safety Performance Specification for Playground Equipment for Public Use*

ASTM F1951, *Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment*

ASTM F2373, *Standard Consumer Safety Performance Specification for Public Use Play Equipment for Children 6 Months through 23 Months*

CARPET AND RUG INSTITUTE

http://www.carpet-rug.org

Green Label Program

INTERNATIONAL CODE COUNCIL

http://www.iccsafe.org

International Building Code (IBC)

MASTER PAINTER'S INSTITUTE (MPI)

http://www.paintinfo.com

Approved Products

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

http://www.nfpa.org

NFPA 101, *Life Safety Code*

NFPA 13, *Installation of Fire Sprinklers*

NFPA 72, *National Fire Alarm and Signaling Code*

NFPA 96, *Ventilation Control and Fire Protection for Commercial Cooking Operations*

NFPA 720, *Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment*

PETERSON FIELD GUIDES

A Field Guide to Venomous Animals and Poisonous Plants, http://www.houghtonmifflinbooks.com/peterson/

UNITED STATES ACCESS BOARD

http://www.access-board.gov/

Architectural Barriers Act Accessibility Standard, http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/aba-standards

UNITED STATES CONSUMER PRODUCT SAFETY COMMISSION

http://cpsc.gov/

CPSC Public Playground Safety Handbook

16 CFR, Part 1201, *Safety Standard for Architectural Glazing*

UNITED STATES DEPARTMENT OF DEFENSE

http://www.dtic.mil/whs/directives/

DODI 6060.2, *Child Development Programs (CDPS*)

UNITED STATES DEPARTMENT OF DEFENSE, UNIFIED FACILITIES CRITERIA (UFC) PROGRAM

http://dod.wbdg.org

UFC 1-200-01, *General Building Requirements*

UFC 2-000-05N (P-80), *Facility Planning Criteria for Navy/Marine Corps Shore Installations*

UFC 3-101-01, *Architecture*

UFC 3-201-01, *Civil Engineering*

UFC 3-201-02, *Landscape Architecture*

UFC 3-401-01, *Mechanical Engineering*

UFC 3-410-01, *Heating, Ventilating and Air Conditioning Systems*

UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls*

UFC 3-600-01, *Fire Protection Engineering For Facilities*

UFC 4-021-01, *Design and O&M: Mass Notification Systems*

UFC 4-021-02, *Electronic Security Systems*

UFC 4-022-03, *Security Fences and Gates*

UNITED STATES DEPARTMENT OF AGRICULTURE

http://www.usda.gov

USDA Program Aid Food Service Equipment Guide for Child Care Institutions

UNITED STATES DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

http://www.gpoaccess.gov/CFR/

29 CFR 1910.1048, *Formaldehyde*

UNITED STATES DEPARTMENT OF THE NAVY

Public Law 104-106, (10 USC 88) *Military Family Act and Military Child Care Act*, http://www.access.gpo.gov

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

http://www.epa.gov

EPA 402-R-93-071, Map of Radon Zones

EPA/402/R-92-014, *Radon Measurement in Schools*

EPA/625/R-92-016, *Radon Prevention in the Design and Construction of Schools and Other Large Buildings*

EPA 402-R-94-009, *Model Standards and Techniques for Control of Radon in New Residential Buildings*

APPENDIX B BEST PRACTICES

B-1 INTRODUCTION.

The following material identifies background information and other current, good design practices for CDCs. The designer is expected to review and interpret this guidance and apply the information according to the needs of the project.

B-2 DESIGNING FOR CHILDREN.

B-2.1 Stages of Development.

Human development research indicates that there are universal, predictable sequences of growth and change that occur in children during the first years of life. Each stage is characterized by behavior that is different from that of the preceding stage. Each stage also integrates all behaviors possible at previous stages, consolidates them, and prepares for development toward the next stage. Knowledge about child development, i.e., behaviors, activities, and materials for a specific age group, and understanding about individual children's needs, must be applied to design the most appropriate learning environment.

B-2.1.1 Infants.

Infancy, from birth to about 12 months, is the period when rapid changes of a child can be noted in terms of intellectual as well as physical development. This period is characterized by the sequential acquisition of abilities such as locomotion and grasping. An infant's behavior is centered on the manipulation of objects and performance of activities for the simple sensation of them.

B-2.1.2 Toddlers.

The major developmental changes from infancy to toddler-hood are the increase in physical capabilities, the use of language, and the ability to internalize thoughts. During this period a child establishes walking and running, begins to explore and experiment with the environment, and increases social experiences such as talking and seeking the attention of others. Personalities are manifested, as well as likes and dislikes. Play for these children will progress into fantasy and parallel play where, although often in groups, toddlers play without much interaction with other children.

B-2.1.3 Preschool.

The preschool age child, between three and five years, has increased control of fine motor skills, a large vocabulary, and often engages in cooperative play. These children are better able to concentrate and remember.

B-2.2 Anthropometric Guidelines.

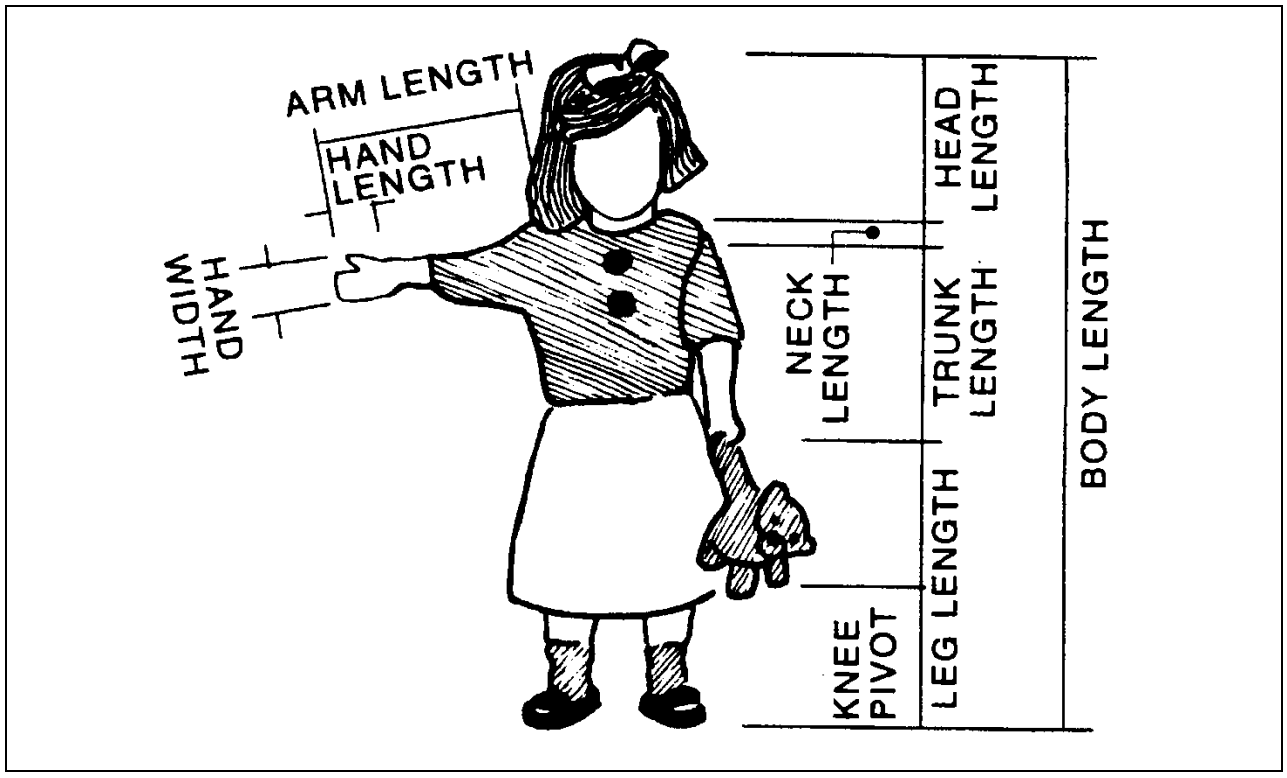
Average physical dimensions of children, according to their chronological age, are presented in Table B-1 and illustrated in Figure B-1. These figures do not apply to children with disabilities.

Table B-1. Anthropometrical Data

	Age In Years (The following dimensions represent averages)															
	Birth		0.5		1		2		3		4		5		6	
	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
Body Length	500	19.7	660	26	750	29.5	860	33.8	950	37.4	1040	41.9	1120	44.9	1170	46
Head Length	125	4.9	150	5.9	175	6.9	190	7.5	195	7.7	198	7.8	200	7.9	203	8
Head Width	97	3.8	119	4.7	132	5.2	140	5.5	142	5.6	145	5.7	145	5.7	145	5.7
Head Circum-ference	556	21.9	439	17.3	472	18.6	498	19.6	505	19.9	511	20.1	511	20.1	516	20.3
Trunk Length	211	8.3	295	11.6	320	12.6	345	13.6	363	14.3	381	15	389	15.3	399	15.7
Shoulder Width	150	5.9	178	7	203	8	224	8.8	236	9.3	246	9.7	254	10	262	10.3
Chest Circum-ference	330	13	437	17.2	475	18.7	508	20	521	20.5	528	20.8	538	21.2	554	21.8
Abdominal Circum-ference	N/A		411	16.2	445	17.5	462	18.2	470	18.5	516	20.3	518	20.4	521	20.5
Pelvic Width	81	3.2	117	4.6	130	5.1	145	5.7	157	6.2	175	6.9	185	7.3	196	7.7
Arm Length	193	7.6	254	10	305	12	371	14.6	417	16.4	424	16.7	503	19.8	533	21
Hand Length	N/A		N/A		97	3.1	107	4.2	119	4.7	124	4.9	127	5	130	5.1
Hand Width	36	1.4	41	1.6	43	1.7	48	1.9	51	2	51	2	56	2.2	58	2.3
Leg & Thigh Length	168	6.6	208	8.2	244	9.6	312	12.3	371	14.6	437	17.2	582	22.9	627	24.7
Sitting Height	N/A		447	17.6	488	19.2	538	21.2	572	22.5	597	23.5	622	24.5	635	25
Knee Width	38	1.5	N/A		64	2.5	66	2.6	69	2.7	69	2.7	69	2.7	71	2.8
Weight (Kg/lbs)	3.4	7.5	7.6	16.8	10	22	12.6	27.8	14.6	32.2	17.3	38.1	19.5	43	21	46.3
Knee Pivot to Floor	N/A		N/A		N/A		244	9.6	264	10.4	287	11.3	318	12.5	340	13.4

1 Anita R. Olds, Ph.D., ARCHITECTURAL PROTOTYPE DOCUMENT, Commonwealth of Massachusetts, 1987; Diffrient, N., Tilley, A.R., and Bardagly, J.C., HUMANSCALE 1/2/3 MANUAL, Cambridge: MIT Press, 1974; Society of Automotive Engineers, Inc., ANTHROPOMETRY OF U.S. INFANTS & CHILDREN, Michigan: 1975

Figure B-1. Anthropometric Dimensions



B-2.3 Choking Hazards.

See current edition of "Caring for Children" book (from American Academy of Pediatrics) which indicates choking guidelines and physical dimensions of children, according to their chronological age.

B-3 GENERAL DESIGN GUIDANCE.

B-3.1 Space Attributes.

The design effort must allow for, and be sensitive to, the differences in space attributes for children and those for adults as well as the differences in space usage by the children in different age groups. Information about the characteristics and activities of the children is included to provide rationale for aspects of design. The requirements and recommendations set forth in this FC are aimed at establishing optimal design, though, when appropriate, specific maximum or minimum requirements are stated. The center design must meet the needs of children, caregivers, administrators, and parents by performing the following functions:

- Support the staff's care of children by creating safe and healthy environments that allow them to focus their efforts on the care and nurture of children. Provide features that encourage positive relationships between staff, children, and parents.

- Create an environment that comfortably accommodates the needs of well-qualified staff in order to attract and retain them.
- Facilitate family involvement in the center, particularly with the child's caregivers.
- Respond to local conditions, climate, and regional preferences in the design, while also considering the goals of the parents and sponsoring agency or agencies.
- Create a safe environment for both children and staff. Design the facility to ensure that children can not leave the facility without staff knowledge. Window and door criteria in Chapters 3 and 4 support this design objective.
- Create an appropriate, well thought-out and attractive child-oriented environment. The CDC should avoid a typical institutional atmosphere; it should be inviting and feel "home-like" for the child.
- Accommodate a child's scale, including how they will use the space, what they will see, and what kind of experience they will have, i.e., design through the eyes of a child.
- Provide an intriguing environment, but one devoid of overpowering colors, features and literal themes. Too much literalness can inhibit a child's creativity.
- Size the child activity rooms to accommodate the recommended group sizes and staff-to-child supervision ratios. Efficiently use space and provide strategically situated storage to accommodate effective supervision.
- Provide durable and cost effective materials and details. A CDC is used intensely; the design must be particularly sensitive to the life cycle cost of materials.
- Create a reasonably accommodating center for staff, parents and children in a cost effective manner.
- Provide for flexibility as the installations' demographic needs change.

B-3.2 Exterior Design.

Design CDCs to reflect a residential, non-institutional character. The physical environment supports the operational quality of a center and profoundly affects the behavior and development of children, as well as the efficient functioning and sense of well being in adult caregivers. The design must be sensitive to all environmental influences without compromising the functional program requirements. Accomplish this through sensitive architectural design that addresses the issues of environment, proportion, scale, forms, landscaping, and imagery that are important in this type of facility. Choose appropriate colors and materials that are complementary to installation plans. A pleasant functional environment influences the way caregivers react to the

children. Because this facility is focused on children, use a pallet intriguing and rich but not over-stimulating or “flashy.”

B-3.3 Interior Design.

Think of the center as a “home away from home” for the child. Design the interior spaces to dispel an institutional feeling, especially if it is treated in a home-like way. One example is circulation areas that allow stopping places for social interaction. Include elements such as neutral warm colors, low-level lighting, and soft residential-type furniture to create an inviting and reassuring reception for children. Provide offices with exterior windows to the extent possible. Use finishes that feel home-like. For instance, small-scale finish materials, such as bricks, are typically preferable to large pre-cast panels. The dimension of brick is more congruent with the size of a child and his or her home experience.

Use textures to help cue children in activity areas. Provide a variety of textures on surfaces within reach of children, especially for infants and toddlers. Soft textures relax children while harder finishes and surfaces make a space noisier and more chaotic. Utilize soft textures whenever possible to promote relaxed and quiet behavior. Hard textures are more appropriate for large motor activity areas. Using subtle, varied and natural textures is highly encouraged.

B-3.4 Signage.

Interior signage and graphics are an important part of making the facility inviting to children and adults. The use of color to code different age group modules is an excellent way to create interest, identify the module and help children with a visual orientation throughout the facility. Use colors, textures, and finish materials on the walls and/or floors to define circulation patterns. Use signs with words and symbols where appropriate.

B-3.5 Site Walkways.

Develop a successful transition from the parking lot to the building entry by providing interesting walks that pass through natural or landscaped areas, wherever possible, and which overlook engaging sights such as playgrounds. Consider a child's perspective in this development.

B-3.6 Vehicular Circulation.

Private vehicle drop-off areas are not permitted within the antiterrorism stand-off distances.

B-3.7 Landscaping.

B-3.7.1 Buffers.

Consider buffering play areas from traffic with earth berms at the site perimeter of 3 to 4 ft. (900 to 1200 mm) in height with a 3:1 slope. Also consider earth berms to screen

parking and service areas. Higher berms at the site perimeter could be used to provide acoustical protection from a noise source, but the height and slope will be determined by the site and noise source specifics. To maintain supervision and safety, higher berms are only permitted on one side of the site.

In windy climates, use trees as natural windbreaks. In hot, sunny climates, use trees to supplement the required shade structures (see Chapter 5, “Shade”, for more on shade requirements).

B-3.7.2 Building Entry.

Provide colorful flowering plantings that are visually interesting throughout the seasons to create a sense of welcome for the children at the main entry.

B-4 INDIVIDUAL ROOM DESIGN GUIDANCE.

B-4.1 Entrance/Lobby/Reception.

The character of the main entry should communicate security and professionalism to the parents. At the same time, it must be fun and engaging to children. Pay attention to the design, materials, finishes, interesting volumes and colorful details.

B-4.2 Child Activity Rooms.

A prime objective of a successful design is to create conditions that allow caregivers and children to interact both verbally and non-verbally in large and small groups. To do this successfully, activity room space should not appear crowded. Include low tables and chairs and the space for caregivers to communicate individually with children. Define functional areas by furniture arrangements that vary depending upon the age group.

In order to maximize the amount of uninterrupted activity space and space devoted to childcare functions, design the circulation between the entrance and exits to be as direct as possible. Adjacent to circulation, it is appropriate to position tables and work surfaces, which tend to involve more crowded functions while retaining corners and floor area for more protected and nurturing activities.

The following practices result in the most optimum child activity room design:

- **Maintain corners.** Preserve room corners for child activity areas. Do not locate the room entrances/exits near a corner.
- **Efficiency.** Plumbing elements include child hand washing, toilets, adult sink with counter, diaper changing, and other sinks. Group the fixed elements to share a plumbing wall or minimize piping runs.

B-4.2.1 Infants.

Infants engage in crawling, walking, floor play, table play, and wheel toy play. Provide a safe, soft, stimulating environment in which babies can crawl, explore, and interact with

their caregivers. The infant room needs to be warm and nurturing in character. Because each infant may have a unique schedule, a variety of activities can take place in the infant room at any given time, ranging from playing, diaper changing, eating, sleeping, cuddling, and nursing. This variety of activities requires that quiet areas be separate from more active areas.

B-4.2.2 Pre-toddlers.

The pre-toddler activity room will hum with activity as pre-toddlers quickly move through their space, involved in all the activities available to them. Design an environment that is stimulating, offering the child a safe, yet warm and nurturing place to spend the day. Scale furnishings and equipment for this age group to encourage growth toward independence. Consider that pre-toddlers may nap more often than once a day. Pre-toddlers will gather at child-scaled tables for snacks and lunchtime. They can feed themselves with some assistance from their caregivers. In the pre-toddler open activity area, offer a range of opportunities for exploring and challenges in developing large motor skills. Design the activity area for running and cruising (movement through the space to view and select from a variety of activities) without disrupting children in other activities.

B-4.2.3 Toddlers.

Toddlers are busy experiencing their environment and developing essential motor skills as they take part in active play. In the toddler open activity area, offer a range of opportunities for exploring and challenges in developing these motor skills. Provide features such as wide access to portable platforms and generous, clear pathways that avoid sharp corners. Locate manipulative toys and materials on low, open shelving where the toddler can see and easily reach them. Though generally scale the space to child size, the activity room design must also permit caregiver access to all spaces.

B-4.2.4 Preschool.

Children at this age are actively exploring their environment; exercising large muscle skills by running, jumping, galloping, riding wheeled toys and playing various ball games. Provide a large amount of architecturally unrestricted space that caregivers and children can divide into smaller interest areas. Their level of skills enables them to take part in more advanced activities, requiring a greater number of interest areas configured for small groups of children in each area. Other activities for this group are dramatic play, music, painting, puzzles, manipulative play, block play, pre-math, reading, and writing. Preschool age children are involved in various projects, including simple food preparation, problem solving, science, and gardening.

B-5 BUILDING SYSTEMS GUIDANCE.

B-5.1 Fire Protection and Life Safety.

The following are requirements that are contained in other guidance but are frequently overlooked or misinterpreted:

- Provide tactile signage at each exit door and on interior signage to meet accessibility and life safety requirements.
- Meet sprinkler design density, design area, hose stream allowance, duration of supply, and piping materials required by UFC 3-600-01. Note that some system designs permitted by NFPA 13 are not permitted by UFC 3-600-01.
- Within the fire detection and alarm system, ensure that the visual notification appliances meet the minimum candela required for the space in which they are located including increased candela ratings in sleeping areas..
- Provide visual notification devices that flash in synchronization when more than two strobes are within an occupant's field of view. This feature reduces the potential for adverse reactions by persons subject to photosensitive epilepsy.
- Provide fire alarm reporting and mass notification system external communication capability in accordance with NFPA 72, UFC 3-600-01 and UFC 4-021-01 and that is compatible with the Installation's existing systems. Consult with the Installation since these may be sole source items.
- Keep the top 18 in. (460 mm) from the ceiling clear for sprinkler and smoke detector operation. This is often overlooked in storage rooms with built-in shelving or racks.

B-5.2 Radon.

Check the EPA's Map of Radon Zones (by state), EPA 402-R-93-071 (available from http://www.epa.gov/), to determine the radon priority area. Also, check the results of the Navy radon survey by contacting the NAVFACENGCOM Facilities Engineering Command (FEC) or Integrated Product Team (IPT) Air Pollution Engineer. Provide passive sub-slab depressurization systems for projects located in Priority Areas No. 1 (predicted average radon level is greater than 4/pCi/L). Change the system to active, if needed, based on follow-up testing. Check the following EPA documents available from the EPA Radon Information Center, (703) 356-5346:

- *EPA's Model Standards and Techniques for Control of Radon in New Residential Buildings, EPA 402-R-94-009.*
- *Radon Prevention in the Design and Construction of Schools and Other Large Buildings, EPA/625/R-92-016,*
- *Radon Measurement in Schools, EPA/402/R-92-014.*

B-6 OUTDOOR ACTIVITY AREA.

B-6.1 Play Areas and Equipment.

Turn over the sand to a depth of 18 in. (460 mm) annually and replace every two years.

B-6.2 Safety Background.

The major cause of playground injury is falling onto hard surfaces. Falls, head entrapments, strangulations, and contact with protrusions/projections on heavy swing seats account for most fatalities. Locate moving elements in areas away from natural child movement between zones.

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APPENDIX C POISONOUS AND NON-POISONOUS PLANTS

Many popular house and garden plants are considered poisonous and can produce symptoms ranging from minor to severe. Table C-1 provides a non-comprehensive list of common plants that are known to be poisonous. Table C-2 provides a list of plants for which no evidence currently exists of a poisonous quality. These lists are provided by the Maryland Poison Center. Within the United States, check with local extensions of the US Department of Agriculture for more information about the nature of common plantings in specific locations. These lists are not intended to serve as a guide for plants to use or not use but are merely provided for informational purposes. See Chapter 3 for more information on landscaping and plant selection.

Table C-1. Common Poisonous Plants

Amaryllis	Jonquil
Azalea	Lantana
Barberry	Lily-of-the valley
Black locust	Mayapple
Boxwood	Mistletoe
Caladium	Morning Glory
Castor bean	Mountain laurel
Chinaberry	Narcissus
Chinese evergreen	Nephthytis/Arrowhead
Chrysanthemum	Nightshade family
Crown of thorns	Oak (acorns)
Daffodil	Oleander
Dumbcane/Dieffenbachia	Peace Lily
English ivy	Peony
Euonymous	Philodendron family
Four o'clock	Poison ivy/oak/sumac
Foxglove	Pokeweed
Fruit pits or seeds	Pothos
Gladiola	Privet
Holly	Rhododendron
Hyacinth	Snowball bush/Hydrangea
Iris	Water hemlock
Jerusalem cherry	Wisteria
Jimsonweed	Yew

Table C-2. Common Non-Poisonous Plants

African violet	Marigold
Begonia	Mulberry (ripe berries only)
Christmas cactus	Norfolk pine tree
Coleus	Peperomia
Corn plant	(spring) Petunia
Crocus	Poinsettia*
Dandelion	Prayer plant
Dogwood	Pyracantha/Firethorn
Dracaena	Rose
Easter lily	Rubber tree plant
Ferns	Sansevieria/Snake plant
Ficus*	Scheffiera*
Forsythia	Spider plant
Fuchsia	Swedish Ivy
Geranium	Tulip*
Hibiscus	Wandering Jew
Honeysuckle	Wax plant
Impatiens	Wild strawberry/Snakeberry
Jade plant	Zebra plant
Lilac	

***** Sap may be irritating.

APPENDIX D SAMPLE FURNISHINGS, FIXTURES AND EQUIPMENT LISTS

D-1 FF&E SAMPLE LISTS.

The following list is suggested items, broken down by traditional contractor-provided FF&E and user-provided items.

Table D-1. Sample Furnishings and Equipment

Functional Area and Items	FF&E	User Provided
Administrative Areas		
Artwork	✓	
File cabinet (4 drawers or 5 drawers)	✓	
Office chair with arms, office desk, arm chair	✓	
Copy machine (floor model) and fax machine	✓	
Time clock, safe	✓	
Lounge table(s), chair	✓	
Coat rack, magazine rack(s)	✓	
Chair/table group(s), chair/couch group	✓	
Color TV(s) ,DVD(s), TV cart(s)	✓	
Clock	✓	
Cash register, calculator, computer/printer		✓
Wastebasket	✓	
Projector		✓
Interactive dry erase board		✓
Laminating machine	✓	
Book shelves	✓	
Credenza	✓	
Microwave oven, coffee maker, refrigerator, washers and dryers	✓	
Small refrigerator with lock for medications	✓	
Vacuum cleaner		✓
Maintenance Cart	✓	
Storage unit, shelving units	✓	
Infant CAR		
Cribs/mattresses	✓	
Crib sheets and blankets		✓
Adult chairs with arms	✓	
Diaper/trash containers	✓	
Music player, music boxes		✓
Low shelves	✓	
High chairs	✓	
Table(s), cube/chairs	✓	
Infant climbers with fall protection	✓	

Table D-1. Sample Furnishings and Equipment

Functional Area and Items	FF&E	User Provided
Pull toys and mobiles		✓
Banners, pictures/posters, and artwork		✓
Clock, refrigerator (under counter, 5 CF minimum)	✓	
Air purifier		✓
Diaper changing pads		✓
Bibs, sippy cups		✓
Activity boxes		✓
Nesting /stacking toys		✓
Music collections		✓
Puzzle racks, bins		✓
Pound boards, sorting boxes, balls		✓
Books		✓
Puppets		✓
Area rug(s)	✓	
Water play set	✓	
Smocks		✓
Tactile materials, bristle blocks		✓
Bye bye buggy	✓	
Pre-toddler CAR		
Cots	✓	
Cot sheets and blankets		✓
Toddler chairs, round tables, rectangular tables	✓	
Double sided, low shelving, book shelves	✓	
Sand/water table	✓	
Climber playfoam	✓	
Art easels	✓	
Fence easels	✓	
Art smocks		✓
Play kitchen, play dishes, play food, play fruit, cultural food		✓
Cook set(s)	✓	
Bye bye buggy,	✓	
Tricycles		✓
Adult chairs with arms, couch/chair	✓	
Trash containers	✓	
Music player		✓
Sand toys, push pull toys, soft blocks		✓
Puzzles, interlocking manipulatives		✓
Cars, trucks, dolls, doll carriages		✓
Banners, pictures/posters, and artwork		✓
Filing cabinet, clock, refrigerator	✓	

Table D-1. Sample Furnishings and Equipment

Functional Area and Items	FF&E	User Provided
Air purifier		✓
Diaper changing pads		✓
Activity boxes		✓
Nesting/stacking toys		✓
Sippy cups, Bibs		✓
Music collections		✓
Puzzle racks		✓
Pound boards		✓
Rhythm instruments		✓
Hats		✓
Books		✓
Area rug(s)	✓	
Water play set	✓	
Doll high chair(s), doll bed(s), doll house(s)		✓
Science set(s), aquarium(s), magnets, stethoscope(s), and kaleidoscopes		✓
Pegs, tactile materials, bristle blocks		✓
Beads and lace		✓
Toddler CAR		
Cots	✓	
Cot sheets and blankets		✓
Toddler chairs, round tables, rectangular tables	✓	
Double sided, low shelving, book shelves	✓	
Sand/water table	✓	
Climber playfoam	✓	
Art easels	✓	
Art smocks		✓
Play kitchen, play dishes, play food, play fruit, cultural food		✓
Bye bye buggy	✓	
Tricycles		✓
Soft blocks		✓
Adult chairs with arms, couch/chair	✓	
Trash containers	✓	
Music player and music boxes		✓
Sand toys, push pull toys		✓
Puzzles, interlocking manipulatives		✓
Cars, trucks, dolls, doll carriages		✓
Banners, pictures/posters, and artwork		✓
Filing cabinet	✓	
Fence easels	✓	

Table D-1. Sample Furnishings and Equipment

Functional Area and Items	FF&E	User Provided
Clock	✓	
Air purifier		✓
Diaper changing pads		✓
Bibs, sippy cups		✓
Activity boxes		✓
Nesting/stacking toys		✓
Music collection		✓
Puzzle racks		✓
Pound boards, sorting boxes, balls		✓
Rhythm instruments		✓
Dress ups, hats		✓
Books		✓
Puppets		✓
Area rug(s)	✓	
Water play set	✓	
Doll high chair(s), doll bed(s), doll house(s)		✓
Cook set(s)	✓	
Science set(s), aquarium(s), magnets, stethoscope(s), and kaleidoscopes		✓
Pegs, tactile materials, bristle blocks		✓
Beads and lace		✓
Preschool/Pre-K/K CAR		
Cots	✓	
Cot sheets and blankets		✓
Chairs, tables, couch/chair	✓	
Double sided shelves, low shelving, book shelves	✓	
Sand/water table	✓	
Sand toys		✓
Art easels	✓	
Art smocks		✓
Play kitchen, play dishes, play food, play fruit, cultural food		✓
Tricycles		✓
Workbench(s)	✓	
Trash containers	✓	
Music player		✓
Doll carriages, doll high chair(s), doll bed(s), doll house(s)		✓
Puzzles		✓
Cars, trucks, dolls		✓
Clock, refrigerator	✓	
Dress ups, hats		✓

Table D-1. Sample Furnishings and Equipment

Functional Area and Items	FF&E	User Provided
Books		✓
60 puppets		✓
Area rug(s)	✓	
Woodwork set(s), water play set(s)	✓	
Cook set(s)	✓	
Science set(s), aquarium(s), magnets, stethoscope(s), kaleidoscopes		✓
Pegs, tactile materials, bristle blocks		✓
Beads and lace		✓
File cabinet	✓	
Parachutes		✓
Playhouses, picnic tables	✓	

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APPENDIX E SAMPLE KITCHEN EQUIPMENT

E-1 KITCHEN EQUIPMENT LISTS BY FACILITY SIZE.

The following are equipment lists for small, medium and large kitchens. The kitchen must be designed by a qualified kitchen designer – see Chapter 3 for qualifications.

The CDC kitchens are designed to support short term storage, warming and food preparation. Delivery of supplies arrives from exterior of the building and trash is removed to a dumpster along this route. Trained staff prepares and wash-up. One food delivery utility cart for each CAR is loaded with food and beverage and transported to each classroom where it remains. When meal service is complete, the cart is returned to the kitchen for wash-up and storage.

Where items in equipment lists are indicated as “Optional”, Designer of Record must consult with program authorities in Chapter 1 to confirm if item is required.

E-1.1 Small CDC.

1 Food delivery utility carts (NSF approved or equivalent standards), with three shelves of minimum shelf size 18-in. x 26-in. (455 mm x 660 mm) and overall maximum height of 34 in. (865 mm)
2 Stainless steel wall shelf over food delivery utility carts at 12 in. (305 mm) deep *
3 Trash receptacle of minimum 44 gallons (167 L) on mobile trash receptacle dolly
4 Fire protection system panel *
5 Stationary shelving units (NSF approved or equivalent standards) for dry storage
6 Reach-in freezer, single door, of 19 $ft.^3$ (.54 m^3) minimum capacity (in MILCON)
7 Hand sink, wall mounted with support brackets at each entrance *
8 Optional slicer (NSF approved or equivalent standards)
9 Food preparation stainless steel work table with turned-up rolled rim edges, 6-in. (150 mm) high back splash, drain boards, work sinks *
10 Stainless steel wall shelf over prep work sinks *
11 Stainless steel wall shelf over prep work surface *
12 Reach-in refrigerator, two door, of 46 $ft.^3$ (1.3 m^3) minimum capacity for snacks *
13 Optional mobile stainless steel mixer stand
14 Optional mixer, 12 qt. (11.4 L) (NSF approved or equivalent standards)
15 Cook's and snack preparation island stainless steel work table with counter work sink, under shelf, double sided over shelf *
16 Ceiling mounted pot rack *

17 Shelving unit (NSF approved or equivalent standards) for service dishes
18 Reach-in refrigerator, two door, of 46 $ft.^3$ (1.3 m^3) minimum capacity *
19 Stainless steel work table with cross bracing on back and sides *
20 Optional mobile food warmer with universal rack slides and maximum height of 34.25 in. (870 mm) (NSF approved or equivalent standards) *
21 Stainless steel shelf over cook's work table for spices, utensils and miscellaneous items *
22 Optional stainless steel wall shelf adjacent to the griddle for spices, utensils and miscellaneous items (may be part of restaurant range) *
23 Exhaust hood, low volume high velocity (remote make-up air, if necessary) *
24 Fire protection system, as required *
25 Restaurant range (48 in. (1220 mm) left to right) with convection oven base and cooking surface consisting of four burners and 24-in. (610-mm) wide griddle *
26 Shelving unit (NSF approved or equivalent standards) for clean pots and pans *
27 Pot and pan ware washing stainless steel table with turned-up rolled rim edges, 10 in. (255 mm) high back splash, three pot and pan washing sinks, drain boards, drain board mounted garbage disposal, vacuum breaker and open base with legs and cross bracing *
28 Optional stainless steel, wall-mounted pot rack and wall shelf *
29 Optional garbage disposal with back splash mounted pre-rinse *
30 Optional wall-mounted stainless steel dish rack shelf (42 in. (1065 mm) left to right minimum) *
31 Optional push-thru dishwasher (NSF approved or equivalent standards) *
32 Stainless steel shelving unit (NSF approved or equivalent standards) for clean dishes, pitchers, cups *
33 Office desk, single pedestal
34 Office chair
35 Wall shelf over desk *
36 Dry erase/cork board (near office desk)
* Built-in equipment

E-1.2 Medium CDC.

1 Food delivery utility carts (NSF approved or equivalent standards), with three shelves of minimum shelf size 18 in. x 26 in. (455 mm x 660 mm) and overall maximum height of 34 in. (865 mm)
2 Optional stainless steel wall shelf over food delivery utility carts (12 in. (305 mm) deep) *
3 Trash receptacle of minimum 44 gallons (167 l) on mobile trash receptacle dolly
4 Fire protection system panel *
5 Stationary shelving units (NSF approved or equivalent standards) for dry storage
6 Reach-in freezer, single door, of 19 $ft.^3$ (.54 m^3) minimum (in MILCON)
7 Hand sinks, wall mounted with support brackets at each entrance *
8 Optional slicer (NSF approved or equivalent standards)
9 Food preparation stainless steel work table with turned-up rolled rim edges, 6-in. (150-mm) high back splash, drain boards, work sinks *
10 Optional garbage disposal, control panel and back splash mounted pre-rinse *
11 Stainless steel wall shelf over prep work surface *
12 Stainless steel wall shelf over prep work surface *
13 Reach-in refrigerator, two door, of 46 $ft.^3$ (1.3 m^3) minimum for snacks *
14 Optional mobile stainless steel mixer stand
15 Optional mixer, 12 qt. (11.4 l) (NSF approved or equivalent standards)
16 Cook's and snack preparation island stainless steel work table with counter work sink, under shelf, double sided over shelf *
17 Ceiling mounted pot rack *
18 Shelving unit (NSF approved or equivalent standards) for service dishes
19 Dual temperature reach-in refrigerator/freezer with two full-length doors each of 19 $ft.^3$ (.54 m^3) minimum capacity *
20 Stainless steel work table with cross bracing on back and sides *
21 Optional mobile food warmer with universal rack slides and maximum height of 34.25 in. (870 mm) (NSF approved or equivalent standards) *
22 Stainless steel shelf over cook's work table for spices, utensils and miscellaneous items *
23 Optional stainless steel wall shelf adjacent to griddle for spices, utensils and miscellaneous items (may be part of restaurant range) *
24 Exhaust hood, low volume high velocity (remote make-up air, if necessary) *
25 Fire protection system, as required *
26 Optional griddle, (36 in. (915 mm) left to right) with convection oven base *
27 Six burner Range (36 in. (915 mm) left to right) with convection oven base *
28 Shelving unit (NSF approved or equivalent standards) for clean pots and pans
29 Pot and pan ware washing stainless steel table with turned-up rolled rim edges, 10-in. (255-mm) high back splash, three pot and pan washing sinks, drain boards, drain board mounted garbage disposal, vacuum breaker and open base with legs and cross bracing *
30 Optional stainless steel wall mounted pot rack and wall shelf *
31 Optional garbage disposal with back splash mounted pre-rinse *
32 Optional wall mounted stainless steel dish rack shelf (42 in. (1065 mm) left to right minimum) *
33 Optional push-thru dishwasher (NSF approved or equivalent standards) *
34 Stainless steel shelving unit (NSF approved or equivalent standards) for clean dishes, pitchers, cups *
35 Office desk, single pedestal
36 Office chair
37 Wall shelf over desk *
38 Vertical file, four drawer
39 Mobile shelving units (NSF approved or equivalent standards) for walk-in refrigerator

40 Walk-in refrigerator and medium temperature refrigeration system, capacity coordinated with installation and program managers *
41 Walk-in freezer, capacity coordinated with installation and program managers *
42 Dry erase/cork board (near office desk)

* Built-in equipment

E-1.3 Large and Extra Large CDC.

1 Food delivery utility carts (NSF approved or equivalent standards), with three shelves of minimum shelf size 18 in. x 26 in. (455 mm x 660 mm) and overall maximum height of 34 in. (865 mm)
2 Optional stainless steel wall shelf over food delivery utility carts at 12 in, (305 mm) deep *
3 Trash receptacle of 44 gallons (167 l)) minimum capacity on mobile trash receptacle dolly
4 Fire protection system panel *
5 Stationary shelving units (NSF approved or equivalent standards) for dry storage
6 Hand sinks, wall mounted with support brackets at each entrance *
7 Mobile, stainless steel slicer stand
8 Optional slicer (NSF approved or equivalent standards)
9 Food preparation stainless steel work table with turned-up rolled rim edges, 6-in. (150-mm) high back splash, drain boards, work sinks *
10 Optional garbage disposal, control panel and back splash mounted pre-rinse *
11 Stainless steel wall shelf over prep work sinks and drain boards *
12 Reach-in refrigerator, two door, of 46 $ft.^3$ (1.3 m^3) minimum capacity for snacks *
13 Mobile stainless, snack work table with utensil drawer, under shelf and locking casters
14 Optional mobile stainless steel mixer stand
15 Optional mixer, 20 quart (18.9 l) (NSF approved or equivalent standards)
16 Cook's island stainless steel work table with counter work sink, utensil drawer, under shelf, double sided over shelf *
17 Ceiling mounted pot rack *
18 Shelving unit (NSF approved or equivalent standards) for service dishes
19 Single section, dual temperature reach-in refrigerator/freezer with two full length doors each of 19 $ft.^3$ (.54 m^3) minimum capacity *
20 Stainless steel work table with cross bracing on back and sides *
21 Optional mobile food warmer with universal rack slides and maximum height of 34.25 in. (870 mm) (NSF approved or equivalent standards) *
22 Stainless steel shelf over cook's work table for spices, utensils and miscellaneous items *
23 Exhaust hood, low volume high velocity (remote make-up air, if necessary) *
24 Fire protection system, as required *
25 Double full size convection ovens with cook and hold feature and glass doors *
26 Optional tilting griddle/braising pan with 43 in. x 24 in. (1090 mm x 610 mm) typical cooking surface *
27 Optional stainless steel floor trough for tilting/braising pan *
28 Optional pot filler faucet. Mounted on wall or as an option with tilting griddle/braising pan *
29 Eight burner range (48 in. (1220 mm) left to right) with convection oven base *
30 Optional stainless steel wall shelf adjacent to the range for spices, utensils and miscellaneous items (may be a range option item) *
31 Shelving unit (NSF approved or equivalent standards) for clean pots and pans
32 Pot and pan ware washing stainless steel table with turned-up rolled rim edges, 10 in. (255 mm) high back splash, three pot and pan washing sinks, drain boards, drain board mounted garbage disposal, vacuum breaker and open base with legs and cross bracing *
33 Optional stainless steel wall mounted pot rack and wall shelf *
34 Optional garbage disposal with back splash mounted pre-rinse *
35 Soiled dish table with cone/drain board mounted garbage disposal and open base *
36 Wall-mounted stainless steel dish rack shelf (42 in. (1065 mm) left to right minimum) *
37 Dish washer with booster heater (NSF approved or equivalent standards) *
38 Clean dish table with open base *

39 Wall-mounted stainless steel dish rack shelf over clean dish table (42 in. (1065 mm) left to right minimum) *
40 Stainless steel shelving unit (NSF approved or equivalent standards) for clean dishes, pitchers, cups *
41 Office desk, double pedestal
42 Office chair
43 Wall shelf over desk *
44 Vertical file, four drawer
45 Combined walk-in refrigerator/freezer unit and medium and low temperature refrigeration systems *
46 Mobile shelving units (NSF approved or equivalent standards) for walk-in refrigerator/freezer
47 Dry erase/cork board (near office desk)

* Built-in equipment

APPENDIX F GLOSSARY

F-1 ACRONYMS AND ABBREVIATIONS.

ABA	Architectural Barriers Act
ACP	Acoustical Ceiling Panel
AFCEC	Air Force Civil Engineer Center
AFF	Above Finished Floor
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AV	Audiovisual
AWI	Architectural Woodwork Institute
BIA	Bilateral Infrastructure Agreement
C	Celsius
CAR	Child Activity Room
CATV	Cable television
CCTV	Closed circuit television
CDC	Child Development Center
CDH	Child Development Home
CDP	Child Development Program
CFM	Cubic feet per minute
CFR	Code of Federal Regulations
CNIC	Commander of Naval Installations Command
CO	Carbon monoxide
CPSC	US Consumer Product Safety Commission
DB	Design-Build
dBA	Decibels
DoD	Department of Defense

DoDI	Department of Defense Instruction
DVD	Digital Video Disc
EPA	Environmental Protection Agency
F	Fahrenheit
FC	Facilities Criteria
FCC	Family child care
FDC	Fire Department Connection
FEC	Facilities Engineering Command
FF&E	Furnishings, Fixtures and Equipment
FRP	Fiberglass Reinforced Plastic
Ft	Foot (feet)
GFA	Gross Floor Area
GFCI	Ground-Fault Circuit Interrupter
HAZMAT	Hazardous Materials
HNFA	Host Nation Funded Construction Agreements
HVAC	Heating, ventilating, and air conditioning
IBC	International Building Code
In	Inch(es)
IPT	Integrated Product Team
K	Kindergarten
L/s	liters per second
m	meter(s)
mm	millimeter(s)
MILCON	Military construction
MPI	Master Painters Institute

NAVFAC or NAVFACENGCOM. Naval Facilities Engineering Command.

NFA	Net Floor Area
NFPA	National Fire Protection Association
OPNAV	Chief of Naval Operations
PA	Public address
PVC	Polyvinyl Chloride
RH	Relative humidity
RFP	Request for Proposal
SF	Square Feet
SOFA	Status of Forces Agreement
STC	Sound Transmission Class
TR	Tamper Resistant (electrical outlet)
TV	Television
UAS	Uninterrupted Activity Space
UFC	Unified Facilities Criteria
USDA	United States Department of Agriculture
USMC	United States Marine Corps
VCR	Video Cassette Recorder
VCT	Vinyl Composition Tile
VOC	Volatile Organic Compounds

F-2 DEFINITION OF TERMS.

Capacity: Also Operational Capacity. The total number of children that may be cared for at any one time. See also Group and Ratio.

Child Activity Room: the architecturally defined areas in which care is provided for each group of children.

Caregiver: Individuals providing direct care services to children in CDCs. The term, as used in this document, does not denote level of education, training, or staff status. Caregivers include head teachers, assistant teachers, aides, and all others who interact with children on a routine basis for a major part of each day.

Caring for our Children: The National Health and Safety Performance Standards: Guidelines for Out-of-Home Child Care Programs.

Cubby: A relatively small storage component/shelving system, usually open to one side and can be built in or premanufactured.

Decibels:. A unit of measurement for the relative intensity of sound. From 0 (barely perceptible) to 130 (painfully loud), on average.

Gross Floor Area: The total area of all floors of a building including main building lobbies, elevator shafts, egress stairwells and exterior partitions measured to the exterior side of the exterior wall.

Group: The maximum number of children, as determined by age group, who are cared for in the same self-contained activity room. See also Capacity and Ratio.

Infant: A child 6 weeks through 12 months of age.

Mixed-age Group: A group of children in a child development program drawn from more than one age group.

Net Floor Area: The amount of occupiable space to accommodate a space requirement.

Outdoor Activity Area: the exterior, fenced space adjacent to the building that provides for supervised outdoor play activities for the child occupants of the building. It is not simply a place for “recess” but is designed to support a program of activities and be conducive to creative play. It serves as an extension of the interior activity room space.

Parents: For the purposes of this FC, “parent” is understood to include legal guardians responsible for a child.

Playground: Playground may refer to the age-appropriate areas within the outdoor activity area. The outdoor activity area is divided into at least three play areas: one for infants, one for toddlers, and one for Preschoolers/Pre-K/K. Pre-toddlers will use the

infant play area or the toddler play area, as appropriate. The term playground may also refer generically to the outdoor activity area or any of its components.

Preschool Child: A child who is 3 to 5 years old and who does not attend kindergarten or a higher grade.

Pre-toddler: A child between the ages of 12 through 24 months. This age group may also be classified as toddlers, but in this document the category has been broken down into pre-toddler (ages one to two) and toddler (ages two to three). (See Toddler.)

Primary Caregiver: Principal person identified to be responsible for an assigned group of children.

Ratio: The ratio of caregivers to children, i.e., the number of children one caregiver may be responsible for, varying by age of children. See also Group and Capacity.

School-age Child: A child who is six years of age or older or who attends kindergarten or higher.

Toddler: A child between the ages of 24 and 36 months. Children as young as 12 month old may also be classified as toddlers, but in this document the category has been broken down into pre-toddler (12 – 24 months) and toddler (24 – 36 months). (See Pre-toddler.)

Toilet: This refers to the room or space and includes both the water closet and the lavatory (sink and counter)

Uninterrupted Activity Space: space in a care area used exclusively for activity. It excludes all fixed equipment and furnishings (i.e. the diaper changing station, the food preparation station, the toileting areas, storage areas, etc.) and any dedicated circulation space.

UFC 4-740-15
14 April 2011

UNIFIED FACILITIES CRITERIA (UFC)

CONTINUOUS CHILD CARE FACILITIES



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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Center for Engineering and the Environment (AFCEE) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

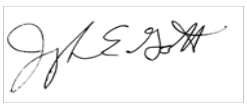
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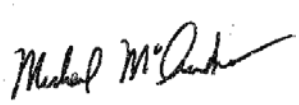
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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Document: UFC 4-740-15
Superseding: None.

Description: This UFC provides design criteria for Army, Navy, and Marine Corps Continuous Child Care Facilities. NOTE: The Air Force does not currently have a program for these facilities.

Reasons for Document: This UFC was developed to provide design requirements to accomplish the following:

- Assist planners to understand the facility requirements to ensure accurate space programs and budgets.
- Provide architects, engineers, and construction surveillance personnel with the essential, minimum requirements for the design and construction of a Continuous Child Care Facility.
- Clarify the operational intent of the facility design.

Impact: The following will result from the publication of this UFC:

- This UFC will reduce the initial cost of design and reduce costs associated with redesign of facilities that do not meet minimum standards. The design should also streamline facility operations.
- This UFC defines the primary programs accommodated by the Continuous Child Care Facility.

Non-Unification Issues: There are four minor unification issues:

- Army health regulations require an upgraded floor finish and a floor drain in the kitchen. However, all Services seek to replicate the appearance of a residential kitchen while meeting the required codes and durability goals for a government-owned facility.
- The Army does not provide an alarm on the crib/infant room exterior door.
- The Army requires a 4-ft. (1220mm) tall outdoor activity area fence versus the Navy and USMS's 5-ft. (1525mm) tall fence. The Navy requires the fence bottom to be buried.
- The Navy excludes all swing types except tire swings.

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CHAPTER 1 INTRODUCTION

1-1 SCOPE OF DOCUMENT.

This UFC provides requirements for evaluating, planning, programming, and designing Continuous Child Care Facilities (CCCFs). The information in this UFC applies to the design of all new construction projects, to include additions, alterations, and renovation projects in the continental Unites States (CONUS) and outside the continental US (OCONUS). This UFC is not intended as a substitution for thorough review during design by individual Program Managers and Operations Staff in the appropriate Service.

1-2 SCOPE OF FACILITY.

CCCFs provide around-the-clock child care to support DoD families. These facilities combine the strengths of in-home-style care with those of center-based facility care. Architecturally, the CCCF shall have the look and feel of a residential home, but it shall comply with the applicable codes and requirements in this UFC. There are two types of facilities and the facility type must be confirmed prior to project initiation with the agencies noted in Chapter 1, Program Authorities:

- Option A represents a facility that typically supports parents on shift work for whom the normal child development center (CDC) operating hours are not adequate. These children tend to only occupy the facility for the duration of one work shift and are typically limited to 12 years of age or less.

- Option B represents a facility that typically supports families of wounded warriors, shift workers, and emergency or crisis care and may on occasion accommodate an older child. These facilities also accept children for potentially longer periods of time than Option A.

These variations necessitate some changes to the bathroom configuration and minor provisions required to adapt the staff den/office to also serve as an isolation area for sick children. To accommodate the generally higher percentage of infants in Option A, a second diaper changing station is provided. The functional program spaces are listed and described briefly in Table 1-1 and described in greater detail in Chapters 2 and 4.

TABLE 1-1. CCCF FUNCTIONAL PROGRAM AREAS

Functional Program Area	Description
Foyer	Primary facility entry and ID check-in
Living room	Gathering and quiet social activity area
Play room	Gathering and play area with a variety of structured activity subareas
Dining room	Family-style dining area for all children, also accommodating table-based activities such as crafts and homework
Kitchen	Full-service, residential-style kitchen
Staff desk area	Area with a small desk for ad hoc administrative functions, typically located as part of another space
Crib/infant room	Sleeping space and infant activity area
Bedrooms	Separate rooms for boys and girls
Option A toilets	These toilets support the Option A facility configuration. They consist of unisex facilities located in close proximity to the bedrooms but also accessible from the living/activity spaces.
Option B toilets	These toilets support the Option B facility configuration. They consist of gender-specific facilities located directly off each bedroom and two separate unisex facilities located off the hall/public area.
Staff toilet	Unisex accessible toilet
Laundry	Laundry room and janitor functions
Storage closet	General facility storage
Staff den/office	Staff office that also serves as an isolation area for the Option B facility configuration
Staff storage	Area with lockable storage for staff personal items, typically located as part of another space
Outdoor storage	Storage with direct access from the outside
Outdoor activity area	Fenced activity area for all children, provided for both Options A and B
Option B outdoor activity area	A second activity area supports the Option B facility configuration and accommodates the potentially older children in a patio setting

1-3 **USERS OF FACILITY**.

The following are the typical facility users:

- Children.
- Staff. Trained staff occupies the facility at all times in numbers that meet program requirements for staff-child ratios.
- Parents. Parents typically only occupy the facility at pick-up and drop-off times.

1-4 **PROGRAM AUTHORITIES**.

Prior to project development, confirm the acquisition methodology and coordinate the design team composition and facility requirements with the following contacts for the appropriate Service:

- Army. Family Morale, Welfare, and Recreation Command (FMWRC), Child, Youth, and School Services and the Center of Standardization, Huntsville, AL.

- Navy. CNIC (N91), Navy Family Readiness, (Program Manager), and CNIC (N944A), Fleet & Family Readiness, (Facilities Support).

- Marine Corps. HQ USMC, Personal and Family Readiness Division, Construction Branch (MRD); HQ USMC, Personal and Family Readiness Division, Children, Youth and Teen Programs (MRY-3); and HQ USMC, Installations and Logistics, Land Use and Military Construction (LFL)

CHAPTER 2 PLANNING AND LAYOUT

2-1 SIZE DETERMINANTS.

CCCF size is determined by the facility configuration option (A or B) and, in some cases, the number of children to be accommodated.

2-2 SPACE PROGRAM.

An interactive spreadsheet is available to help develop a space program for a CCCF. It is completed by selecting the appropriate Service branch, the appropriate optional facility configuration, the number of children to be accommodated, if applicable, and the type of construction. Based on these three or four selections, the spreadsheet generates a draft space program. This draft program shall be confirmed with the agencies identified in Chapter 1, Program Authorities, and customized as necessary for the specific project and project site.

This spreadsheet is available as a downloadable Microsoft© Excel© file from the Whole Building Design Guide Website: http://www.wbdg.org/zips/CCCFSpaceProgramTool.zip

2-3 LOCATION DETERMINANTS.

Determine the most appropriate and cost-effective location for a CCCF based on the following factors. The agencies identified in Chapter 1, Program Authorities, shall approve the final site location.

2-3.1 Site Size.

The minimum site area for a CCCF is 2 acres (.8 ha), but additional area may be necessary. The final site area shall be determined by local conditions, the final building and site layout, and the code and military requirements identified in Chapter 3.

2-3.2 Function.

Locate the facility to serve the function and the target user groups:

- Facilities serving shift work parents shall be located near CDCs, installation family housing, or community support areas that are en route to primary shift-work areas.
- Facilities serving in-patient medical facilities should be located near those facilities.

Regardless of function served, avoid the locations noted under Chapter 2, Safety, below.

2-3.3 Safety.

Avoid locations near busy streets and intersections. If this is not possible, provide mitigation measures, such as bollards, to increase safety at pedestrian areas and playgrounds. Do not locate CCCFs directly adjacent to the following hazards or nuisances:

- Fuel or other HAZMAT storage buildings
- Maintenance shops, including woodworking and painting areas
- Dry-cleaning facilities
- Correctional/detention facilities
- Security areas
- Any facility producing odors, smoke, dust or pollution
- Explosives
- Radiation
- Utility substations and high voltage overhead power lines

Avoid locating CCCFs adjacent or near the following facilities to the degree possible based on land availability and mission:

- Service stations/convenience stores
- Unaccompanied housing facilities
- Aircraft runways/helipads (except for emergency medical facilities)
- Railroads

2-3.4 Natural Environment.

Ensure the availability of natural light in the site selection and orientation of the building. Select a site with as many natural amenities as possible for a beneficial learning environment. These include the following: nontoxic plants and trees; non-dangerous animals; earth forms; rolling terrain; and natural protection from the sun, wind and rain. Develop a site plan that makes the most of the site's existing natural resources.

2-3.5 Combined Facilities.

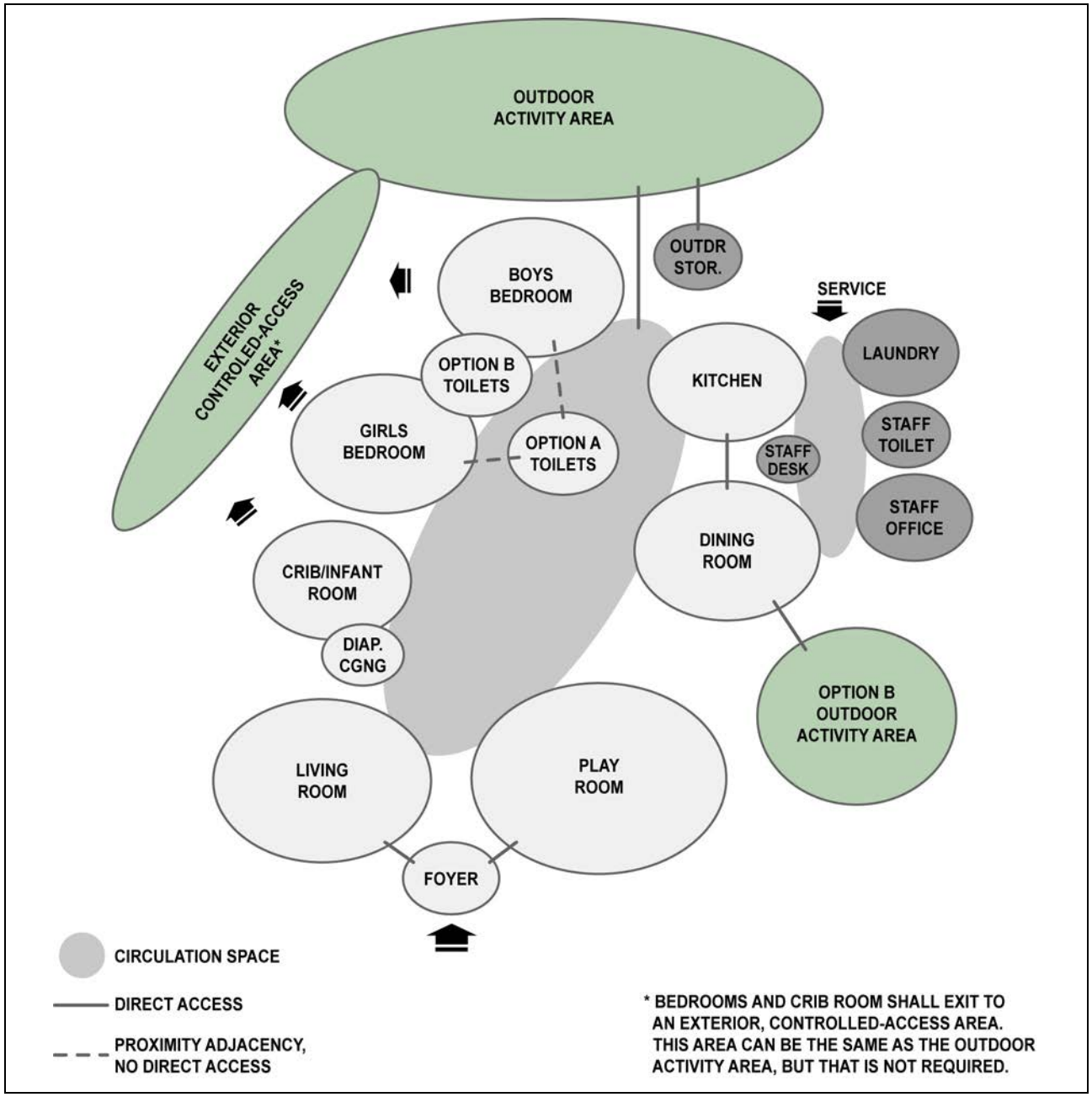
CCCFs shall not be combined with other facilities without approval by the agencies identified in Chapter 1, Program Authorities. Because of specialized operational

requirements such as evacuation drills, CCCFs shall only be approved to be combined with CDCs and School Age Care Facilities. If combined, the CCCF shall be located as a separate wing and on the ground level. Comply with Chapter 3 for fire protection separation and exit requirements.

2-4 LAYOUT AND ADJACENCIES.

The appropriate layout and adjacencies of the CCCF are illustrated in Figure 2.1. This diagram does not convey a building shape. Explore opportunities to dual-use circulation space as additional activity area for children—to the degree possible, open areas should easily flow from one to the other in order to maximize gross motor activity areas for children. See the Functional Data Sheets in Chapter 4 for additional information on the space types and their relationships to each other.

FIGURE 2-1. CCCF BUBBLE DIAGRAM



CHAPTER 3 GENERAL DESIGN CRITERIA

3-1 GENERAL.

UFC 1-200-01, "General Building Requirements" provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, sustainability, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

3-2 ACCESSIBILITY.

The specifications in UFC 1-200-01 and its references contain alternate specifications based on children's dimensions and anthropometrics for ages 3 and older. This UFC contains alternate specifications for younger children for water closets and lavatories. Also note the following guidelines for the purpose of the CCCF design:

- Children below the age of 3 years are not considered to be self-mobile wheelchair users; they are assisted and transferred by caregivers.
- Children age 3 and older are considered to be self-mobile wheelchair users.

3-3 CHILD ABUSE PREVENTION.

The facilities design is to keep children safe within the center, to safeguard them from outside intruders, and to protect them from hazards to the fullest extent possible. Visibility of all areas, interior and exterior, is a key element in the prevention of child abuse. Plan for maximizing direct visual access through building organization and design, placement of windows, toilet room design, and playground design (e.g., by eliminating walls, where possible, or using half walls, CCTV, vision panels, and convex mirrors). See 3-8.2 CCTV for details.

3-3.1 Building Perimeter.

Treat the perimeter of the building and play yards as a controlled filter with only one primary means of public access and egress. Control all service and emergency points, with access limited to authorized individuals.

3-4 ARCHITECTURE.

3-4.1 Stories.

CCCFs shall be one-story buildings constructed at or near grade.

3-4.2 Exterior Design.

The design shall reflect a residential, non-institutional character. For example, small-scale finish materials, such as bricks, are preferable to large pre-cast panels. The dimension of brick is more congruent with the size of a child and his or her home experience. Minimize the use of irregular geometry in the overall building design that results in wall angle other than 90 degrees in the bedrooms and living/activity spaces.

3-4.2.1 **Entrance**.

The building and the outdoor activity areas shall each have only one primary means of public access. Control all other service and emergency egress points, with access limited to authorized individuals. Design the entry approach to be visible by inside staff. Incorporate a point of reference or landmark that serves as a welcome and a transition. Visually separate the primary entrance from other entrances and service areas.

3-4.2.2 **Roof.**

Roofs shall be steep sloped.

3-4.2.3 **Windows and Doors.**

Windows and doors shall replicate a residential style and scale. Provide window area in each child-occupied room to meet the LEED® credit for Daylight and Views and provide operable windows in climates where appropriate to take advantage of natural ventilation, reducing the amount of mechanical ventilation as allowable by code.

The operable portion of windows shall be a minimum of 36 in. (915mm) above finished floor, such as a single-hung, top-operable unit. Operable windows shall include screens. Locate all windows so that children have visual access to the outside with a maximum sill height of 24 in. (610mm) above finished floor. Casement and other projecting-type windows shall not project beyond wall thickness.

3-4.3 **Interior Design.**

Design the interior spaces to dispel an institutional feeling, and use residential-style layouts, scales, and finishes. Ensure collaboration between interior designer, architect, and the agencies identified in Chapter 1, Program Authorities.

3-4.3.1 **Interior Doors and Windows.**

3-4.3.1.1 **Interior Glass.**

All interior glass must be tempered safety glass at a minimum and mirrors must be constructed with break-resistant materials. Laminated interior safety glass is preferred if budget allows.

3-4.3.1.2 **Interior Doors.**

Interior doors shall be solid wood panel. Provide vision panels at adult and child viewing heights in all doors, including closets and storage rooms, except toilets. Vision panels shall be sized and placed so a person opening the door can see if children are sitting or standing in front of the door.

Install hinge finger-pinch protection devices wherever doors are accessible to children. All locking doors shall be operable from the inside without a key and with a single motion (emergency passage).

3-4.3.2 **Window Treatments.**

All window treatments shall be either cordless, have cords that are out of reach of children, or have continuous-loop cords that are permanently anchored to the wall. Vinyl mini-blinds are not permitted. Any textiles used in window treatments shall have passed the tests specified in NFPA 701.

3-4.3.3 **Counters, Casework, and Cabinets.**

Counters, casework, and cabinets shall be of high-quality and durable construction. Specify Architectural Woodwork Institute (AWI) Premium or Custom for finishes per *AWI Quality Standards Illustrated, current edition.* Doors, drawers, and casework faces shall be wood veneer at a minimum. Specify .75-in. (20-mm) minimum thickness for plywood, plywood backing, and solid wood panels.

Countertops shall be solid surface/solid composite plastics only. All counters throughout the facility shall have rounded safety corners with a 1-in. (25-mm) radius in plan view and a .5-in. (12-mm) radius for horizontal edges.

3-4.3.4 **Other Interior Construction.**

Provide blocking for all wall- or ceiling-mounted equipment and furnishings. Provide residential-style trim throughout the facility.

No facility display boards shall use tacks, small magnets, or other choking hazards.

3-4.3.5 **Finishes**.

3-4.3.5.1 **General**.

For finish criteria in specific areas, see the Functional Data Sheets in Chapter 4.

3-4.3.5.2 **Soft Floor Coverings**.

Floor coverings shall be impervious to bacteria, fungus growth, odor retention, and comply with fire and sanitation requirements. Use carpet tiles that do not have large patterned designs, for example, games or alphabets. Comply with the following for all carpet tiles and area rugs:

- Backings shall be anti-microbial of synthetic or inorganic material. Use carpet tiles with an attached cushion and a releasable adhesive system. Ensure adhesive or binding components of the carpet do not emit toxic fumes.

- Fibers shall be stain and soil resistant 100 percent solution-dyed nylon. Minimum yarn face weight shall be 28 oz (1.04 kg/m^2). Use heavy commercial wear classification carpet of level loop construction to minimize snagging.

- Ensure there are no tripping hazards at carpet/resilient transition. Area rugs shall be secured with a commercial-grade, two-sided carpet tape around the perimeter. Binding on rugs shall be heavy duty .375 in. to 1 in, (9.5 to 25mm) wide.

- Use carpets tested for Volatile Organic Compounds (VOCs) and that bear a Green Label from the Carpet and Rug Institute indicating that the carpet emissions are within the acceptable range.

- Use products containing less than 0.05 parts per million (ppm) of formaldehyde. Any product purchased with formaldehyde levels above 0.05 ppm must bear a label in accordance with 29 CFR 1910.1048.

3-4.3.5.3 **Resilient Floor Coverings**.

Resilient floor coverings shall be commercial-grade linoleum or vinyl sheet with heat-welded seams.

3-4.4 **Acoustics.**

3-4.4.1 **Exterior Acoustics.**

3-4.4.1.1 **Noise Levels.**

If noise levels at the CCCF exceed the following then comply with the acoustical criteria provided below:

- Outdoor activity area. Continuous: 70 dBA, Intermittent: 80 dBA

- Building exterior with sleeping and quiet areas placed next to exterior wall. Continuous: 60 dBA, Intermittent: 65 dBA

- Building exterior with sleeping and quiet areas protected and not located next to exterior walls. Continuous: 65 dBA, Intermittent:70 dBA

3-4.4.1.2 **Acoustical Criteria.**

If environmental noise levels exceed the maximums noted above, provide the following acoustical treatments:

- Use acoustically laminated glass with a Sound Transmission Coefficient (STC) rating of 35 to 45, having an air space of 2 in. to 4 in. (50 mm to 100mm) for all window and door glazing. (Conventional double-glazing and thermal glazing is not effective in this case.)

- Use high-quality commercial doors with a minimum STC rating of 30 for exterior doors.

3-4.4.2 Interior Acoustics.

Design the facility to provide a comfortable acoustical environment and provide comprehensive sound isolation and sound absorption measures for individual spaces as appropriate. Provide acoustical design to prevent sound from noisy spaces such as toilets, mechanical rooms, and play rooms from having negative impact on the bedrooms and infant/crib room. Comply with the following:

- Partitions can be single layer gypsum wallboard but shall have cavity insulation and be completely caulked at the top and bottom of the partition.

- Provide acoustical baffles in all ductwork that penetrates partitions.

- Do not place electrical outlet boxes back-to-back.

At a minimum, provide the required sound transmission coefficient (STC) ratings identified in Chapter 4, Functional Data Sheets, for individual spaces. Use the "Suggested Design Values" STC ratings in UFC 3-450-01, "Noise and Vibration Control" as the basis for the sound design of partition, door and window assemblies if required. Utilize gypsum board wall "improvements" to increase the STC of gypsum board "Stud Type" partitions to achieve the project sound requirements. Unless indicated in Chapter 4, STC ratings do not need to be field verified.

3-5 PLUMBING.

All sinks shall have hot and cold water supplies.

3-6 MECHANICAL.

Mechanical equipment shall not be located in an attic space.

3-7 FIRE PROTECTION AND LIFE SAFETY.

Because the DoD staff-to-child ratio is less than that prescribed by NFPA 101 Life Safety Code®, additional fire protection and life safety features are required. The additional features compensate for the reduced number of staff. Fire Protection requirements for CCCF are based on the most restrictive requirements of the NFPA

101®, New Day-Care Occupancies, and New Residential Board and Care Occupancies. CCCFs shall also meet the requirements of 32.3 Large Facilities.

3-7.1 Use and Occupancy Classification.

This facility shall be classified as Use Group I-2.

3-7.2 Exit Requirements.

Comply with the following and see the Chapter 4 Functional Data Sheets for additional door hardware and exiting requirements:

- Dead end corridors of any length are not permitted.
- All doors in the egress paths shall be a minimum of 36 in. (915mm) wide and shall provide a minimum clear width of 32 in. (815mm).
- No means of egress or means of escape shall pass through any other occupancy in the same building.
- No CCCF shall be located above another occupancy.
- A CCCF that is combined with another facility shall have a minimum of a two-hour fire resistance rating between the occupancies.
- Emergency evacuation plans shall be incorporated into the overall facility signage package and shall be permanently displayed in enclosed frames.

All doors and exit paths from the facility except from the mechanical room shall comply with the following:

- Doors shall have full-width push pad panic hardware that meets Accessibility requirements. The contact or pressing surface must extend the full width of the door. This is to prevent snagging on evacuation cribs.
- Exits shall have a maximum drop of .25 in. (6mm) and ramps shall be equipped with all-weather non-slip surface for emergency evacuation of wheeled evacuation cribs and wheelchairs. All ramps shall meet Americans with Disabilities Act (ADA) requirements.
- Provide a smooth paved-surfaced evacuation route to a safe gathering area not less than 75 ft. (23m) from the facility for all exits and sleeping rooms. This route shall not cross any emergency vehicle access path, parking area or street, but the paved evacuation path shall connect to a public way and shall not dead end in grassed areas. The evacuation route shall meet ADA requirements. These routes shall comply with the lighting requirements for exterior pedestrian walkways per UFC 3-530-01, “Design: Interior and Exterior Lighting and Controls”. Provide egress

gates with a minimum of 44 in. (1020mm) clear width in the outdoor activity area fences.

3-7.3 Emergency Lighting.

Provide emergency lighting to illuminate the staff desk area where the CCTV monitors are located (allowing staff to make emergency calls and carry out other duties necessary for the safety and security of the children) and in all areas required by NFPA 101®. Whenever possible, incorporate the emergency lighting into the normally provided lighting fixtures. Provide security lighting at all entries and exits.

3-7.4 Fire Separation.

Provide a one-hour fire resistive fire barrier around the following:

- Laundry room
- All storage rooms greater than 100 ft^2 (9.3m^2)
- All boiler or fuel-fired heater rooms

3-7.5 Fire Suppression Systems.

Provide automatic sprinkler systems in accordance with NFPA 13. Comply with the following criteria:

- Provide wet pipe sprinkler system. Dry pipe sprinkler system may be used for those portions of the facility subject to freezing. Anti-freeze and pre-action systems are not permitted.
- Use quick response-type sprinklers in wet pipe sprinkler systems.
- Discharge inspectors' test connections to a safe, outside location onto a hard surface outside of the outdoor activity area or congregation areas. Indicate location on drawings.
- Make fire department connection (FDC) accessible without entering or transiting a children's play area or crossing a discharge path. Provide the FDC on the street side of the building within 150 ft. (45m) of a fire hydrant outside of a fenced area and arranged so that the hose lines can readily and conveniently be attached without interference from any near-by object.
- Domestic stoves shall be provided with a residential fire suppression system in the domestic hood or the stoves shall be equipped with burners and controls that have their temperature limited to a maximum temperature of 662 degrees F (350 degrees C).

- The allowance of NFPA 101® to omit sprinklers from occupancy conversions cannot be used.

3-7.6 Fire Detection and Alarm System.

Comply with the following additional requirements:

- Locate the control panels in environmentally controlled locations in the facility.
- Use fully addressable control panels with addressable detectors, supervisory sensors, pull stations, notification appliances and other devices.
- Provide a mass notification system that is combined with the building fire alarm system.
- Do not use loud and jarring devices such as bells, horns, and klaxons as they can severely frighten young children causing them to hide or panic.
- Provide manual pull stations with protective covers inside the facility at each exterior door except for the mechanical room.
- Provide smoke detection in all areas, including closets over 20 ft^2 (1.86m^2), but excluding the kitchen and spaces that are not climate controlled, such as the attic and the mechanical equipment room.

3-7.7 Carbon Monoxide Detection.

Provide a protected premises carbon monoxide detection system in accordance with NFPA 720 for each building provided with fuel burning appliances. The carbon monoxide system shall include the following features:

- Automatic carbon monoxide alarm signal initiation.
- Notification of carbon monoxide alarms to building occupants using the audible and visual appliances of the mass notification system.
- Transmission of carbon monoxide alarms to the Base Fire Department as a supervisory signal in accordance with NFPA 72.
- Transmission of carbon monoxide detection system trouble and supervisory signals to the Base Fire Department in accordance with NFPA 72.
- Combination-type carbon monoxide detection systems that are integrated in operation with the building mass notification system and fire alarm

system and that meet the requirements of NFPA 72 for combination systems.

- Class B initiating device circuits, notification appliance circuits, and signaling line circuits.

- Install carbon monoxide detectors in accordance with the manufacturer's published instructions. Locate detectors on the ceiling in the same room as all permanently installed fuel-burning appliances. Also provide at least one carbon monoxide detector centrally located within each area served by a separate air handler.

3-7.8 **Conversions.**

A conversion from another occupancy to a CCCF shall comply with the requirements of this UFC and the NFPA occupancy chapters for New Board and Care and Day-Care. The requirements for Existing Board and Care and Existing Day-Care occupancies shall not be used.

3-8 **ELECTRICAL.**

All outlets accessible to children shall be listed tamper resistant and/or ground-fault circuit interrupted (GFCI) protected. Removable caps or plugs are not acceptable.

3-8.1 **Lighting.**

For the overall design approach, adapt the relevant Residential Housing and Childcare sections of UFC 3-530-01. However, maintain light levels at all times and the use of table and floor lamps should be minimized due to the potential for damage caused by active children. Security lighting shall be provided for all pedestrian walkways and building entrances and exits. See Chapter 4, Functional Data Sheets, for any specific light level and control requirements.

3-8.2 **CCTV**.

CCTV systems are considered an important supplement to direct visual access. Provide the infrastructure required to support the CCTV system with cameras located to ensure complete and unobstructed surveillance of child care areas. The agencies identified in Chapter 1, Program Authorities, will determine if funds will be provided, and the source of those funds, for the design and procurement of the equipment external to the outlet (cameras, monitors, operating consoles) in order to establish a complete and usable system. See Chapter 4, Functional Data Sheets for monitor and camera locations.

CCTV controls and recording equipment shall be located in a secure closet or cabinet. Recorded image capacity is required for 30 days of images. CCTV monitors include one desk monitor and one large monitor with accessible views for the parents and caregivers, coordinate monitors location with user. Provide conduit (minimum 19mm (.75)) and cabling in conduit for installation of system. CCTV may require outlets higher

in the ceilings, walls or both. Provide electrical service adjacent to the anticipated locations of cameras and monitors.

- Size Requirements. Provide .74SM to 1.11SM (8SF to12SF) for CCTV recording and viewing equipment. Recording equipment is optional.

- System Selection. Consider the size of the image, clarity of the image, color of the image, and distance to the image on the monitor during CCTV system selection. For example, if a split screen of nine images is color rather than black and white, the images may be discernible 1500 mm (5 ft.) away; but if the images are black and white, they may only be discernible from 900MM (3ft.) away. If the split screen has four color images, it may be visible 2100MM (7ft.) away, and so on. Design the monitoring station with the specific CCTV system in mind to ensure effective usability.

3-9 **FURNISHINGS.**

Comply with following for furnishings in areas accessible to children:

- Furnishings shall have rounded corners and edges with a minimum .5-in. (12-mm) radius in plan view and for horizontal edges.

- Furnishings shall not splinter or have toxic surfaces.

- Furnishings that are 36 in. (915mm) tall or higher shall be secured to prevent tipping.

- To avoid suffocation, do not use beanbags or overly pliable or yielding cushions and pillows that will allow an infant or small toddler to sink into the material.

- All furnishings shall meet standards for child safety and pinch/entrapment protection in CPSC 202, *The Safe Nursery.*

Additional furnishing and equipment criteria for specific spaces within a CCCF are provided in Chapter 4.

3-10 **SITE WORK**.

3-10.1 **Landscaping**.

To ensure child safety, plants with thorns and poisonous or toxic plants are not permitted. Plants that produce fruits, nuts, or seeds that represent choking hazards, regardless of toxicity, are not permitted. Verify the selected and existing plant material for meeting these requirements—the submittal section of the specifications require written verification by the nursery contractor that plants with thorns, poisonous plants, toxic plants, or fruit bearing plants are not planted in the outdoor activity area. Refer to

a comprehensive, commercially-available field guide for lists of poisonous plants. See Appendix C for non-comprehensive lists of common poisonous and non-poisonous plants.

3-10.2 **Site Circulation and Parking**.

Service access shall not cross the outdoor activity areas. Provide a minimum of 10 parking spaces for staff and parents.

3-10.3 **Site Plumbing.**

Provide a minimum of one hose bibb on each building elevation. Install hose bibbs in a recessed wall box to prevent impact injury. Provide freeze-proof hose bibbs at locations where temperatures can drop below freezing.

3-10.4 **Site Lighting and CCTV**.

The site lighting shall be designed to accommodate exterior CCTV camera monitoring for security and child abuse prevention. Provide exterior camera outlets to cover all building entries, the main approach and the outdoor activity area.

CHAPTER 4 SPECIFIC DESIGN CRITERIA

4-1 INTRODUCTION.

This chapter identifies the specific design needs for the individual spaces. Building design criteria are provided in a standard Functional Data Sheet (FDS) table format that generally follows the Uniformat II/Work Breakdown Structure. The Interior Construction/Built-in Equipment category includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window treatments, laundry machines, and retractable overhead screens. The Furnishings and Equipment category includes loose/moveable items.

Outdoor activity area design criteria are provided in textual format following the FDS tables.

4-2 **BUILDING DESIGN CRITERIA**.

TABLE 4-1. FOYER

Description/ Usage	The foyer is the primary facility entrance and ID check-in area. The design should feel open, inviting, and homelike. This area will open up into the living room and play rooms, and parents and children should be able see these areas from the entrance.
Ceiling Ht.	8 ft. (2.4m) minimum. Vary the foyer ceiling height to help define the space and distinguish it from the adjacent living and play rooms.
Windows/Doors	The entrance door shall have a side light and shall have a residential style appearance and an emergency passage manual lock.
Interior Construction/ Built-in Equipment	Provide some sense of separation between the foyer and the living and play rooms to help define the area while maintaining visible connections between the rooms. Consider partial walls and/or 42-in. (1065-mm) high half-height walls. Provide a display board per Chapter 3 near the entrance of the room for posting messages and facility information.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. **Floor.** Resilient sheet flooring system such as vinyl or linoleum with a simulated stone or wood-grain pattern. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) acoustical ceiling panels (ACP). Non modular construction shall use painted gypsum wallboard.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical. Provide 20 fc (215 lux) average general ambient and security lighting at entrance and exit.
Communication	**Telephone.** Provide one jack at the check-in desk. **Data.** Provide one jack at the check-in desk. **CCTV.** Provide outlets for camera coverage of the exterior entrance and the foyer interior. Coordinate interior coverage with adjacent spaces to ensure complete coverage while minimizing the outlet/camera count. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** Provide a duress alarm that alerts the Installation security office. Actuator shall be located at the maximum accessible-compliant height above finished floor and shall include a flip-up protective covering.
Acoustics	No special provisions required.
Furnishings and Equipment	Floor mat.
Special Requirements	Provide a doorbell at the exterior door. A check-in area is required and may be near the foyer/main entrance or a secondary entrance. At this check-in area, provide a check-in desk, check-in computer, and phone. If the staff desk area (Table 4-6) is combined with the check-in area, coordinate layout and design features.
	For use during project execution by the appropriate Service agency
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-2. LIVING ROOM

Description/ Usage	The living room is a gathering and social activity area geared towards sedentary activities such as reading and television watching. The design should emulate a residential living room.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Provide windows per Chapter 3.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. **Floor.** Resilient sheet flooring such as vinyl or linoleum with a simulated stone or wood-grain pattern, or carpet tiles per Chapter 3. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) ACP. Non modular construction shall use painted gypsum wallboard.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical. Provide 20 fc (215 lux) general ambient and 40 fc (540 lux) at reading areas.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** Provide outlets for camera coverage of the interior. Coordinate coverage with adjacent spaces to ensure complete coverage while minimizing the outlet/camera count. See 3-8.2 CCTV for details. **CATV.** Provide one outlet and coordinate location with the furniture plan. **Security.** None required.
Acoustics	No special provisions required.
Furnishings and Equipment	Comfortable seating such as adult and child-sized lounge chairs, loveseats and sofas; side tables; TV stand; bookshelves; TV; DVD player; and area rugs (if no carpet) per Chapter 3.
Special Requirements	
	For use during project execution by the appropriate Service agency
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-3. PLAY ROOM

Description/ Usage	The play room is a gathering and social activity area geared towards energetic activities. It will include a variety of staff-structured play areas.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Provide windows per Chapter 3.
Interior Construction/ Built-in Equipment	Provide clip strips throughout the room for display of children's artwork directly below the chair rail.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. Provide a chair rail at 36 in. (915mm) above finished floor with a washable wainscot below. Provide impact-resistant wallboard up to 48 in. (1220mm). **Floor.** Resilient sheet flooring system such as vinyl or linoleum with a simulated stone or wood-grain pattern. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) ACP. Non modular construction shall use painted gypsum wallboard.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical. Provide 30 fc (325 lux) general ambient.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** Provide outlets for camera coverage of the interior. Coordinate coverage with adjacent spaces to ensure complete coverage while minimizing the outlet/camera count. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** None required.
Acoustics	Provide wall- and/or ceiling-mounted acoustical attenuation features.
Furnishings and Equipment	Child height tables and chairs, area rugs, and a variety of play items and toy packages as required by program.
Special Requirements	
	For use during project execution by the appropriate Service agency
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-4. DINING ROOM

Description/ Usage	The dining room emulates a large, family-style dining area for meals and other table-based activities such as homework and arts and crafts. It is open to the kitchen and may be open to the play room, but it should have some sense of separation from the play area and may be separated by circulation space.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Provide windows per Chapter 3.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. **Floor.** Resilient sheet flooring system such as vinyl or linoleum with a simulated stone or wood-grain pattern. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) ACP. Non modular construction shall use painted gypsum wallboard.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical. Provide 20 fc (215 lux) average general ambient.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** Provide outlets for camera coverage of the interior. Coordinate coverage with adjacent spaces to ensure complete coverage while minimizing the outlet/camera count. Provide monitors that are viewable from both the dining area and the adjacent kitchen/food preparation area. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Furnishings and Equipment	Adult- and child-height dining tables and chairs. High chairs.
Special Requirements	If the staff desk area (Table 4-6) is located here, coordinate layout and design features.
	For use during project execution by the appropriate Service agency
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-5. KITCHEN

Description/ Usage	The kitchen resembles a large, residential-style kitchen with ample preparation and food storage areas.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Provide windows per Chapter 3.
Interior Construction/ Built-in Equipment	Provide a minimum of 20 linear feet (6.1m) of counter space with upper and lower cabinets. Cabinets shall have heavy-duty hinges with non-protruding handles/hardware and integral child safety devices/latches. Counters shall have an integral backsplash and shall be solid surface. Provide an island and/or peninsular counter with base cabinets. Provide heavy-duty, "professional" grade, built-in residential appliances: oven and range top with an exhaust hood and fire suppression system (also see Chapter 3, Fire Suppression Systems) and a two-door reach-in refrigerator/freezer with minimum capacity of 19 ft^3 (.54 m^3) refrigerator and 19 ft^3 (.54 m^3) freezer with a built-in ice maker. Provide an under-counter, commercial-grade dishwasher (NSF International approved). In Option B facilities, provide an additional under-counter ice maker and two under-counter refrigerators for self-service drinks. These accommodate the older children that may occupy these facilities. Confirm approved equipment providers with the agencies noted in Chapter 1, Program Authorities.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. **Floor.** Resilient sheet flooring system such as vinyl or linoleum with a simulated stone or wood-grain pattern. For **Army,** provide a slip-resistant quarry tile floor. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. For **Army,** provide a quarry tile base. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm), vinyl-coated ACP. Non modular construction shall use painted gypsum wallboard.
Plumbing	Provide a two-compartment, under-mount stainless steel kitchen sink with a minimum .5 HP (.4 kW) garbage disposal and removable drain plug. Provide connections to the dishwasher, the refrigerator/freezer, and other equipment as necessary. Provide a single compartment, under-mounted hand-washing sink near the dining room. For **Army,** provide a floor drain.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical. Provide 20 fc (215 lux) general ambient and 50 fc (540 lux) at the counters.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** Provide outlets for camera coverage of the interior. Coordinate coverage with adjacent spaces to ensure complete coverage while minimizing the outlet/camera count. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Furnishings and Equipment	Microwave, toaster, coffee maker, cookware, cooking and eating utensils, dinner and drinkware, and paper towel and soap dispensers.
Special Requirements	Ensure that staff standing at the food preparation areas can see the entire dining area and the CCTV monitors located therein. See 3-8.2 CCTV for details. Ensure access to a near-by storage closet/pantry.
	For use during project execution by the appropriate Service agency
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-6. STAFF DESK AREA

Description/ Usage	The staff desk area is a small administrative area with a desk for ad hoc administrative functions, typically located as a sub area of another space. Effective locations include combining it with the check-in area, the dining room/kitchen area, or off of circulation space.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. **Floor.** Coordinate with adjacent areas. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) ACP. Non modular construction shall use painted gypsum wallboard.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical.
Communication	**Telephone.** Provide one jack. **Data.** Provide a minimum of one jack. Note in Navy and USMC facilities, this jack does not need to conform to NMCI requirements. **CCTV.** Coordinate with adjacent spaces to ensure outlets for camera coverage. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Furnishings and Equipment	Small desk, desk chair, computer, and phone.
Special Requirements	Confirm the location and configuration with the agencies identified in Chapter 1, Program Authorities. Coordinate the design features with the adjacent spaces.
	For use during project execution by the appropriate Service agency
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-7. CRIB/INFANT ROOM

Description/ Usage	This room is a sleeping area for infants and pre-toddlers. It also accommodates diaper changing and bottle feeding.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Provide windows and interior door per Chapter 3. The exterior door shall meet the requirements for exit doors per Chapter 3. This exterior door shall have an automatic hold open device integral to the door or door closer. Flip down door stops are not permitted. Design door thresholds and hardware to facilitate the exiting of an evacuation crib with up to four children pushed and/or pulled by a single adult.
Interior Construction/ Built-in Equipment	Provide window treatments per Chapter 3. Floor length draperies or vertical blinds are not permitted in this space. Provide a 34-in.-high, 24-in.-deep (865 x 610mm), 42 in. (1065mm) long (minimum) solid-surface changing counter with integral storage underneath and integral, retractable steps that lock in place. Provide a safety device on all sides of the changing surface area that extends 3 in. (75mm) above the surface of the mat (mats are typically 1 in. (25mm) thick). This changing surface shall be integral with the sink counter. Ensure all edges are rounded and surfaces are smooth. Provide hands-free paper towel (cone-type), soap, glove, and plastic bag dispensers within reach of the caregiver at the table. Provide a minimum of eight (8) compartmentalized cabinets 9-in.-wide, 9-in.-high, and 12-in.-deep (230 x 230 x 305mm) for storage of diapers and products. These cabinets shall be within easy reach of a caregiver standing at the station with one hand on the child. Confirm the need for a separate small counter area with base and upper cabinets and an under-counter refrigerator with the agencies indentified in Chapter 1, Program Authorities. Also see Special Requirements below.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. **Floor.** Resilient floor such as vinyl or linoleum with a simulated stone or wood-grain pattern, or carpet tiles per Chapter 3. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) ACP. Non modular construction shall use painted gypsum wallboard.
Plumbing	At the diaper changing station, provide one deep, integral or under-mount (under-mount shall be stainless steel) sink with a swivel goose neck faucet, and hands-free operation. If sensor-operated controls are used, provide a 30 second automatic shut-off. Provide a dedicated shut-off valve. If the counter/refrigerator area is included, provide a separate adult-height handwashing sink at that counter.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical. Provide individual thermostats, a switched exhaust fan at the diaper changing area, and maintain 35 to 50% humidity.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical. Maintain a minimum of .5 fc (5 lux) at all times to accommodate child observation requirements but do not exceed 5 fc (52 lux) for sleeping. Normal operating light levels are 20 fc (215 lux) general ambient and 30-40 fc (320-430 lux) task lighting at the counters.

TABLE 4-7. CRIB/INFANT ROOM

Communication	**Telephone.** None required. **Data.** None required. **CCTV.** Provide outlets for camera coverage of the interior. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** Provide a local alarm at the exterior door that sounds whenever the door is opened. **Army** does not alarm the crib/infant room exterior door.
Acoustics	Provide partition construction with a minimum STC rating of 52 per Chapter 3, Acoustics. Interior doors and windows/vision panels do not need to be STC-rated.
Furnishings and Equipment	Provide cribs for sleeping and emergency evacuation. A minimum of two cribs shall be evacuation cribs that shall be of durable construction, be a maximum of 29 in. (735mm) wide, and have sturdy caster wheels approximately 4 in. (100mm) in diameter. The evacuation crib shall be able to support and transport a minimum of five 18-month-old children weighing a total of 120 lbs. (55 kg). Provide two foot-operated, covered waterproof, washable trash containers, with self-closing airtight lids. Provide area rugs if no carpet.
Special Requirements	Provide childproof latches or magnetic locks to any storage cabinets within a child's reach. Option A facilities: Provide a hall/public area-accessible diaper changing station on the wall shared with the crib/infant room diaper changing station. This second diaper changing area shall mirror the one described above. Provide a window between the two stations that is the full width of the changing tables and allows views between the areas by staff standing at the stations. Provide all the related components in the hall/public area station, including the diaper storage compartments, exhaust fan and the covered trash container for soiled diapers.
	For use during project execution by the appropriate Service agency
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-8. BEDROOMS

Description/ Usage	Separate bedrooms for boys and girls.
Ceiling Ht.	9 ft. (2.7m) minimum.
Windows/Doors	Provide windows and interior door per Chapter 3. The exterior door shall meet the requirements for exit doors per Chapter 3. This exterior door shall have an automatic hold open device integral to the door or door closer. Flip down door stops are not permitted.
Interior Construction/ Built-in Equipment	Provide window treatments per Chapter 3. Floor length draperies or vertical blinds are not permitted in this space. Option A facilities: Provide the following in each room and in a public area usually just outside the bedrooms: pre-manufactured, compartmentalized, open-front cubbies with a shelf and minimum of two coat hooks. These cubbies shall be anchored to the floor and/or wall. Ensure that clothing stored in each individual cubby can be separate from and will not come in contact with clothing stored in other cubbies. Provide 36 in. (915mm) of clear space directly in front of cubbies. These cubbies accommodate the child-storage function for the typical ages of the child occupants of Option A facilities and are contrasted with the FF&E noted below for Option B facilities. Also to accommodate the faster turnover rate, Option A facilities shall have a 32 ft^2 ($3m^2$) storage closet for cots and additional linens storage on shelving. Closet shall have twin-leaf doors with vision panels per Chapter 3.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. **Floor.** Resilient floor (with area rugs) such as vinyl or linoleum with a simulated stone or tile or wood-grain flooring pattern, or carpet tiles per Chapter 3. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) ACP. Non modular construction shall use painted gypsum wallboard.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical. Maintain a minimum of .5 fc (5 lux) at all times to accommodate child observation requirements but do not exceed 5 fc (52 lux) for sleeping. Normal operating light levels are 20 fc (215 lux) general ambient and 30-40 fc (320-430 lux) task lighting at the side tables/beds.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** Provide outlets for camera coverage of the interior. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** Provide a local alarm at the exterior door that sounds whenever the door is opened.
Acoustics	Provide partition construction with a minimum STC rating of 52 per Chapter 3, Acoustics. Interior doors and windows/vision panels do not need to be STC-rated.
Furnishings and Equipment	Twin beds with under-bed drawer storage and side tables. Option B facilities: Provide lockable trunks with each bed to accommodate storage for older children and provide one armoire per every two beds. Secure the armoire to the wall to prevent tipping.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-9. OPTION A TOILETS

Description/ Usage	These toilets support the Option A facility configuration and include two unisex toilets/bathrooms off of the public area/hallway near the bedrooms.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	Provide lockable doors without vision panels. The doors shall be designed to allow opening from the outside during an emergency when locked.
Interior Construction/ Built-in Equipment	Provide a solid-surface countertop with a shatter-proof mirror over the lavatory. Provide toilet-tissue dispensers within reach of a child on the water closet. Provide a hands-free paper towel dispenser without serrated edges at the lavatory. Provide towel racks, shelving, and a screwed-in curved shower curtain rod at the tub.
Finishes	**Walls.** Semi-gloss epoxy paint with mold inhibitor on mold-resistant gypsum wallboard. **Floor.** Seamless sheet vinyl or linoleum with the edges turned up the walls a minimum of 6 in. (150mm) to form an integral coved base. **Base.** Integral. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) vinyl-coated ACP. Non modular construction shall use scrubable eggshell or semi-gloss paint with mold inhibitor on mold-resistant gypsum wallboard.
Plumbing	Comply with *Caring for Our Children, National Health and Safety Performance Standards: Guidelines for Out-of-Home Child Care* for water temperature control. In one of the two toilets, provide a child-height water closet with a seat height of 12 in. (305mm) and flush controls 20 to 30 in. (510 to 760mm) above finished floor and a child-height lavatory mounted at 22 in. (560mm) above finished floor with 19 in. (480mm) clearance for knee space. In the other toilet, provide standard accessible water closet and lavatory. All sinks shall have single-action, pre-mixing, automatic shut-off controls mounted within 14 in. (355mm) of the leading edge of the lavatory. In each room provide a one-piece, full-height, solid-acrylic combination bathtub and tub/shower surround with two recessed soap dishes, a non-slip surface, and fixed and handheld showerheads. Provide a floor drain in each room.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical. Provide humidistat-controlled exhaust system.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	Provide partition construction with a minimum STC rating of 45 per Chapter 3, Acoustics. Doors do not need to be STC-rated.
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-10. OPTION B TOILETS

Description/ Usage	These toilets support the Option B facility configuration and include gender-specific rooms directly off of each bedroom and two unisex toilets off of the public area/hallway. The typical configuration of the gender-specific facilities includes three areas (toilet room, bath/shower room and lavatories) and is described in Special Requirements below.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	Provide lockable doors without vision panels to the gender-specific toilet and bath/shower rooms and to the two unisex toilets. The doors shall be designed to allow opening from the outside during an emergency when locked.
Interior Construction/ Built-in Equipment	Provide a solid-surface countertop at the gender-specific lavatory. Provide mirrors over each lavatory. Provide toilet-tissue dispensers within reach of a child on each water closet. Provide a paper towel dispenser without serrated edges at each lavatory. Provide towel racks, shelving, and a screwed-in curved shower curtain rod at the tubs.
Finishes	**Walls.** Impervious tile up to 48 in. (1220mm) above finished floor with epoxy paint with mold inhibitor on mold-resistant gypsum wallboard above. **Floor.** Impervious tile. **Base.** Match floor. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) vinyl-coated ACP. Non modular construction shall use epoxy paint with mold inhibitor on mold-resistant gypsum wallboard.
Plumbing	Comply with *Caring for Our Children, National Health and Safety Performance Standards: Guidelines for Out-of-Home Child Care* for water temperature control. **Gender-specific Toilet Rooms.** Provide both a child-height water closet with a seat height of 14 to 15 in. (355 to 380mm) and flush controls 20 to 30 in. (510 to 760mm) above finished floor and a child-height lavatory mounted at 31 in. (790mm) above finished floor with 24 in. (610mm) clearance for knee space. **Gender-specific Bath/shower Rooms.** Provide a one-piece, full-height, solid-acrylic combination bathtub and tub/shower surround with two recessed soap dishes, a non-slip surface, and fixed and handheld showerheads. **Gender-specific Lavatories.** Provide two integral or under-mount lavatories. **Unisex Toilets:** In one, provide a child-height water closet with a seat height of 10 in. (250mm) and flush controls 20 to 30 in. (510 to 760mm) above finished floor and a child-height lavatory mounted at 17 in. (430mm) above finished floor. In the other, provide a child-height water closet with a seat height of 14 to 15 in (355 to 380mm) and flush controls 20 to 30 in. (510 to 760mm) above finished floor and a child-height lavatory mounted at 31 in. (790mm) above finished floor with 24 in. (610mm) clearance for knee space. All sinks shall have single-action, pre-mixing, automatic shut-off controls mounted within 14 in. (355mm) of the leading edge of the lavatory. Provide a floor drain in each space.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	Provide partition construction with a minimum STC rating of 45 per Chapter 3, Acoustics. Doors and windows do not need to be STC-rated.

TABLE 4-10. OPTION B TOILETS

Furnishings and Equipment	
Special Requirements	The gender-specific facilities are typically configured as follows: The main lavatory area is open to the bedroom with a separate private toilet/lavatory room off to one side and an accessible bath/shower room off to the other side.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-11. STAFF TOILET

Description/ Usage	This is a unisex, accessible facility.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	Provide a lockable door without a vision panel. The door shall be designed to allow opening from the outside during an emergency when locked.
Interior Construction/ Built-in Equipment	Provide a solid-surface countertop with a full-width mirror over the lavatory. Provide toilet-tissue dispenser, paper towel dispenser, built-in trash receptacle, and soap dispenser.
Finishes	**Walls.** Epoxy semi-gloss paint with mold inhibitor on mold-resistant gypsum wallboard. As an option, also provide impervious tile up to 48 in (1220mm) above finished floor. **Floor.** Resilient sheet flooring system such as vinyl or linoleum, or impervious tile. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain, or impervious tile. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) vinyl-coated ACP. Non modular construction shall use epoxy paint with mold inhibitor on mold-resistant gypsum wallboard.
Plumbing	Provide accessible water closet and lavatory. Provide a floor drain.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. **CATV.** None required. **Security.** None required.
Acoustics	Provide partition construction with a minimum STC rating of 45 per Chapter 3, Acoustics. Doors and windows do not need to be STC-rated.
Furnishings and Equipment	
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-12. LAUNDRY

Description/ Usage	The laundry room should be located near staff areas and an exterior wall. It includes the facility janitor functions.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	Provide a lockable door with a vision panel per Chapter 3.
Interior Construction/ Built-in Equipment	Provide large, heavy-duty residential washer and dryer. Provide a built-in table for folding laundry and shelves for storage.
Finishes	**Walls.** Epoxy painted water-resistant gypsum wallboard. **Floor.** Sealed concrete, a resilient sheet flooring system such as vinyl linoleum, or impervious tile. **Base.** Rubber or match floor. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) vinyl-coated ACP. Non modular construction shall use epoxy-painted water-resistant painted gypsum wallboard.
Plumbing	Provide a laundry sink, connections to the washer, and a janitor's sink. Provide a floor drain. Provide recessed washing machine connector box for each utility connection to the machine.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical. Provide humidistat-controlled exhaust system to maintain a maximum of 50% relative humidity. Do not vent the dryer exhaust near a building entrance.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** Provide outlets for camera coverage of the interior. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** None required.
Acoustics	Provide partition and door construction with a minimum STC rating of 52 per Chapter 3, Acoustics.
Furnishings and Equipment	
Special Requirements	Confirm the need for HAZMAT storage provisions with the Installation Safety Officer.
	For use during project execution by the appropriate Service agency
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-13. INTERIOR STORAGE

Description/ Usage	Interior storage includes dry food storage and general facility items. The food storage should be located near the kitchen and the general item storage may be one or more additional storage closets, depending on final building configuration.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	Provide a lockable door with a vision panel per Chapter 3.
Interior Construction/ Built-in Equipment	Coordinate with agencies noted in Chapter 1, Program Authorities, to provide the preferred shelving/storage system to maximize storage in these spaces.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. **Floor.** Resilient sheet flooring system such as vinyl or linoleum. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) ACP. Non modular construction shall use painted gypsum wallboard.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical. In all storage areas large enough for a child to enter, provide occupancy-sensor-controlled minimum light level of 5 fc (52 lux). The occupancy sensor shall be sensitive enough to detect a small seated child. This is a child abuse/child safety requirement.
Communication	**Telephone.** None required. **Data.** See Special Requirements. **CCTV.** See Special Requirements. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Furnishings and Equipment	
Special Requirements	CCTV recording equipment may be located in a storage closet; confirm data and other requirements if this option is exercised. See 3-8.2 CCTV for details. Paint a horizontal red stripe on all walls at 20 in. (510mm) below finished ceiling to indicate maximum height of storage.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-14. STAFF DEN/OFFICE

Description/ Usage	Private office for staff administrative functions. In Option B facilities, this room will also be used to isolate a sick child from the facility general population and for family counseling, as needed.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	Provide a lockable door with a vision panel per Chapter 3.
Interior Construction/ Built-in Equipment	None required.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. **Floor.** Carpet tiles per Chapter 3. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) ACP. Non modular construction shall use painted gypsum wallboard.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical. Option B facilities: Provide negative pressure.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical.
Communication	**Telephone.** Provide one jack. **Data.** Provide a minimum of one jack plus additional jacks as necessary for equipment such as a printer. Note in Navy and USMC facilities, this is the only jack that will conform to NMCI requirements. **CCTV.** Provide a monitor. Option B facilities: Provide outlets for camera coverage to accommodate use as an isolation room. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** Provide a duress alarm that alerts the Installation security office. Actuator shall be located at the maximum accessible-compliant height above finished floor and shall include a flip-up protective covering.
Acoustics	Provide partition construction with a minimum STC rating of 45 per Chapter 3, Acoustics. Doors and windows/vision panels do not need to be STC-rated.
Furnishings and Equipment	Desk, desk chair, side chair(s), credenza, lockable filing cabinet, computer, printer, and other office equipment as necessary. Option B facilities: Also provide lounge seating and a couch.
Special Requirements	
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-15. STAFF STORAGE

Description/ Usage	The staff storage area is a small area with lockable storage for small personal items, such as coats and bags. It is located within or combined with other facility areas. Effective locations/combinations include the small desk area and the laundry room.
Ceiling Ht.	8 ft. (2.4m) minimum.
Windows/Doors	None required.
Interior Construction/ Built-in Equipment	The storage area can be configured as a counter with lockable upper cabinets and an adjacent lockable coat closet or as half-size lockers. See Special Requirements.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard. **Floor.** Coordinate with adjacent areas. **Base.** Resilient with residential (or millwork) profile, solid color or wood-grain. **Ceiling.** Modular construction shall use 2 ft x 2 ft (610 x 610mm) ACP. Non modular construction shall use painted gypsum wallboard.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** Coordinate with adjacent spaces to ensure outlets for camera coverage. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Furnishings and Equipment	None required.
Special Requirements	Confirm the location and configuration with the agencies identified in Chapter 1, Program Authorities. Coordinate the design features with the adjacent spaces.
	For use during project execution by the appropriate Service agency
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

TABLE 4-16. OUTDOOR STORAGE

Description/ Usage	Room with direct access from the outside for storage of outdoor play equipment. This room may be located within the building footprint or as a separate shed structure. Confirm location with the agencies noted in Chapter 1, Program Authorities. If the room is located within the building footprint, access from the interior is not required. If it is an exterior shed, it shall be an enclosed, weather-tight, vandal-proof storage shed that is architecturally compatible with the CCCF.
Ceiling Ht.	9 ft. (2.7m) minimum. 7 ft. (2.1m) minimum if a separate shed.
Windows/Doors	Provide a lockable door with a vision panel per Chapter 3, including both interior and exterior door criteria. Door shall be a minimum of 48 in. wide (1220mm).
Interior Construction/ Built-in Equipment	Storage shelves, racks and/or bins, as necessary.
Finishes	**Walls.** Semi-gloss epoxy painted gypsum wallboard or CMU. If exterior shed, use a prefabricated wood or plastic shed that meets the child safety standards identified in Chapter 4, Play Equipment. **Floor.** Sealed concrete sloped to the door for drainage. **Base.** None required. **Ceiling.** Unfinished.
Plumbing	None required.
HVAC	Provide a system per Chapter 3, General, and Chapter 3, Mechanical. Ventilate but do not air condition.
Fire Protection and Life Safety	Provide system per Chapter 3, General, and Chapter 3, Fire Protection and Life Safety.
Power	Provide outlets per Chapter 3, General, and Chapter 3, Electrical.
Lighting	Provide system per Chapter 3, General, and Chapter 3, Electrical.
Communication	**Telephone.** None required. **Data.** None required. **CCTV.** None required. See 3-8.2 CCTV for details. **CATV.** None required. **Security.** None required.
Acoustics	No special provisions required.
Furnishings and Equipment	
Special Requirements	No HAZMATS are stored in this space. Paint a horizontal red stripe on all walls at 20 in. (510mm) below finished ceiling to indicate maximum height of storage. Locate storage to be readily accessible to the outdoor play area. If it is a separate shed, its placement shall not create blind spots in the outdoor activity area. Provide hard-surface pathways connecting storage with the outdoor activity area.
For use during project execution by the appropriate Service agency	
Occupancy	Staff. Children.
Min. net ft^2 (m^2)	

4-3 **OUTDOOR ACTIVITY AREA DESIGN CRITERIA**.

4-3.1 **General**.

The CCCF outdoor activity area is similar to that for the CDC described in UFC 4-740-14, but on a much smaller scale. CCCFs will not provide separated (fenced) age-specific play areas and most will only have space for one or two pieces of equipment.

A certified playground safety inspector that is not affiliated to an equipment manufacturer shall design the playground or review and approve the final design. The outdoor activity area design and all features shall comply with the Consumer Product Safety Commission (CPSC) 325, *Public Playground Safety Handbook,* and with any other references in this UFC for specific design elements and features.

4-3.2 **Layout**.

If available area and site layout permit, provide separate areas for older and younger children. A separate area is required in Option B facilities where the age difference between children can be greater. The Option B area will typically be a covered patio.

4-3.3 **Fencing**.

Enclose the perimeter of the entire outdoor activity area with a fence. **Navy** and **USMC** fence shall be a minimum 5-ft. (1525mm) high fence. **Army** fence shall be 4-ft. (1220mm) high fence. Vinyl-coated chain link is the preferred fence material, and the final design shall comply with the following:

- Meet the Installation design standards to the degree possible while meeting these criteria.
- Exposed galvanized wire is not permitted.
- The top edge shall be selvage knuckled. The fencing components shall not expose sharp points or edges that could cut or puncture children's skin. All fastening devices used for fence construction shall be turned sideways or shall not project perpendicular to the fence surface beyond .125 in. (3.2mm). Fences shall have smooth caps and no finials or sharp picket tops.
- Space between vertical elements shall be no more than 3.5 in. (85mm).
- No openings in the fence shall be between .375 in. (9mm) and 1 in. (25mm) in size as pinch protection.
- Coordinate gate sizes to accommodate the evacuation cribs (See Chapter 4, Infant/crib Room).

- Perimeter egress gates shall only be operable from the interior side, have adult-controlled securing devices to prevent child operation, and pinch/crush protection on the hinges. In addition, design the gate to preclude operation by an adult reaching over the fence from the exterior side as a child-abuse prevention measure.

- Provide at least one access gate that is 8 ft. (2440 mm) wide for service vehicles.

- Ensure that fences do not impede caregiver supervision of children.

- For **Navy** projects, bury the fence bottom a minimum of 3 in. (75mm) below grade.

Additional information on entrapment dimensions is provided in CPSC 325.

4-3.4 **Play Equipment**.

4-3.4.1 **Industry Standards.**

Playground equipment and any shade structures shall comply with the minimum standards put forth in the guidelines listed below. In some cases, this UFC may include more stringent guidelines than those listed. In those cases, follow the criteria identified in this UFC. Use the most recent editions of the following publications:

- CPSC 325, *Public Playground Safety Handbook*.

- ASTM F1292, *Standard Specification for Impact Attenuation of Surface Materials within the Use Zone of Playground Equipment.*

- ASTM F1487, *Standard Consumer Safety Performance Specification for Playground Equipment for Public Use.*

- ASTM F1951, *Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.*

- ASTM F2223, *Standard Guide for ASTM Standards on Playground Surfacing*.

- ASTM F2373, *Standard Consumer Safety Performance Specification for Public Use Play Equipment for Children 6 Months through 23 Months.*

4-3.4.2 **Additional DoD Standards.**

Show all use zones for play equipment on the site plan to ensure there is no conflict between play activities on the ground and swinging or jumping from the equipment. Do not overlap use zones.

4-3.4.2.1 **Selection Criteria.**

- **Novelty.** Select interesting play equipment with both simple and complex features. Select equipment that can be modified.

- **Flexibility.** Select a composite unit that stimulates a wide range of motor functions and that can be used equally well by one child or by several children simultaneously. Do not select themed items that are designed to look like specific objects.

- **Challenge.** Provide equipment that provides clear, graduated stages of accomplishment, e.g., variable-height steps or climbing equipment with landings at different heights.

- **Aesthetics.** Design children's playgrounds for appearance as well as function. Select equipment colors and styles that are appealing to children and compatible with the facility exterior. Integrate equipment with natural vegetation and landforms.

4-3.4.2.2 **Installation Criteria.**

The equipment purchasing agreement shall include a requirement for the manufacturer to inspect the equipment after installation and confirm in writing that installation conforms to manufacturer's instructions and to CPSC and ASTM Guidelines. Also provide a contractual agreement for a skilled, certified, independent playground safety consultant to inspect the entire playground after the installation is completed. Have experienced playground installers conduct or supervise installation.

4-3.4.2.3 **Exclusions.**

Do not use the following items in the outdoor activity areas, regardless of CPSC or ASTM approval:

- Animal-shaped, metal, or hard-seat swings. **Navy** excludes all swing types except tire swings.

- Wood equipment—wood equipment is not permitted due to maintenance concerns.

- Metal slide surfaces.

- Merry-go-rounds.

- Trampolines.

- See-saws.

- Zip lines.

4-3.4.2.4 Exceptions and Modifications.

The following is an exception to previous DoD policy: Tunnels and tunnel slides are allowed but require openings or view panels.

4-3.5 Surfaces.

CCCF outdoor activity areas typically have three categories of surface areas with specific requirements: use zones, wheeled toy pathways, and general. Comply with ASTM F2223, *Standard Guide for ASTM Standards on Playground Surfacing,* and the following criteria.

4-3.5.1 Use Zones.

Use zones are the areas under and around playground equipment and are defined by ASTM F1487. A required submittal is the commercial playground safety surface manufacturer's warranty and liability in the specifications and transfer to the Using Service. Include a written verification by the manufacturer that the playground safety surface meets the requirements of the CPSC 325 and ASTM in the submittal section of the specifications.

DoD prefers poured-in-place resilient safety surfaces. Approval from the using Service agencies identified in Chapter 1, Program Authorities, is required for any other use zone surface material.

4-3.5.2 Wheeled Toy Pathways.

If space and budget will accommodate wheeled toy pathways, the acceptable materials include concrete and stone and masonry pavers. The edge of pathways shall be tapered for transitions and shall not create trip hazards. Joints shall be not wider than .5 in. (12mm) because they may cause toys to tip. Adjacent grading and/or sod installation shall be within .75 in. (19mm) of the pathway surface height and shall allow for settlement to minimize replacement. Comply with the following when designing the wheeled toy pathways:

- Modular paving. Use non-grouted interlocking type pavers on sand placed over a continuous concrete setting bed. Install brick, stone or other non-interlocking type paving in grout over a continuous concrete setting bed. Do not install non-interlocking paving on sand in play areas, as the modular units may settle unevenly, resulting in a hazardous irregular surface. Where winter freezing is common and where poor soils occur, use a gravel base under concrete and reinforce to prevent cracking and deterioration. Integrally colored pavers are encouraged to create visual interest.

- Concrete. Add color additives or surface finishes to improve the appearance of concrete and reduce glare. Avoid smooth steel trowel finishes, which can become slippery when wet. Where winter freezing is

common and where poor soils occur, use a gravel base under concrete and reinforce to prevent cracking and deterioration. Cast-in-place concrete over a well-compacted sub-grade is the most durable, maintenance-free paving material for hard surface areas.

4-3.5.3 **General.**

This encompasses any portion of the outdoor activity area not included in the other two defined areas. Use grass or other natural landscaping surfaces. Use grass primarily in open, active play areas, passive play areas, and areas with low traffic levels. Do not use grass where wear and maintenance will become a problem. Locate grass in sunny areas where it will dry out quickly after rain. Artificial turf is not recommended for use as a playground surface; it can be abrasive, convey an unnatural impression, and can result in significantly higher surface temperatures than natural turf. Prior to approving artificial turf, confirm negative lead content from an independent lead-certified laboratory. See Chapter 3, Landscaping, for more information on non-paved areas.

APPENDIX A REFERENCES

ASTM F1292, *Standard Specification for Impact Attenuation of Surface Materials within the Use Zone of Playground Equipment,* ASTM International, www.astm.org

ASTM F1487, *Standard Consumer Safety Performance Specification for Playground Equipment for Public Use,* ASTM International, www.astm.org

ASTM F1951, *Standard Specification for Determination of Accessibility of Surface Systems under and around Playground Equipment,* ASTM International, www.astm.org

ASTM F2223, *Standard Guide for ASTM Standards on Playground Surfacing,* ASTM International, www.astm.org

ASTM F2373, *Standard Consumer Safety Performance Specification for Public Use Play Equipment for Children 6 Months through 23 Months,* ASTM International, www.astm.org

AWI Quality Standards Illustrated, Architectural Woodwork Institute, www.awinet.org

Caring for Our Children, National Health and Safety Performance Standards: Guidelines for Out-of-Home Child Care Programs, American Academy of Pediatrics, http://www.aap.org/

29 CFR 1910.1048, *Occupational Safety and Health Standards, Toxic and Hazardous Substances, Formaldehyde,* Occupational Safety & Health Administration, www.osha.gov

CPSC 325, *Public Playground Safety Handbook,* The Consumer Product Safety Commission (CPSC), http://cpsc.gov/

CPSC 202, *The Safe Nursery,* The Consumer Product Safety Commission (CPSC), http://cpsc.gov/

Green Label program, Carpet and Rug Institute, http://www.carpet-rug.org

International Building Code, International Code Councilhttp://www.iccsafe.org

LEED® Green Building Rating System, The United States Green Building Council, www.usgbc.org

NFPA 13, *Standard for the Installation of Sprinkler Systems,* National Fire Protection Association, http://www.nfpa.org

NFPA 72, *National Fire Alarm and Signaling Code,* National Fire Protection Association, http://www.nfpa.org

NFPA 101, *Life Safety Code*, National Fire Protection Association, http://www.nfpa.org

NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films,* National Fire Protection Association, http://www.nfpa.org

NFPA 720, *Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment,* National Fire Protection Association, http://www.nfpa.org

UFC 1-200-01, *General Building Requirements*, Unified Facilities Criteria Program, http://dod.wbdg.org

UFC 3-450-01, *Noise and Vibration Control,* Unified Facilities Criteria Program, http://dod.wbdg.org

UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls,* Unified Facilities Criteria Program, http://dod.wbdg.org

UFC 4-740-14, *Design: Child Development Centers,* Unified Facilities Criteria Program, http://dod.wbdg.org

Whole Building Design Guide, National Institute of Building Sciences, http://www.wbdg.org

APPENDIX B SPACE PLANNING

B-1 OPTION A FACILITY SAMPLE SPREADSHEET.

Figure B-1 shows a sample completed spreadsheet for a typical Option A facility.

FIGURE B-1. SAMPLE OPTION A FACILITY CCCF SPACE PROGRAM

Sample Option A Facility CCCF Space Program

Select Service Branch: Navy

Facility Type — Select type of facility: Option A

Facility Sizing — Select no. of boys/girls: 6

Navy and USMC facility sizing is based on a standard of 8 infants and allows either 4 or 6 each of boys and girls.

Number of infants:	8
Number of boys:	6
Number of girls:	6

Modular Construction — Select yes or no: No

The use of modular construction will affect the net-to-gross requirements. Select 'Yes' to program the use of modular construction.

Program Spaces		m^2	$ft.^2$
Foyer		11.15	120
Living room		30.10	324
Play room		40.13	432
Dining room		33.44	360
Kitchen		22.30	240
Staff desk area		1.86	20
Crib/infant room		48.31	520
Diaper changing/food prep		6.50	70
Bedrooms		100.33	1,080
Option A toilets			
Child-height toilet		8.36	90
Accessible toilet		8.36	90
Staff toilet		4.18	45
Laundry		7.90	85
Storage		11.15	120
Staff den/office		9.29	100
Staff storage		1.39	15
Outdoor storage		7.43	80
	Subtotal - Total Net Building Area	352.18	3,791
	Net-to-gross	118.09	1,271
Covered exterior space	(Located in the outdoor activity area.)	18.58	200
	Subtotal - Gross Building Area	488.86	5,262

Exterior Program Spaces	m^2	$ft.^2$
Parking	325.15	3,500
Outdoor activity area	185.80	2,000
Subtotal - Net Site Program Spaces	510.95	5,500
TOTAL BUILDING FOOTPRINT + EXTERIOR PROGRAM	999.81	10,762

B-2 OPTION B FACILITY SAMPLE SPREADSHEET.

Figure B-2 shows a sample completed spreadsheet for a typical Option B facility.

FIGURE B-2. SAMPLE OPTION B FACILITY CCCF SPACE PROGRAM

Sample Option B Facility CCCF Space Program

Select Service Branch: Army

Facility Type — Select type of facility: Option B

Facility Sizing

Army facility sizing is fixed and based on 6 infants and 7 each of boys and girls.

Number of infants:	6
Number of boys:	7
Number of girls:	7

Modular Construction — Select yes or no: Yes

The use of modular construction will affect the net-to-gross requirements. Select 'Yes' to program the use of modular construction.

Program Spaces		m^2	$ft.^2$
Foyer		15.79	170
Living room		39.02	420
Play room		25.08	270
Dining room		50.17	540
Kitchen		17.65	190
Staff desk area		1.86	20
Crib/infant room		33.44	360
Diaper changing/food prep		1.86	20
Bedrooms		91.04	980
Option B toilets			
Shower		7.43	80
Wash		7.43	80
Toilet		7.43	80
Hall toilet		7.43	80
Staff toilet		4.18	45
Laundry		7.90	85
Storage		11.15	120
Staff den/office		13.94	150
Outdoor storage		5.11	55
	Subtotal - Total Net Building Area	347.91	3,745
	Net-to-gross	64.11	690
Covered exterior space	(Area split between the outdoor activity area and the Option B facility outdoor activity area.)	61.31	660
	Subtotal - Gross Building Area	473.34	5,095

Exterior Program Spaces	m^2	$ft.^2$
Parking	325.15	3,500
Outdoor activity area	185.80	2,000
Subtotal - Net Site Program Spaces	510.95	5,500
TOTAL BUILDING FOOTPRINT + EXTERIOR PROGRAM	984.29	10,595

APPENDIX C POISONOUS AND NON-POISONOUS PLANTS

Many popular house and garden plants are considered poisonous and can produce symptoms ranging from minor to severe. Table C-1 provides a non-comprehensive list of common plants that are known to be poisonous. Table C-2 provides a list of plants for which no evidence currently exists of a poisonous quality. These lists are provided by the Maryland Poison Center. Within the United States, check with local extensions of the US Department of Agriculture for more information about the nature of common plantings in specific locations. These lists are not intended to serve as a guide for plants to use or not use but are merely provided for informational purposes. See Chapter 3 for more information on landscaping and plant selection.

Refer to a comprehensive, commercial field guide for a complete list of poisonous plants.

TABLE C-1. COMMON POISONOUS PLANTS

Amaryllis	Jerusalem cherry
Azalea	Jimsonweed
Barberry	Jonquil
Black locust	Lily-of-the valley
Boxwood	Mistletoe
Caladium	Mountain laurel
Castor bean	Narcissus
Chinaberry	Nephthytis/Arrowhead
Chinese evergreen	Nightshade family
Chrysanthemum	Oak (acorns)
Crown of thorns	Peony
Daffodil	Philodendron family
Dumbcane/Dieffenbachia	Poison ivy/oak/sumac
English ivy	Pokeweed
Euonymous	Privet
Four o'clock	Rhododendron
Fruit pits or seeds	Snowball bush/Hydrangea
Gladiola	Water hemlock
Holly	Wisteria
Hyacinth	Yew
Iris	

TABLE C-2. COMMON NON-POISONOUS PLANTS

African violet	Marigold
Christmas cactus	Mulberry (ripe berries only)
Coleus	Norfolk pine tree
Corn plant	Peperomia
Crocus	(spring) Petunia
Dandelion	Poinsettia*
Dogwood	Prayer plant
Dracaena	Pyracantha/Firethorn
Easter lily	Rose
Ferns	Rubber tree plant
Ficus*	Sansevieria/Snake plant
Forsythia	Scheffiera*
Fuchsia	Spider plant
Geranium	Swedish Ivy
Hibiscus	Tulip*
Honeysuckle	Wandering Jew
Impatiens	Wax plant
Jade plant	Wild strawberry/Snakeberry
Lilac	Zebra plant

***** Sap may be irritating.

UFC 4-740-20
20 March 2023

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND

AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**

This UFC supersedes UFC 4-740-20, *Libraries*, dated 1 May 2006.

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FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States, its territories, and possessions is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Military Department's responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Technical content of UFC is the responsibility of the cognizant DoD working group. Defense Agencies should contact the respective DoD Working Group for document interpretation and improvements. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide website https://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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CHAPTER 1 INTRODUCTION

1-1 REISSUES AND CANCELS.

This UFC reissues and cancels UFC 4-740-20, *Libraries*, dated 1 May 2006.

1-2 PURPOSE AND SCOPE.

This UFC provides guidelines for evaluating, planning, programming, and designing libraries. Guidance is provided for developing library facilities appropriate for each installation to combine with operations and population requirements.

This information must be used by architects/engineers (A/E), designers, base civil engineers (BCE), library directors, command and headquarters' review personnel, and others involved in developing and approving library construction projects. It is intended to help all participants better understand contemporary library requirements, programs, and design criteria so they can effectively participate in the project development process.

For Navy libraries located within Historic Resource Facilities (HRF), refer to FC 4-760-10N, *Navy Museums and Historic Resource Facilities*, for additional requirements.

1-2.1 Libraries Mission Statement.

The mission statement for library facilities at DoD installations is to provide professional library programs and services to meet the military mission, educational, and leisure-time needs of the base community, including active-duty personnel (including all U.S. and foreign military), families, retirees, civilian employees, and other authorized users. The mission objectives for DoD libraries include the following three priorities, ranked by order of importance:

1. Mission support
2. Educational support
3. Quality of life support

1-2.1.1 Mission Support.

Installation mission support is the primary priority of each DoD library facility. The support functions provided are determined by the library director at each installation and may include the identification, organization, and procurement of technical reference services and publications for official use. Funding for DoD library facilities helps develop the services, programs, materials, and personnel needed to provide support for installation-specific mission requirements.

1-2.1.2 Educational Support.

Support for Professional Military Education (PME) and Voluntary Education Programs (VEP) for active-duty military personnel and authorized civilian contractors is the second priority for library facilities, programs, and services at installations around the world.

1-2.1.3 Quality-of-Life Support.

General library facilities, programs, and services help improve the quality of life for active-duty personnel, their families, retirees, and other authorized customers. The placement, siting, and possibly colocating of a library facility with other quality of life amenities can create destinations and a sense of community. The planned creation of destinations with many amenities or attractions for the installation community to come together is a quality-of-life force multiplier. This quality-of-life support is an important function of most facilities; however, installation mission support is always the first priority.

1-2.2 Types of Libraries.

The planned users, collections/content, and mission of the installation population determine the functional type of library. The facility and criteria used to develop a library should reflect the assigned type. The Air Force identifies base library types in AFMAN 32-1084, *Standard Facility Requirements*, CC 740675 Base Libraries 7416. Requirements and design criteria for academic, technical/scientific, medical, and specialty libraries are not included in this UFC.

- General libraries (“branch” or “public” type library)
- Academic libraries
- Medical libraries
- Technical/scientific libraries
- Specialty libraries (including legal)

1-2.2.1 General Libraries.

General libraries are centralized facilities that serve the whole installation and its entire population. These facilities offer information, materials, collections, and services similar to general public libraries found in most communities and schools. Design criteria for different types, configurations, and sizes of DoD general library facilities are the focus of this UFC.

1-2.2.2 Academic Libraries.

Academic libraries are an integral part of a formal school or college-level educational institution. These libraries are often used by students as a quiet place for studying and research and for collaborative work with other students.

1-2.2.3 Medical Libraries.

These libraries are located within medical facilities and feature specific medical collections.

1-2.2.4 Technical/Scientific Libraries.

Technical or scientific libraries provide detailed information and reference materials for personnel who work in research, development, testing and evaluation (RDT&E) programs or support other scientific and technical functions.

1-2.2.5 Specialty Libraries.

1-2.2.5.1 Legal Libraries.

Legal libraries are integral to the practice and college-level education of law. These libraries are often used by students and practitioners of law as a quiet place for studying and research and for collaborative work with others.

1-2.2.5.2 Site Libraries.

Site libraries contain a collection of print and non-print materials issued to a remote location at the request of the local installation or services commander to enhance library services. They may or may not have paid staff and set operating hours. Site libraries operate under the administration of the local site commander and are serviced from a general library or library service center.

1-2.2.5.3 Field Libraries.

Field libraries (Air Force-specific) house a collection of general reading materials issued from and directed by a general library or library service center to an Air Force, DoD, or State Department activity for which the Air Force has responsibility (see DoDI 1015.10, *Military Morale, Welfare, and Recreation (MWR) Programs*, Enclosure 10). Field libraries may or may not have set operating hours or paid staff and may operate on the honor system.

1-2.2.5.4 Forward and Expeditionary Libraries.

Materials and resources for contingency operations, including pre-departure needs, and support to remote sites, collections of paperback books, newspapers, periodicals, and audio/visual (A/V) materials may be issued to library-inaccessible locations serviced from a command/headquarters or general library.

1-2.3 Library Systems and Relationships.

Library design and construction projects may be the first library facility at an installation or one of a number of networked and cooperative facilities with different roles in achieving the library’s mission at DoD installations.

1-2.3.1 General Libraries.

General libraries serve the installation community in a manner comparable to public libraries that serve a civilian community. General libraries coordinate their services to support the mission and education of installation personnel, including those served by other types, such as technical or academic. Considerations for force-multiplying the

quality of life or creation of community space must be included in planning these general library facilities.

1-2.3.2 Accessory Libraries.

Accessory libraries feature academic, technical, scientific, or medical content and specialized programs to serve the unique educational program curriculum needed to support mission requirements at each installation, and often a specific building and mission. Often these libraries will be located inside another building. Coordinate with the host building to maximize the efficiency of space and facility resources. Spaces such as restrooms, elevators, stairs, and conference rooms could potentially be shared with the host building but this will be installation-specific.

1-2.3.3 Extension Libraries.

Extension libraries feature general and public interest content but consist of a reduced program to serve as mobile, temporary, or specific population or educational opportunity to support the quality of life or readiness of each installation. Extension libraries may or may not have a dedicated building, space, or may be a mobile site, such as a bookmobile.

1-2.4 Library Users.

Generally, library users include active-duty personnel, their families, retirees, and other authorized customers. Base/installation engineers, library directors, major command, or headquarters should provide the designers with anticipated population, demographics, common commitments and missions of users, and other desired usages of the library facilities. In designated locations, the library may be used by the surrounding community.

1-3 APPLICABILITY.

This UFC applies to all Service elements and contractors involved in the planning, design, and construction of general libraries worldwide. Other library types and renovation/additions will adopt portions of the guidance applicable to the scope and intent of their project.

1-4 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high-performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and government criteria referenced therein.

1-5 CYBERSECURITY.

All facility-related control systems (including systems separate from a utility monitoring and control system) must be planned, designed, acquired, executed, and maintained in

accordance with UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems*, and as required by individual Service implementation Policy.

1-6 GLOSSARY.

Appendix B contains acronyms, abbreviations, and terms.

1-7 REFERENCES.

Appendix C contains a list of references used in this document. The publication date of the code or standard is not normally included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

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CHAPTER 2 PROGRAMMING AND PREDESIGN

2-1 GENERAL.

This chapter presents criteria specifically applicable to the design of each functional area and space of library facilities. Primary design considerations are presented for each functional area, indicating the anticipated use, performance, organization, character, and relationships between each area's component spaces. Example criteria are provided for space sizes, storage requirements, furnishings, equipment, and technical requirements for each component space within each functional area. The technical requirements and special criteria provided in this chapter address only items in addition to standard requirements by code, UFC references, and professional or construction service contracts. General considerations are presented in Chapter 3.

The guidelines in this chapter apply to all sizes and types of library facilities. Specific guidance for space allocation, in the three prototypical sizes of general libraries, is presented in Table 2-1. All guidance is provided based on the recommended space sizes and capacities for each overall facility size, supplemented by standard use and size factors, as appropriate. These recommendations may be modified in the design of an individual project to reflect local program requirements and capacity needs.

2-1.1 Program Definition.

The Requirements Document defines the program for design of an individual project, including functional requirements and design criteria. This includes the space programming and facility or project area/size. The programs found in this chapter are only guidance and example programs, plus descriptions of typical measures for the site design, building design, and building system concepts in Chapter 3. In addition, any unique local requirements concerning building programs, design criteria, and technical systems should be included in the Requirements Document.

Table 2-1 General Library Space Allocation

Functional Area/Space	#	Small	#	Med.	#	Large
Public Service Areas						
Display And Bulletin Boards	1	100	1	240	1	320
Circulation Area (w/Circulation Desk)	1	300	1	350	1	420
OPACS/ILS	1	90	1	120	1	240
Technology Hub	1	12	1	20	1	28
Reading Areas	15	600	22	880	15	1,800
General Collections	1	1,200	1	3,200	1	7,200
Reference Collections	1	200	1	400	1	700
Special Collections	1	75	1	200	2	320
Audio and Video Collections	1	50	1	75	1	100
Digital Media	1	50	1	75	1	100
Study/Huddle Rooms	6	240	12	480	18	720

Functional Area/Space	#	Small	#	Med.	#	Large
Teen Area (Reading)	1	180	1	600	1	900
Teen Area (Holdings/Collections)	1	60	1	160	1	400
Photocopier/Fax/Scan	1	80	1	160	1	240
Newspaper/Paperback Racks	1	40	1	80	1	120
Outdoor Reading Terrace		n/a		n/a		n/a
Information Services						
Customer Computer Lab	1	450	1	1,250	1	2,400
Printers/Stands/Projection Equipment	1	50	1	160	1	320
Storage	1	40	1	80	1	180
Community Technology	1	120	1	240	1	450
Meeting Space						
Group Meeting, Conference	1	200	1	200	2	400
Group Meeting, Classroom	1	1,000	1	1,200	1	2,000
Group Meeting, Small	2	180	4	340	5	500
Coffee/Café	1	160	1	500	1	1,000
Storage Closet	2	40	2	80	2	120
Children's Areas						
Children's General Collection	1	150	1	400	1	800
Children's Special Collection	1	20	1	80	1	120
A/V Collections	1	40	1	80	1	120
Children's Story Alcove & Activities	1	150	1	200	1	400
Storage	2	40	2	105	2	175
Administration Areas						
Office (1x, Director)	1	125	1	125	1	125
Office (2x, Assistant IT)	2	200	2	200	2	200
IT Workroom/Server Room	1	125	1	125	1	125
General/Open Office	3	160	6	300	8	400
Breakroom	1	125	1	125	1	150
Storage	1	36	1	112	1	200
Conference Room (May be combined with Staff Break Room)	1	160	1	200	1	240
Staff Restroom	1	50	1	50	1	100
Staff Lockers	1	24	1	64	1	80
Shower Facilities	1	16	1	16	1	32
Technical Service Areas						
Staff Conference/Meeting Room	1	120	1	160	2	280
Loading Dock	1	80	1	80	1	100
Workroom (staff)	1	200	1	400	1	600

Functional Area/Space	#	Small	#	Med.	#	Large
Storage for Material Processing	1	200	1	300	1	400
Storage for Supplies (Bulk, Technical)	1	40	1	60	1	80
Storage for Supplies (Technology And Programs)	1	20	1	30	1	40
Storage (DRMO) and Seasonal	1	20	1	30	1	50
Support Areas, Facility/Utility:						
Mechanical Room	1	500	1	800	1	1,000
Pump Room (Fire/Water)	1	64	1	80	1	100
Electrical Room	1	100	1	160	2	240
Lobby/Waiting Room	1	200	1	400	1	600
Vestibule	1	80	1	100	1	120
Janitor Closet	1	64	1	80	2	160
Public Toilet	2	500	3	600	5	720
Vending	1	18	1	36	2	48
Shower Facilities	2	32	2	32	5	72
Water Fountain (Bottle-Filling)	1	20	1	20	1	40
Elevator	0	-	0	128	0	320
TOTAL PROGRAM AREA	9,196		16,768		29,215	

2-2 SPACE ALLOWANCES CRITERIA.

The recommended set of functional areas and spaces for different sizes of general library facilities are shown in Table 2-1. This table provides example space size programs for representative facilities in each of three library program size categories. These are not definitive space programs but guides to approximate space sizes recommended for the given size facility. For facility sizes not included in this table, proportionally adjust the program figures shown for the specific facility's intended population and services. In developing the space program for an individual facility, consider the issues of overall building design and relationships described in this UFC.

Each base may determine that different or additional requirements are relevant to its local program. These considerations may affect the functional areas and spaces included in the program and their relative sizes.

2-2.1 Multiple Library Facilities

When the base population is separated by geographic or transportation barriers, planning should consider providing multiple facilities sized individually for the geographic populations. This is particularly important for equal accessibility to the library. Community destinations are a key issue for quality of life.

In these cases, each facility should be size-classified for the population to be served and the functions to be provided. Efficiencies may be gained by consolidating

management and administrative functions for a particular area or command with multiple libraries into a library services center.

2-3 CORE FUNCTIONAL AREAS.

General libraries have six specific core functional areas plus non-assignable support areas, with local variations in the scope of operation under each category. These functional area categories include the following:

- Public services areas
- Information services areas
- Meeting space areas
- Children's areas
- Administration areas
- Technical services areas
- Support areas (including mechanical rooms)

See paragraph 2-8 for additional information.

2-4 FACILITY REQUIREMENTS.

In developing the space program for an individual facility, consider the issues of overall building design and relationships discussed in Chapter 3 and Chapter 4. The space allocation sizes provided are not definitive space programs but guides to approximate space sizes recommended for the given size facility. Space requirements for library extension services (LES) facilities are based on local conditions and identified requirements of the community served.

In addition to the space program for each facility, consider the need or potential for consolidating the library into a shared facility with a BEC or learning center. It may be beneficial for some functional areas, like computer labs, to be shared with the BEC. Management, supervision, and maintenance responsibilities may also need to be evaluated along with the facility requirements.

2-5 CONSIDERATIONS FOR LIBRARY DESIGN.

2-5.1 Productivity.

Technological advances, demographic shifts, and continual demands for innovation have created pressures for environments to support the changing nature of work and workplaces. The various functions, programs, and customers in a library lead to designs to provide adaptability that enables spaces to change with work groups, activities, and projects.

The current understanding of learning spaces for mental focus and performance should be considered with other design objectives and within a total project context in order to

achieve quality study and collaboration spaces. Also, library quiet spaces are intended to include mental focus and productivity strategies that are often co-supportive with sustainable design principles, functional programming, and functionality. Endeavour to find a balance for the longevity and durability of the facility with all the issues considered. The WBDG Design Objectives website (https://www.wbdg.org/design-objectives/productive) provides five fundamental principles of productive building designs.

2-5.1.1 Promote Health and Well-Being.

Indoor environments strongly affect human health. An effective environment should be designed to support and enhance the health and well-being of its occupants. Sustainable design principles also help achieve this objective and the facility's quality of life mission.

2-5.1.2 Provide Comfortable Environments.

An environment designed and operated to provide the highest achievable levels of visual, acoustic, ergonomic, and thermal comforts for its occupants underpins worker effectiveness. Consider documenting predicted thermal comfort as described in ASHRAE 55, *Thermal Environmental Conditions for Human Occupancy*.

2-5.1.3 Design for the Changing Workplace.

Provide spaces with flexibility, social support, and technology to promote new ways of working, learning, and engaging in a number of activities.

2-5.1.4 Integrate Technological Tools.

Effectively integrate technological tools and distribution networks required in today's environments to enable occupants to perform activities or their duties, starting first and foremost with properly designed pathways and spaces.

2-5.1.5 Assure Reliable Systems and Spaces.

Reliability is one of the greatest concerns for building occupants since it directly affects their safety, health, and comfort. Occupants must be able to rely on sufficient functional space, building systems, equipment, and tools that function consistently and are properly maintained.

2-5.2 Energy and Resource Efficiency.

The mission of DoD and other federal agencies includes the protection and preservation of America's natural resources. Designs optimized for conservation of energy and other resources will contribute to achieving these missions and help to minimize environmental and air-quality pollution. Refer to UFC 1-200-02 for more information.

2-5.3 Resiliency, Operations, or Natural Disaster Response.

Building resiliency is the capacity of a building to continue to function and operate under extreme conditions, such as (but not limited to) extreme temperatures, sea level rise, natural disasters, etc. The base may provide a risk or vulnerability assessment applicable to the project site. As the built environment faces the impending effects of global climate change, building owners, designers, and builders can design facilities to optimize building resiliency. If desired by the installation or community, review UFC 4-023-10, *Safe Havens*, for measures or improvements.

2-5.4 Adaptability with Modular Furniture.

Building or space adaptability is the capacity to accommodate diverse uses of the occupancy or program. Modular furniture can be used to accommodate the events and function in the library's public service space or children's space. It may also be arranged for individuals for informal uses. It should be comfortable yet durable, with multiple configuration options. Provide an anchor or bracket to secure bookshelves.

2-5.5 Security.

The public entrance/exit is a prominent architectural component to facilitate customer wayfinding. Its design and detailing must follow UFC 4-022-01, *Security Engineering: Entry Control Facilities / Access Control Points*, and UFC 4-026-01, *Design to Resist Forced Entry*, where access control or denial is appropriate. Provide RFID scanners in the entry lobby to protect against theft. A separate "staff only" entrance may be provided that is not in a prominent location but near dedicated staff parking areas. Other exits must be for emergency use only and alarmed.

Staff at the circulation desk, or alternatively a staff work station, should have visual control over most of the reading areas for adults and children, the entry lobby, and entries to the activity areas, restrooms, and outdoor reading terrace. The circulation desk should not dominate the feeling of the library. Staff at the circulation desk or in the work room should be able to monitor equipment and activities in the computer, A/V, and technology areas. If utilized, outdoor reading terraces must be accessible only from inside. Provide curved-face surveillance mirrors or closed-circuit television (CCTV) for all hidden areas (e.g., behind stacks, around corners) for customer safety and theft prevention. The children's area needs to be visible from the circulation desk for increased security. The use of glass walls around the children's area may be used to increase visibility into the space.

2-5.5.1 After-Hours Access.

Areas such as the café, meeting rooms, restrooms, vending machines, and vestibule should have limited access for after-hours use, with CCTV monitoring and automatic door hardware with timed locking and remote unlocking. These spaces should be connected and visible to the rest of the library but located so they may be used after hours without giving access to the library.

2-5.6 Technology Center.

A technology center must include computers for public use along with printers/plotters. Tablets, laptops, headphones, and other equipment can be checked out at the desk. 3D printers may also be provided for use at each installation's discretion.

Checking out of equipment happens in a technology hub and should be located near a heavily circulated area. It should be easily located and monitored by library staff.

2-6 LOCATION AND DETERMINANTS.

2-6.1 Site Evaluation and Location.

Library facilities should be convenient and located near the center of base activities yet in quiet and uncongested areas. Consider locating them near the health and wellness center, family discovery center, dormitories, housing, and shopping areas where possible. Avoid noisy locations, such as those near arterials, airfields, and industrial facilities. Libraries may be included as parts of composite facilities with other community or mission-related functions or should be close to base educational facilities.

Consider the potential for sharing some functional areas with the BEC and family services utilizing consolidated structures, if possible. Centralized information resources provide one-stop shopping on any subject. However, library collections and technical services must function separately, with only support spaces or information services shared. These facilities should also be readily accessible from the main entrance to the base. Where possible, locate base libraries within walking distance of base operations, housing areas, shopping, and recreational facilities. Consider desirable natural site features, such as trees, vegetation, wetlands or existing water, potential water retention areas, and terrain. Existing natural site features may be incorporated into required site elements like antiterrorism/force protection (AT/FP) setback distances or vehicle barriers that may help to blend the facility into the natural setting of the site.

2-6.2 Site Size.

The minimum site area required for a free-standing library is two or three times the gross area of the building. More area may be needed if the site has any special features, such as irregular contours, existing specimen trees, or rock outcroppings to be preserved. Review UFC 3-201-02, *Landscape Architecture*, for guidance and criteria. Assure the selected site will accommodate an adequate number of parking spaces convenient to the library entrance and setback requirements provided in UFC 4-010-01. A preliminary site design must ensure the basic building and site criteria can be accommodated. Site size should provide for future expansion, if practical.

2-6.3 Site Organization.

Locate the building on the site to provide the most convenient access to take advantage of desirable views and natural site features. Examples may include providing protection from undesirable winds and glare; shading the building, especially glazed areas, from excessive sun in warm climates; and exposing the reading terrace to sun in cold

climates. Outdoor reading terraces are recommended in most climatic regions. Local base personnel should consider if such outdoor spaces would be used. Locate book and A/V collection boxes either in front of the library near the street or next to a vehicular drop-off loop with convenient sidewalk access for library staff.

2-6.4 Access and Visibility.

Provide easy access by automobile and base traffic. Choose a site with a prominent, visible location. The facility should be easily identifiable from approaching cars, base transportation, and pedestrian pathways. See the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) for the traffic control device requirements.

2-6.5 Site Utility Requirements.

Locate libraries for access to major utilities, including water, sewage, electricity, telephone, and gas lines. Provide water service, sanitary and storm systems, natural gas, steam service or fuel oil system (whichever is used), electricity, telephone, and fire alarm service to the building in accordance with UFC 1-200-01, UFC 3-201-01, *Civil Engineering*, UFC 3-210-10, *Low Impact Development*, and local service procedures. Include connections to the base computer network and communication systems.

2-6.6 Building Layout and Adjacencies.

To reinforce the library facility's secondary mission—to contribute to the quality of life—additional considerations should be taken for the relationship of adjacent buildings, transportation routes, services, and activities. Managers, base personnel, and design teams should work to locate the library within the base community and built environment to create places or spaces that are destinations and facilitate the programs and services that improve the quality of life for active-duty personnel and their families, retirees, and other authorized customers. The planned creation of destinations with many amenities or attractions in a place for the base community to come together is a quality-of-life force multiplier. Quality of life support is a priority of most facilities; however, installation mission support is always the first priority.

2-6.6.1 Accessory Library Connections.

Smaller libraries may not be most beneficial as a stand-alone facility but better contribute to the quality of life or create destinations when connected to or included within a building hosting a complementary function.

2-7 BUILDING FUNCTIONAL AREA RELATIONSHIPS.

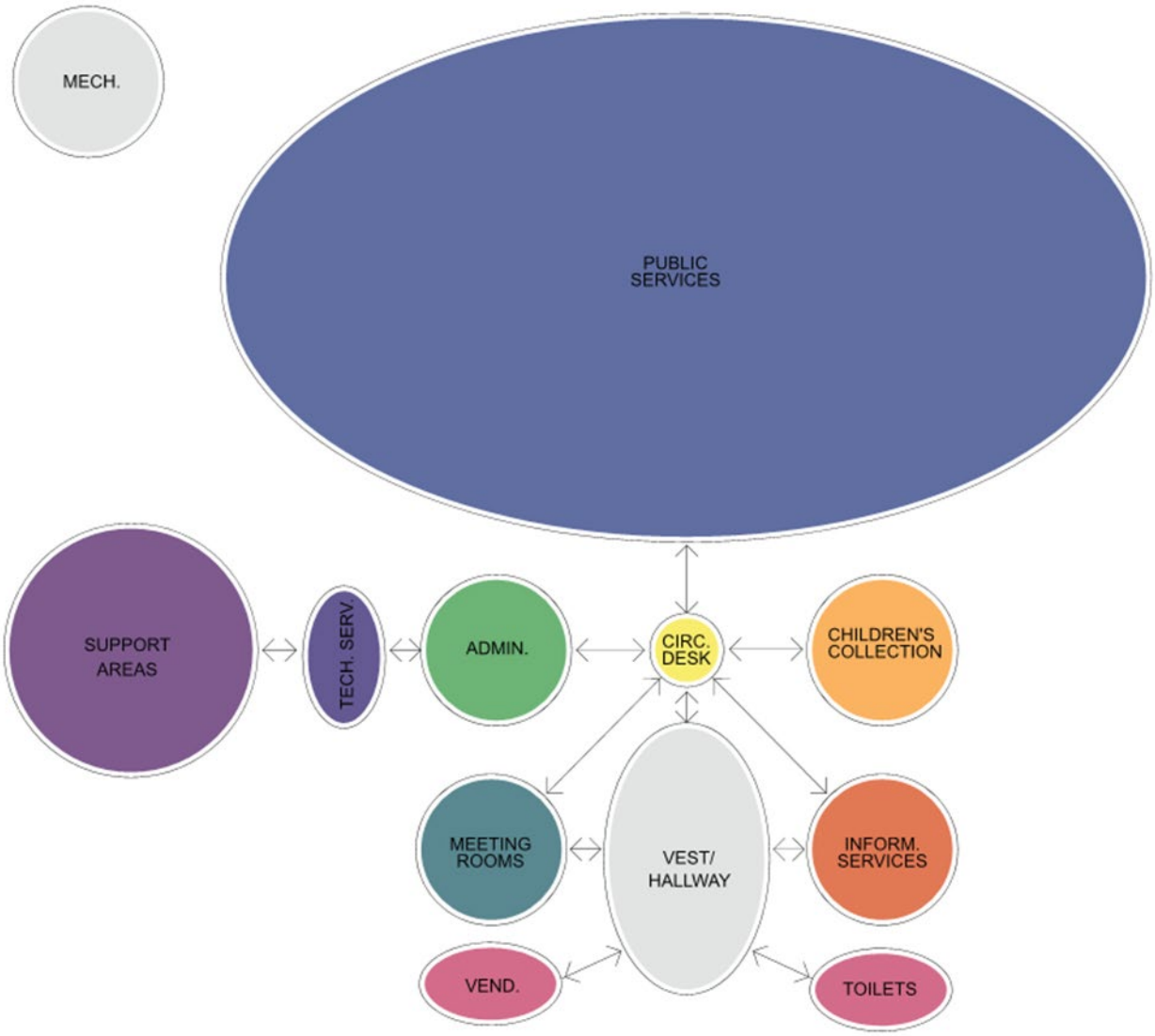
Internal adjacencies and functional relationships set up a facility for operational success. The entry lobby should have direct access to the meeting/conference rooms, restrooms, and other public support areas. A continually staffed location, such as the circulation desk, will have visual control of the public services, children's, and informational areas. The core building functional areas include:

- Public services areas

- Information services areas
- Meeting space areas
- Children’s areas
- Administration areas
- Technical services areas
- Support areas

The scope of operations may vary, depending upon specific installation and size requirements for each facility. Refer to the Functional Area Diagrams in Figure 2-1, Figure 2-2, and Figure 2-3 for an example of this functional relationship translated across facility size. Expeditionary libraries and some medium or small general libraries may be required to combine some core functional areas due to space limitations, existing infrastructure, or unique situations regarding the specific library.

Figure 2-1 Functional Area Diagram, Small



SMALL

Figure 2-2 Functional Area Diagram, Medium

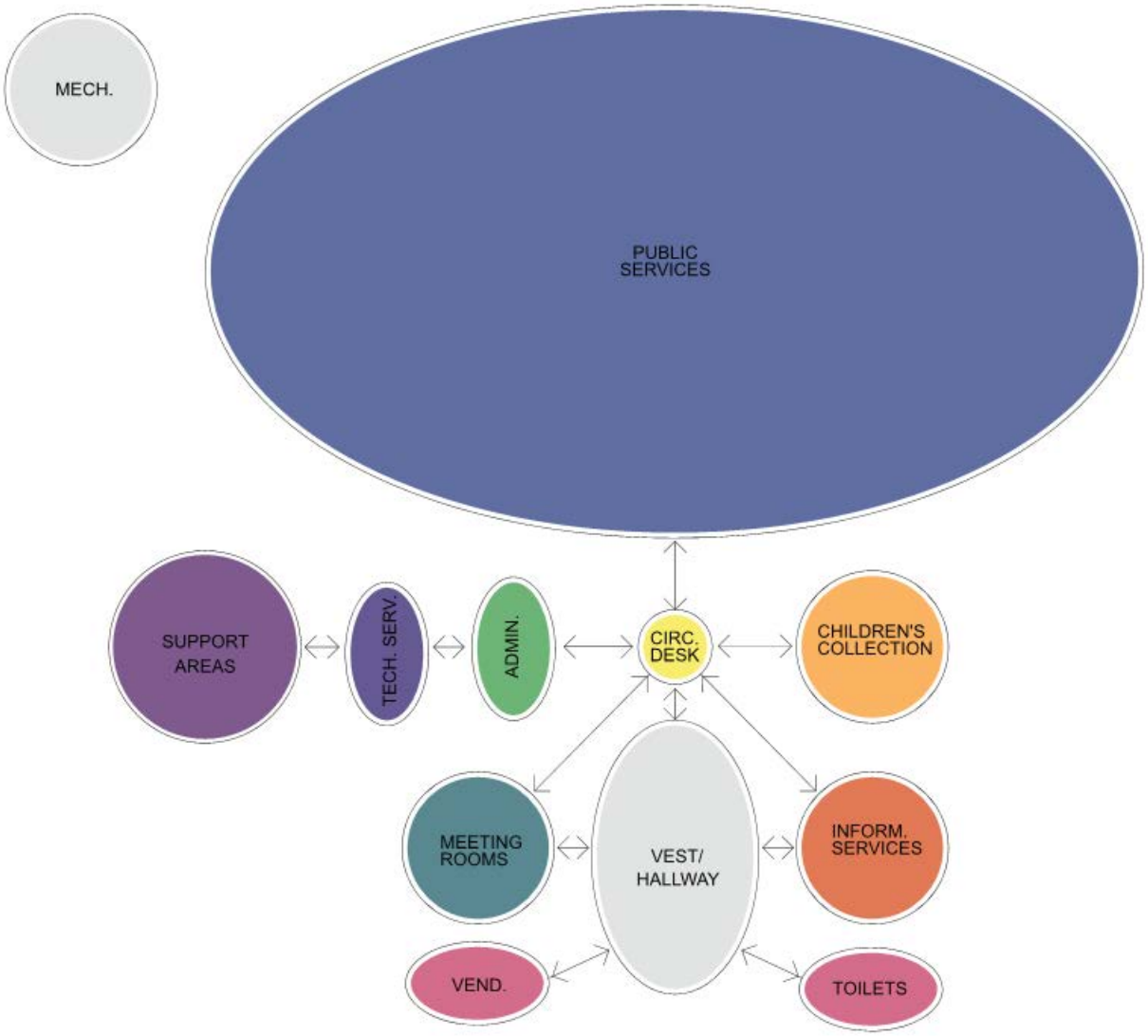
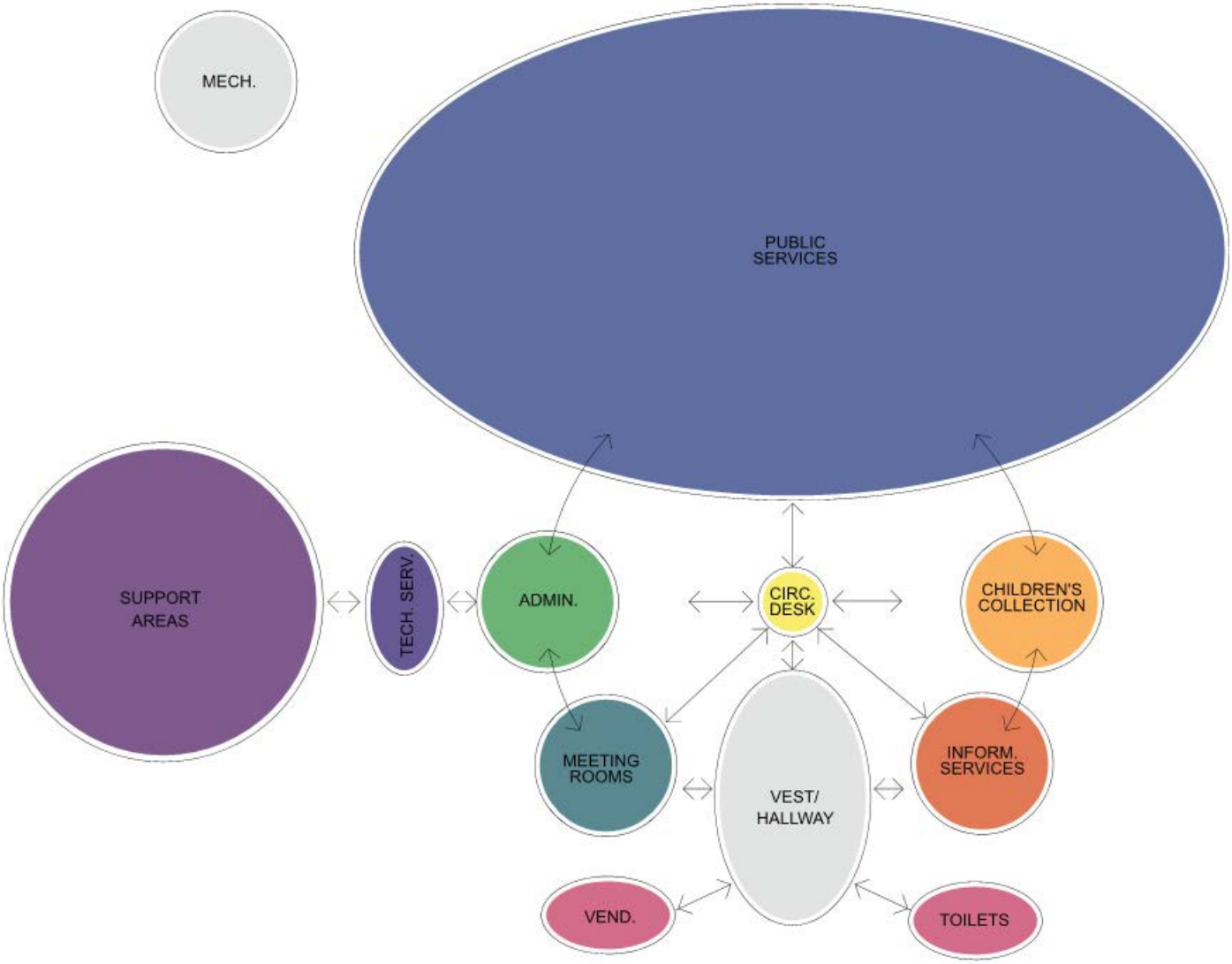


Figure 2-3 Functional Area Diagram, Large



2-8 PROGRAM AREAS.

2-8.1 Technical Services Area.

Activities conducted in the technical services areas include operational library functions such as acquisitions, cataloging, receiving, and processing collection items. These activities are usually colocated inside a large workroom along with storage areas, supplies, and equipment.

2-8.2 Administration Area.

Conference/meeting rooms may be used for meetings, seminars, lectures, story hours and other children's programs, A/V presentations, films, music, temporary exhibitions, receptions, adult study, and other similar functions. Not all events conducted in these rooms will be related to library activities.

2-8.3 Children's Area.

Requirements for children's areas will be specific to the installation's dependent population, if any. Typical areas include general and special collections, reading/story/activity areas, and a computer area. The majority of the area must be flexible and utilized for circulation between the collections, meetings, lectures, story hours, and other children's programs that may include A/V presentations, films, music, and temporary exhibitions. Use child-scaled furnishings and equipment with attractive materials, colors, and graphics. Furniture, decorations, toys, and displays may also be used to reinforce the themed environment of the children's areas. Provide visual access or control of the children's area from the circulation desk or similar workstation.

2-8.4 Information Services Area.

Computers available for customer use are the primary components of the information services areas. Areas for customer computers will be located in open areas inside public services or in an enclosed room or computer lab. Libraries that select an open area approach should colocate information services with the technology hub described in paragraph 2-8.5.3.

2-8.4.1 On-Line Public Access Catalog Computers.

Card catalogs have been replaced by Online Public Access Catalog (OPAC) computer terminals to look up information regarding available materials. These terminals are personal computers that require power and high-speed Internet connections to access data networks. Public access catalog database information is typically managed by outsourced providers to access this information. These terminals may also be used by library staff to access the Integrated Library System (ILS), which is a database of resources.

2-8.4.2 Reproduction, Fax, and Scanning Areas.

Provide electrical power for photocopiers and scanners per the manufacturer's specifications. Provide accommodations for a photocopier(s) with payment equipment, as required. Two printers, maintained at the circulation desk, must be networked to the computer stations to allow printouts to be sent from the computer stations and payment collected at the circulation desk. Photocopiers must have scanning capabilities or provide scanning stations within the information services area that include CD burners and other media storage devices as technology changes. Provide accommodations for a fax machine.

2-8.4.3 Community Technology Room.

Community technology rooms or “maker space” are dedicated for equipment or technology-based crafting, art, and educational projects by groups and individuals. Science, technology, engineering, math curriculum, and robotics clubs use these spaces for practical application of classroom skills. The installation’s specific funding options, volunteers, educational services, and support of mission requirements vary and must be verified for each library. When developing future plans and goals, educational populations must also be considered. Specialized technical solutions for ventilation, lighting, electrical receptacles, plumbing, fire protection, security, and information technology must be matched to each library’s community technology room and planned activities.

2-8.5 Public Services Area.

The component spaces for public services areas include reader stations, casual reading areas, study areas for individual and group use, general collections storage, reference materials, periodicals, casual browsing, and the circulation area, with support areas. Libraries are now used as meeting and collaboration spaces as often as research and quiet study. The public services spaces should meet the expectation for collaboration, creativity, and group learning as well as provide for traditional study and research by individuals.

2-8.5.1 Public Services Collections.

Design public services areas with the main reading space as the focal point. Areas for periodicals, reference collections, and A/V stations need not be in separate rooms but should be well defined. Use alcoves, shelves, furnishings, and architectural elements to define different spaces. Organize public services area functions to match typical library use sequences, starting at the entrance and proceeding to the circulation area, OPAC computer stations, book stacks, and reading areas. Locate functions that require frequent staff assistance, such as OPAC computer stations and A/V stations, close to the circulation desk. Organize shelving for easy collection searches and to accommodate changes in collection sizes and organization. Generally, shelves placed continuously along the edges of a space make searches more difficult than do groupings of parallel shelves. Use full-height shelving instead of partitions to distinguish between primary and secondary reading areas.

Most of the public services and children’s spaces should be visible from the circulation desk. This can be done by using low-profile furnishings. For instance, OPAC computer stations and shelving for special or reference collections and book stacks in other critical areas should be limited to a height of 3.5 feet (1000 mm); however, this does not apply to most general collection stack areas. Accommodate the needs and preferences of customers by providing reading areas that vary in size, degree of privacy, orientation to the outside, furnishing types, and arrangement. Provide at least one small area with residential qualities, like soft furniture, for a casual, relaxing atmosphere. The outdoors should be visible from the main reading areas and access from the public services area to an outdoor reading terrace (if utilized) should be provided. Coordinate the location of

convenience outlets with the locations of office and check-out equipment. Small group study areas may be placed near conference/meeting rooms and/or located around the public services areas. Provide accommodations for wireless Internet connectivity throughout the facility.

2-8.5.2 Circulation Area and Desk.

The main point of customer service interaction occurs at the circulation desk. When any distancing, safety, or security measures are desired, include them at the circulation desk. Locate the circulation area near the front entrance to facilitate surveillance of the entry lobby, computer area, children's areas, and main reading areas. Traditionally, the circulation desk is fixed but a mobile circulation desk can be utilized if desired. The circulation desk must be visible from the entry lobby and should have overviews of the public services and children's areas. Circulation desks should also have a view of restroom and conference/meeting room entrances. Locate the circulation area near reference, microform (if provided), and A/V spaces. Primary services include check-out/return functions, registering borrowers, processing overdue materials, reserving materials, and assisting customers. Locate drop slots away from queuing lines to facilitate quick returns and avoid bottlenecks. To prevent media damage, provide separate book and A/V drop slots with padding on the customer side of the desk. Locate self-check-out ILS equipment across from or near the circulation desk for supervision and assistance.

Aesthetically pleasing circulation desks should be provided to create favorable customer first impressions. Provide raised counter edges to hide computer equipment and connections, avoid clutter, and enclose storage shelves or cabinets behind the circulation desk. A minimum of 6 feet (1800 mm) clearance should be provided behind the circulation desk for staff activities. Consider including a consultation area or adjacent reading area with seating for customers and library staff adjacent to the reference desk. The reference desk may need to be combined with the circulation area or desk when staff or space is limited.

2-8.5.3 Technology Hub.

Locate A/V collections in a highly visible area, preferably near the circulation area, where staff members can easily provide assistance. A/V materials include digital movies, digital music audiobooks, tutorials, and instructional materials. Provide appropriate shelving, cabinets, and browser boxes for each media collection.

In addition, technology such as tablets, laptops, cameras, and headphones can be checked out here with the assistance of library staff. All technology should be securely stored and locked at all times, with the ability to charge while stored.

2-8.5.4 Circulation Spaces.

Circulation spaces should be free-flowing and integrated into the functional areas to prevent the perception that they are corridors. Provide durable, easily cleanable floor materials that do not make noise when book carts are used.

2-8.5.5 Displays and Bulletin Board Areas.

Provide areas for displays and bulletin boards for presenting information about current events, special programs, and other changeable information. Displays and bulletin boards should be located near high-traffic areas such as lobbies, entry corridors, and similar areas. Vacant wall space should be considered for these display requirements along with areas for freestanding easels or kiosks. Consider the need for display furniture, wall-mounted boards, and lockable cabinets. Provide display areas for print materials, three-dimensional objects, art, special promotions, community newspapers, areas for new book and A/V displays, and/or space for a central information kiosk, as needed.

2-8.5.6 Material Collections.

Material collections are composed of books, periodicals, maps, documents, computer software, and A/V resources. These collections are frequently available online as subscriptions.

2-8.5.6.1 General Collections.

Areas for general collections are composed of book stacks for fiction, non-fiction, and paperback books that occupy a large majority of the public services space. The size of the general collections and reading areas must be balanced between the required number of reader stations and the size of the general book collection (including growth). Military libraries vary considerably in the sizes of their general collections and their needs for reader stations. The balance of space allocation to stacks and readers must be determined individually for the facility in question. Consider the need for OPAC computer stations located within the general collection stacks for customer and staff convenience.

2-8.5.6.2 Special Collections.

Examples of special collections include rare books, personal papers, and unique materials. These collections are segregated from the general collection stacks. Requirements for special collections will vary at each installation. Provide a separate designated area for a paperback book swap display near primary circulation areas.

Examples of special collections include recommended reading lists, leased books, current events, local interest items, testing/educational materials, learning programs, and college course materials.

2-8.5.6.3 Reference Collections.

Many libraries provide reference material with online subscriptions or more condensed materials. When provided, reference collections will be installation-specific and may include lower-height book stacks, file cabinets for maps and pamphlets, and stands for dictionaries and atlases. Provide tables and chairs for viewing reference materials since they are not usually checked out.

2-8.5.6.4 Periodicals.

Libraries often provide periodical collections through online information catalogs and subscriptions that can be accessed with public computers (see paragraph 2-8.4.1). Where included, design periodical areas to include display shelving for magazines, newspaper racks, lounge chairs, accessory tables, and worktables. Provide a comfortable and inviting reading area, similar to upscale commercial bookstores, near the periodical collections. Utilize display shelves designed for magazines with storage areas behind for back issues.

2-8.5.6.5 Reading Area.

Reading areas are composed of major and minor reading spaces. The majority of the reader stations should be located in the main reading space of the public services area. Minor reading spaces, containing some portion of the total reader stations, may be scattered about in semi-remote locations for private reading or study. Small general, branch, field, and expeditionary libraries may not be sized to accommodate minor reading spaces. Provide data ports and flush electrical outlets for laptops and other equipment in the floor at each reading station. Coordinate spacing and location of electrical outlets with the furnishing's layout. Major reading areas should include moveable furniture to accommodate group events.

2-8.5.6.6 Collaboration Space.

A number of collaboration spaces should be spaced throughout and located within the reading spaces. Each collaboration space would reasonably seat three to five people at a worksurface. Partial-height walls or furniture may be used to define the space and give some privacy to the users. These are in addition to small study rooms (see paragraph 2-8.6.2). Consult with the installation on the specific number or desired elements.

2-8.5.6.7 Teen Areas.

Provide a dedicated space within the public services area for teenagers with material (general and special) collections, reading areas, small group study area with materials, selections and furnishings dedicated for teen audiences, and special interest teen items, like magazines. Partially enclosed spaces near periodicals, A/V stations, and other items frequently used by teenagers are good locations for teen areas. Do not locate the teen area within the children's areas. Teen areas should be designed with similar criteria and infrastructure to match adult program spaces. Provide computer stations with earphones and computer data ports for laptops, where possible.

2-8.6 Meeting Space Area.

The meeting spaces described below include conference/meeting rooms of various sizes, cafés, and other amenities that may be used for meetings, seminars, lectures, A/V presentations, films, music, temporary exhibitions, receptions, adult study, and other similar functions. Not all events conducted in these rooms will be related to library

activities. These meeting spaces should individually be considered for access outside of operational hours.

2-8.6.1 Conference Room.

Locate conference/meeting rooms off the entry lobby so its hours do not have to coincide with the library's hours. Designs should accommodate groups of different sizes (from a seating capacity of 30 for smaller facilities to 80 for larger ones) and a variety of furnishing arrangements. Consider a moveable partition in larger conference/meeting rooms so two simultaneous functions can occur, but only if requirements for maintenance, performance, and added value can be met. In this case, each room must have direct access to the entry lobby for separate access control and ensure each portion of the room has the required egress routes or emergency doors as required by codes. Design the room so it can be darkened for film presentations. Provide locally controlled dimmer switches for lights. Consider the need for telephone and video conferencing and provide the required infrastructure to provide these capabilities. For large conference rooms, consider the need for a small enclosed kitchenette with folding doors.

Locate the speaker's areas to reduce disturbances from people entering and exiting and from direct sunlight and glare. Do not place windows directly behind the speaker's position. Provide a coat closet near the door and lockable storage that is directly accessible from the conference/meeting rooms. Storage rooms should be large enough to accommodate storing tables and stacking chairs used in the activity rooms. For divisible rooms, this storage will be located in a common area that provides access from each room, such as off the entry lobby. Provide modular furniture and conference tables with Internet access, a speaker phone, and data and power accommodations. Provide a drop-down projection screen and wall-mounted whiteboards. Consider providing a smart board connected electronically to a networked printer. Provide millwork for conference materials, storage, displays, or refreshments. Provide a credenza for storage, A/V cart, and trash/recycling cans.

2-8.6.2 Small Group Study Area.

Small group study areas may consist of enclosed rooms and small tables with chairs located in open but secluded areas. Enclosed rooms that accommodate two to four people require approximately 150 square feet (14 square meters). Rooms that accommodate two people require approximately 75 square feet (7 square meters). Small group study areas require comfortable chairs and tables with two to four seats. Provide a whiteboard and trash cans in each enclosed small group study room. Provide ventilation in accordance with UFC 3-410-01, *Design: Heating, Ventilating, and Air Conditioning Systems*, lighting with controllable levels, and data ports and electrical outlets for computers and/or laptops. Provide some private, one-person study rooms with glass doors, where possible, for individual study and test preparation. All enclosed group study rooms should be acoustically sound to minimize disruptive and distracting noise.

2-8.6.3 Coffee Stands and Cafés.

Consider the need for a coffee stand/café within the non-secured area of the library lobby to serve coffee, espresso, other beverages, light snacks, and other items similar to those served in commercial bookstores and public libraries. Vendor services should be provided by outside sources and should not be considered part of the responsibilities of the library staff. Coffee cafés should be located near the main entrance area in a prominent location that will not disturb library operations. Locate coffee cafés in an area of the library such as a shared lobby that can be accessible to the public during hours when the rest of the library facility is closed and secured. Consider the need for an additional exterior entrance to the coffee café and locate appropriately.

2-8.6.4 Public Restrooms.

Provide male, female, and family accessible restrooms according to ABA requirements. The number of toilets and urinals required will vary according to the overall size of each facility. Locate restrooms off the entry lobby to allow access for users of the conference rooms and coffee café during times when the library is closed. In such cases, provide a night security closure at the access control point to secure the rest of the library.

2-8.6.5 Water Fountain.

Locate public water fountains near the restrooms. Include full-height and wheelchair-accessible water fountains according to ABA requirements.

2-8.6.6 Vending Machines.

Address the need for snack or drink machines and other vendor-supplied equipment located near the lobby or vestibule. Locate vending machines in an alcove or area with only a partial view from the entrance or lobby. Do not place vending machines at the entrance or in the lobby because it is unsightly. Provide an anchor or bracket to secure vending machines.

2-8.6.7 Outdoor Reading Terraces.

Where the climate permits, consider an outdoor reading terrace that may be used for adult casual reading or children’s story hours as an enriching addition to a library. The terrace should be entered from spaces visible from the circulation desk and should have no exits to the outside except for emergency egress. Local conditions, such as siting, building configuration, budget, and anticipated use, should be used to justify the appropriate size requirements.

2-8.7 Support Area.

Core areas that support the overall facility include the vestibule/airlock at the entrance, lobby, and circulation areas throughout the facility. Support areas like restrooms and water fountains may need to be located outside the access control point of the library for public access outside of operating service hours. Staff-only support areas include the loading dock, storage, and mechanical rooms.

2-8.7.1 Loading and Receiving Docks.

Provide a covered loading area and double-wide exterior doors. Asphalt or concrete access drives to the loading dock must be a minimum of 12 feet (3650 mm) wide for access by large trucks. Consider the requirements for commercial shipping and delivery companies and large furniture deliveries. Provide easy access to dumpsters or outside trash containers. Provide a doorbell or buzzer at the loading dock entrance door that can be heard in the administration and technical services areas. For Navy and Marine Corps facilities, provide a fall protection system in accordance with OPNAV M-5100.23, *Navy Safety and Occupational Health Manual*, where the elevation between the floor edge of the dock and adjacent surface is 4 ft (1.2 m) or greater.

2-8.7.2 Storage Areas.

Storage areas are vital to librarians for multiple reasons, including:

- Monthly in-processing and out-processing of lease materials
- Storage of supplies, which are usually bought in bulk at the end of the year
- New books, which are often bought in bulk at the end of the year
- Items going to Defense Logistics Agency (DLA) Disposition Services
- Seasonal displays and decorations
- Supplies, copier paper, and crafts for story time all require adequate storage

Provide storage closets, where possible, to maximize the use of available space. Provide lockable doors on all storage closets. Locate an open storage area near the loading dock for items being shipped or received. Verify storage requirements with the library director at each facility since special storage requirements may be required.

2-8.7.3 Janitor Closets.

Locate the janitor closets near the restrooms. Provide a floor-mounted mop sink, dry storage for supplies, shelves for maintenance supplies, and a sloped floor with a floor drain. Provide shelves and hooks for cleaning and maintenance equipment storage. All surfaces must have water-resistant finishes. Include enough room for a mobile cleaning cart.

2-8.7.4 Mechanical Rooms.

Utilize mechanical rooms, as required, for HVAC, plumbing, electrical, hot water, telephone, fire suppression, and other building systems equipment. Locate mechanical rooms so they have entry and service doors located on the outside of the building only to minimize noise and service disruptions. Provide sound proofing, where required. Utilize a sloped floor towards a floor drain for rooms with equipment involving water or that may leak.

2-9 SITE DESIGN ELEMENTS.

Site the library so the main entrance is clearly visible and the architecture provides intuitive wayfinding cues to guide visitors to the main entrance. Preserve and utilize natural site features, such as topography, trees, greenery, and rock outcroppings, to help define the site and accent the building. Use landscape elements to provide definition, screening, and focus for the site.

2-9.1.1 Outdoor Reading Area.

Depending on the climate, it may be shaded or exposed to the sun, or variable with the time of day. The enclosure should be a minimum of 6 feet (2 meters) high and visually permeable. Durable outdoor furnishings, furniture, and shading should be provided. Local conditions, such as siting, building configuration, budget, and anticipated use, should be used to justify the appropriate size requirements.

2-9.1.2 Book Drop-Off.

Book and A/V collection boxes should be located with customer convenience in mind and allow drivers to place materials in collection boxes from their cars when the library is closed. Building openings for collection boxes create AT/FP vulnerabilities and should not be incorporated in new construction. Existing building collection boxes should be replaced with remote boxes and these building penetrations should be permanently sealed. Remote collection boxes should be outside the minimum stand-off distances required by UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings.*

Locate remote book and A/V collection boxes where they offer the most convenient access for customers but do not cause traffic problems. Potential locations include at the front of the library near the street or next to a vehicular drop-off loop road. Remote collection boxes should be located on the driver’s side of the drop-off lane in an island. Provide an efficient pathway from the collection boxes to the staff entrance to minimize the effort required to return these materials to the work room area without utilizing the public entrance to the facility. A/V collection boxes should be padded to prevent potential damage to A/V media. Consider utilizing combination units that feature both types of collection boxes and the potential impact of severe weather, pick-up or “grab and go” equipment or improvements for convenience and safety of patrons, and a covered area to shelter the collection boxes drop-off point.

2-9.1.3 Transit Connections.

Access through base/installation or public transit infrastructure is a program goal and assumed by locating the library on service routes or providing such infrastructure. As an alternative, consider locating libraries at the installation visitor’s center, on- or off-installation high-traffic commercial/retail centers, or similar centers of activity. Provide covered waiting areas and seating that is publicly visible to encourage access to locations shown to have multimodal transportation choices.

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CHAPTER 3 DESIGN

3-1 GENERAL.

This chapter provides general design and material guidance, including requirements for the site, plus building exterior and interior areas. The focus of this information is library-specific issues; general professional knowledge with which A/Es are familiar is not addressed. These guidelines address design considerations for site and building layout, architectural character, function, circulation, and facility systems. Information is provided regarding the preferred materials and finishes that deliver the required durability yet are still aesthetically pleasing. Functional diagrams and other guidance regarding potential layout configurations for different styles of building design are provided to illustrate how the functional area could potentially be organized.

Facility systems information is also provided regarding structural considerations, HVAC systems, plumbing, electrical, fire protection, life safety, communications, A/V requirements, alarm/security systems, and acoustical requirements. Non-government resources from the American Library Association (ALA) are not required but may help in design solutions or facilitate the preparation of specifications and contract documents (see Appendix C).

3-2 DISCIPLINE-SPECIFIC CONTENT.

3-2.1 Civil Engineering.

Connect libraries to utilities, including water, sewage, electricity, telephone, and gas lines. Provide water service, sanitary and storm systems, natural gas, steam service or fuel oil system (whichever is used), electricity, telephone, and fire alarm service to the building in accordance with requirements of UFC 1-200-01, UFC 3-201-01, UFC 3-210-10, and local service procedures. Include connections to the base computer network and communication systems.

3-2.1.1 Drainage.

Reference UFC 1-200-02 and UFC 3-201-01. The A/E should coordinate with local requirements, strategies, base master-drainage plan, and the site-specific geology/soils report.

3-2.1.2 Vehicle Circulation.

Where possible, locate parking areas to the sides of the building where they will not dominate the building entrance. Provide adequate light levels at night in all parking areas for security and safety and handicapped-accessible parking spaces. Consider the need for a dedicated staff parking area located near the staff-only entrance to the building. Spaces for motorcycles and bicycles should also be provided as required by the base population. Consider the location of bicycle racks near the main entrance in a secure location. Refer to UFC 3-201-01 for detailed information regarding vehicle circulation and parking requirements.

3-2.1.3 Site Design.

Site design and engineering must minimize cost and disturbance with consideration of the need to preserve and utilize natural site features, such as topography, hydrological features, trees, greenery, and rock outcroppings to help define the site and accent the building. Use landscape elements to provide definition and focus for the site, with screening from site liabilities if appropriate.

3-2.2 Landscape Architecture.

Refer to UFC 3-201-02 for additional information regarding landscape architecture.

3-2.2.1 Plantings.

Use indigenous plants that are appropriate for the climate and local base conditions. Landscape plantings can dramatically improve the first impression of a facility and help control erosion. In some instances, landscaping may also reduce maintenance requirements. Follow sustainable design principles for xeriscaping and low-water-usage plant design. Do not use poisonous or toxic plants.

3-2.2.2 AT/FP.

The existing landscape may also be used to create stand-off distances required for effective AT/FP measures and create buffer zones around the facility. Refer to UFC 4-010-01 for more information.

3-2.3 Architecture.

The architectural and interior design of the library must be integral and related. They both involve functional analysis and consideration of the appropriate aesthetic or stylistic character, building organization, circulation, supervision, and flexibility requirements, as well as finishes and furnishings. Present an open, inviting image while providing visibility of attractive activities from the approach and entrance. The library should have spaces that vary in character and scale to support different activities. Spaces should emulate the environments found at upscale commercial bookstores, with a range of lounge-like areas. The main activity areas should be grouped in a continuously visible sequence, with easy access between spaces. Single-level facilities are preferred. Refer to UFC 3-101-01, *Architecture*, for more information and follow base or installation guidance requirements.

Create an individual theme for the facility that may be host nation or base/installation related. Many thematic environments can best be presented in lobbies, primary circulation areas, and the main reading area for adults. Theming should apply continuously to the entire design of the facility, from overall architectural expression to specific interior development. The architectural character should reinforce the focus of the building on the main reading room and reader activity spaces. Service and support areas should be subordinate and, where appropriate, expressed as secondary volumes. The library should have a distinctive presence on the base. Materials and detailing should be of high quality, equal to those of the most significant buildings on the base.

The architectural style must comply with installation-specific requirements and be compatible with UFC 3-120-10, *Interior Design*.

3-2.3.1 Daylighting.

Controlled, indirect daylight should be admitted into reading areas through clerestories, skylights, or windows. Use of daylight will reduce the load on electric lights, reduce reader eye strain (eye strain is greatest with fluorescents), and permit visual connection to the outside. Review and implement the criteria in UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*, to the extent appropriate for libraries. However, care must be taken not to expose books to direct sunlight to avoid damage from ultraviolet (UV) rays. Consider sunlight-filtering devices applied to windows and solar shade screens to reduce UV exposure and reduce thermal heat gain. A passive solar design (described in UFC 1-200-02) applied to libraries requires specific efforts to manage glare, UV, and heat gain. Automatic shades or control devices (programmable), sufficient to block UV exposure are required. Refer to UFC 3-101-01.

3-2.4 Interior Design.

Choose furniture that is durable, comfortable, and attractive. Solid wood is a good choice and natural finishes can be used to accentuate the interior décor. Circulation and reference desks need durable counters and front panels, such as metal, granite, or solid surface composite materials. Consider modular furniture components designed specifically for libraries. Counter fronts are high maintenance and require highly durable materials because of wear and tear. People stand, lean, or press against the counter materials at all levels of height, including child heights. Current systems furniture options should be considered as a potential solution for library counters. If a systems furniture library counter is not included, it should at least be considered as a supplementary or complementary feature to provide adaptability for process and technology changes at the circulation area.

Consider graffiti-proof furniture and materials in bathrooms, small group study areas, and other secluded places not easily visible by staff members. Floor material colors and textures will be primary considerations for selecting coordinated furniture and equipment. Do not use compact or high-density shelving in areas accessible to the public. Use book stacks with heavy-duty construction and consider the use of 16-gauge metal stacks and shelves specifically designed for library use that can be secured to avoid being knocked over yet still be moved with books in place. This is very beneficial when rearranging stacks or replacing carpet because books do not need to be removed to relocate the stacks. Wooden book stacks are more attractive and quieter than metal stacks but may require moving books prior to relocation. If single-tier steel bracket shelving is used, follow ANSI/NISO Z39.73-1994 (R2012), *Single-Tier Steel Bracket Library Shelving*. Refer to UFC 3-120-10 for more information.

3-2.5 Geotechnical Engineering.

Refer to UFC 3-220-01, *Geotechnical Engineering*.

3-2.6 Structural Engineering.

Select an economical structural system based on facility size, projected load requirements, local availability of materials and labor, and wind, snow, seismic, geologic, and permafrost conditions. Provide consideration for addition or expansion of projected future needs to easily and economically accommodate future requirements; however, do not over-design the initial construction. Structural bay sizes should reflect space requirements, economy, and subsystem dimensions, such as masonry units and ceiling grids. Structural bay sizes should be compatible with standard shelving unit sizes and standard row-to-row dimensions. Keep to two stories or fewer where possible or the costs associated with designing-in progressive collapse criteria will need to be incorporated. Reference UFC 3-301-01, *Structural Engineering*, for general and location-specific soil, structural, and code requirements.

3-2.7 Fire Protection.

Fire protection and life safety designs must comply with the following sources for detailed guidelines and specifications:

- UFC 3-600-01, *Fire Protection Engineering for Facilities*
- UFC 3-601-02, *Fire Protection Systems Inspection, Testing, and Maintenance*
- Latest edition of the NFPA standards

Occupancy for libraries is classified as assembly by NFPA 101, *Life Safety Code.* Fire protection systems must conform to conventional United States standards and codes. All new and refurbished buildings must have automatic fire detection and/or fire suppression systems, which must be monitored to send signals to the base fire station and/or central control or monitoring facilities. All materials and equipment must be Underwriters Laboratory (UL) listed or Fire Marshal approved. The provision of fire protection systems and equipment must be reviewed for all new and refurbished buildings as part of a “fire risk analysis” and “fire strategy” study, executed during the design period. During the design period, careful consideration must be given to the selection of specific design codes, standards, base-specific criteria, and base fire officer requirements that affect the equipment specifications, design, and installation. Equipment selections should not be considered in isolation, but be reviewed in unison with the overall fire strategy for each building and installation.

3-2.8 Mechanical Engineering.

Provide HVAC systems in compliance with the current edition of the International Mechanical Code (IMC), UFC 3-410-01, and UFC 3-410-02, *Direct Digital Control for HVAC and Other Building Control Systems*. Comply with the recommendations of ASHRAE where applicable by UFC or referenced standards. Perform a lifecycle cost analysis of available energy sources. Due to the nature of the materials and stacks within the libraries, do not program night setbacks or unoccupied modes for the HVAC system unless reports and calculations accounting for humidity and thermal mass of library materials are accepted by base command/AHJ. Provide zone control for

maintaining different environmental conditions in each functional area. HVAC systems for activity areas, like conference and meeting rooms, should be designed to allow night-time operation while the rest of the facility is closed. Ductwork serving the children's areas and the activity areas must be designed to help acoustically separate those areas from the rest of the facility. Provide tamper-proof thermostats that may be internally controlled by the facility manager. Provide programmable controls and use security features so they are only accessible to authorized personnel. Design of new facilities must ensure that building energy consumption must not exceed DoD energy budget figures.

3-2.8.1 Library Materials Environment.

To help protect and preserve library materials, maintaining stable conditions is crucial. Per NISO TR01-1995, *Environmental Guidelines for the Storage of Paper Records*, fluctuations in temperature increase the degradation rate of paper relative to storage at one temperature. In accordance with NISO TR01-1995, the maximum recommended temperature for combined stack and customer spaces in libraries is a stable temperature no higher than 70 °F (21.1 °C) and a stable relative humidity between 30 percent and 50 percent. Institutions should choose a temperature and relative humidity within the recommended ranges that can be maintained 24 hours a day, 365 days a year. The climate-control system should never be turned off and settings should not be lowered at night, on weekends, or at other times when the library is closed. Additional costs incurred by keeping the system in constant operation will be far less than the cost of future conservation treatment to repair damage caused by poor climate.

Libraries with separate rooms for archives and/or special collections may have specific storage needs for various formats, including historic documents, photographs, film, maps, and rare books. Consult NARA Directive 1571, *Archival Storage Standards*, or the Society of American Archivists (SAA) (see Appendix C) for appropriate temperature and humidity standards.

3-2.8.2 Particular Space Engineering.

Certain rooms within the library, such as conference rooms, will be densely occupied at irregular or infrequent intervals as described in UFC 3-410-01. Consider the anticipated occupancy pattern when developing the HVAC equipment layout and sequence of operation to ensure that overall lifecycle cost is minimized. Evaluate opportunities, such as demand-controlled ventilation by occupancy sensors, for these room types.

Comply with AT/FP requirements in the design of HVAC systems. To ensure durability, consider climate conditions, high humidity, industrial atmosphere, saltwater exposure, or other adverse conditions when selecting exterior HVAC components. Design building HVAC systems to accommodate long-term flexibility, renovations, and additions.

3-2.9 Electrical Engineering.

Provide electrical service and distribution equipment, wiring receptacles and grounding, interior and exterior lighting and controls, emergency lighting, telephones, communication systems, fire alarms, and intrusion systems in accordance with UFC 3-520-01, *Interior Electrical Systems*, NFPA 70, *National Electric Code*, and the latest installation design requirements. See the International Trade Administration's Electric Current Worldwide website to determine voltages and cycles in overseas locations (https://legacy.trade.gov/mas/ian/ECW/index.html). Review and implement the criteria in UFC 3-530-01 to the extent appropriate for libraries.

Evaluate and include the following power needs to determine the required electrical service capacities: HVAC systems, technology hub, A/V equipment, computers or terminals, media, copiers, printers, theft detectors, other special equipment required by users, and considerations for expansion. Provide metering for electrical power. Secondary underground service raceways may be PVC Schedule 40. Service grounding system and all wiring methods must meet National Electric Code (NEC) requirements.

3-2.9.1 Receptacle Access.

General convenience receptacles and special power outlets must be specification grade. General spacing of convenience receptacles must be a maximum of 12 feet (3600 mm) on center and 5 feet (1500 mm) on center where carrels occur. Additional access to power and data through access flooring floor outlets or wall outlets should be considered and coordinated with the furnishing plan and activities/uses programmed for task lighting, equipment, computer/projector setup, and user convenience. Provide electrical outlets and public access Wi-Fi for laptops or personal devices in the study areas, reading areas, and coffee cafés. Consider the need for additional electrical outlets at circulation and reference desks, work rooms, offices for staff use, A/V areas, and in reading areas for customer use. The type and scope of computer systems that may be used can vary depending on local base decisions and technological developments.

Provide an intrusion detection alarm system and wall clocks in all functional areas.

3-2.10 Information Technology (Low-Voltage).

Reference UFC 3-580-01, *Telecommunications Interior Infrastructure Planning and Design*.

3-2.10.1 Public Internet and Exterior Resource Access.

Provide commercial Internet access for public and patron use at most computers and Wi-Fi throughout the facility.

3-2.11 Plumbing.

Provide domestic hot and cold water, sanitary and storm drainage, plus propane or natural gas systems (if required) in accordance with design requirements established in UFC 3-420-01, *Plumbing Systems*, and the International Building Code (IBC). Provide hot and cold water to all restrooms, sinks, janitor's closets, and coffee cafés. Provide a water bottle-filling station with the water fountain. Hot water temperature must not exceed 105 °F (40 °C) at the outlet. Provide floor drains in restrooms and janitor's closets. Provide shut-off valves at all fixtures. Provide frost-free hose bibs on all exterior walls if justified by local climatic conditions. Provide metering for gas service. Provide water metering for water conservation and maintenance measures.

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CHAPTER 4 FUNCTIONAL DATA SHEETS

4-1 ADMINISTRATION.

Requirements for administration areas are the same for all types and sizes of libraries. Only the size requirements will vary depending upon the overall size requirements of the entire facility. If possible, design administration areas with visibility to the outdoors and/or interior of the library.

4-2 FUNCTIONAL DATA SHEETS.

Functional data sheets are intended to provide the minimum requirements for the respective rooms and spaces.

Table 4-1 Circulation Area

Description/Usage	The circulation area includes the circulation desk and is the main point of contact for information and assistance.
Occupancy Density	As reception/lobby of an office, 10 to 30 per 1000 ft^2 (93 m^2), including staff work stations, regularly occupied spaces.
Min. Ceiling Ht.	8 ft (2.4 m) minimum
Finishes	**Walls.** Provide a low-maintenance, durable finish. **Floors:** Durable flooring that absorbs sound and can be cleaned. **Ceiling:** Changes in ceiling type and heights should be utilized to guide people to the circulation desk. Consider acoustics and light reflectance in ceiling selection.
Plumbing	None required.
HVAC	Provide system per paragraph 3-2.8.
Fire Protection	Provide system per paragraph 3-2.7.
Power	Provide outlets per paragraph 3-2.9.
Lighting	Provide system per paragraph 3-2.9.
Communication	**CCTV.** Required. **CATV/Internal Video.** Required. **PA/Audio.** Provide phone or microphone connected to library PA system. Coordinate with installation needs, processes, and equipment. **Telephone.** Required, 2 minimum. **Data.** Required at each workstation to access the ILS database. Provide connections to outside computer networks. **Security.** Provide security camera monitors located out of the view of customers. Include space for lost and found items to be stored and provide lockable storage for staff personal items.
Acoustics	Meet library criteria in UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	Coordinate with installation needs, processes, and equipment. Circulation desk should be durable and abuse-resistant. Coordinate requirements for drawers, cabinets, browser boxes, and must be coordinated with end user's needs, processes, and equipment. Provide

	shelving and space for parking carts behind the desk to accommodate returned materials.
Furnishings Fixtures & Equipment (FF&E)	Equip the circulation desk. Coordinate with installation needs, processes, and equipment. Provide anti-fatigue mats behind the service counter areas where staff may stand for extended periods.
User-provided Equipment	Computers, workstation equipment, and ILS. Coordinate with installation.
Special Requirements	Visual connections and control of entrance, public spaces, and circulation.

Table 4-2 Reading Area

Description/Usage	Reading areas are composed of major and minor reading spaces. The majority of the reader stations should be located in the main reading space of the public services area.
Occupancy Density	As library, 10 per 1000 ft^2 (93 m^2) or as most dense use when multi-functional. Confirm with reading stations and open study seats, which may create higher density.
Min. Ceiling Ht.	8 ft (2.4 m) minimum
Finishes	**Walls:** Provide a low-maintenance, durable finish. **Floors:** Flooring should be sound-absorptive, durable, and easy to maintain despite rolling book carts. **Ceiling:** Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-2.8.
Fire Protection	Provide system per paragraph 3-2.7.
Power	Provide outlets per paragraph 3-2.9.
Lighting	Provide system per paragraph 3-2.9.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Coordinate with installation needs, processes, and equipment. **Telephone.** None required. **Data.** Coordinate with installation needs, processes, and equipment. **Security.** None required.
Acoustics	Meet library criteria in UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	Seating and tabletops optional for minor reading areas (or FF&E).
Furnishings Fixtures & Equipment (FF&E)	Seating, tables, and activity support furniture should be mobile and multi-function.
User-provided Equipment	TBD by the installation.
Special Requirements	Multi-use space and multi-function amenities.

Table 4-3 Children's Area

Description/Usage	The children's area includes general and special collections, reading/story/activity areas, and a computer area.
Occupancy Density	As library, 10 per 1000 ft^2 (93 m^2) or as most dense use when multi-functional. Confirm with reading stations and event/activity seats, which may create higher density.
Min. Ceiling Ht.	8 ft (2.4 m) minimum
Finishes	**Walls:** Provide a low-maintenance, durable finish in child-friendly colors. **Floors:** Flooring should be sound-absorptive, durable, and easy to maintain with activities and book carts. **Ceiling:** Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-2.8.
Fire Protection	Provide system per paragraph 3-2.7.
Power	Provide outlets per paragraph 3-2.9.
Lighting	Provide system per paragraph 3-2.9.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Coordinate with installation needs, processes, and equipment. **Telephone.** None required. **Data.** Coordinate with installation needs, processes, and equipment. **Security.** None required.
Acoustics	Meet library criteria in UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	Seating and tabletops optional for minor reading areas (or FF&E).
Furnishings Fixtures & Equipment (FF&E)	Seating, tables, and activity support furniture should be mobile and multi-function.
User-provided Equipment	TBD by the installation.
Special Requirements	Multi-use space and multi-function amenities.

Table 4-4 General and Reference Collections

Description/Usage	Areas for general collections are composed of book stacks for fiction, non-fiction, and paperback books that occupy a large majority of the public services space.
Occupancy Density	As library, 10 per 1000 ft^2 (93 m^2) or as most dense use when multi-functional. Confirm with each installation since this may create higher density.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls:** Provide a low-maintenance, durable finish. **Floors:** Flooring should be sound-absorptive, durable, and easy to replace in sections. **Ceiling:** Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-2.8.
Fire Protection	Provide system per paragraph 3-2.7.
Power	Provide outlets per paragraph 3-2.9.
Lighting	Provide system per paragraph 3-2.9.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Coordinate with installation needs, processes, and equipment. **Telephone.** None required. **Data.** Coordinate with installation needs, processes, and equipment. **Security.** None required.
Acoustics	Meet library criteria in UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	Optional; confirm reference desk and workstations with installation.
Furnishings Fixtures & Equipment (FF&E)	Reference collections will be installation-specific and typically include lower-height book stacks, file cabinets for maps and pamphlets, and dictionary and atlas stands.
User-provided Equipment	TBD by the installation.
Special Requirements	N/A

Table 4-5 Reference Desk and Storage

Description/Usage	Areas for reference collections are composed of book stacks for reference books, computers for online catalog access, and special collections, such as microfilm.
Occupancy Density	As library, 10 per 1000 ft^2 (93 m^2). Confirm with each installation.
Min. Ceiling Ht.	8 ft (2.4 m) minimum.
Finishes	**Walls:** Provide a low-maintenance, durable finish. **Floors:** Provide durable, easy-to-clean flooring that can withstand heavy storage shelves. **Ceiling:** Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-2.8.
Fire Protection	Provide systems per paragraph 3-2.7.
Power	Provide outlets per paragraph 3-2.9.
Lighting	Provide system per paragraph 3-2.9.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Coordinate with installation needs, processes, and equipment. **Telephone.** None required. **Data.** Coordinate with installation needs, processes, and equipment. **Security.** None required.
Acoustics	Meet library criteria in UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	Optional; confirm reference desk and workstations with installation.
Furnishings Fixtures & Equipment (FF&E)	Reference collections will be installation-specific and typically include lower-height book stacks.
User-provided Equipment	TBD by the installation.
Special Requirements	Optional; confirm reference desk and workstations with installation.

Table 4-6 Study/Huddle Rooms

Description/Usage	Small group study areas may consist of enclosed rooms and small tables with chairs located in open, but secluded, areas.
Occupancy Density	As conference room, 50 per 1000 ft^2 (93 m^2). Confirm with study seats, which may create higher density.
Min. Ceiling Ht.	9 ft (2.7 m) minimum.
Finishes	**Walls:** Provide a low-maintenance, durable finish. **Floors:** Flooring should be sound absorptive, durable, and easy to replace in sections or maintain. **Ceiling:** Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-2.8.
Fire Protection	Provide system per paragraph 3-2.7.
Power	Provide outlets per paragraph 3-2.9.
Lighting	Provide systems per paragraph 3-2.9.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Coordinate with installation needs, processes, and equipment. **Telephone.** None required. **Data.** Coordinate with installation needs, processes, and equipment. **Security.** None required.
Acoustics	Meet conference room criteria in UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	Optional study booth or table.
Furnishings Fixtures & Equipment (FF&E)	Study chairs and accessories, study table if not built-in, white board and tray, and clock.
User-provided Equipment	TBD by the installation.
Special Requirements	N/A

Table 4-7 Teen Area

Description/Usage	Provide a dedicated space within the public services area for teen audiences and special interest collections for fiction, non-fiction, paperback books, and audio books.
Occupancy Density	As library to conference/meeting, 10 to 50 per 1000 ft^2 (93 m^2) or as most dense use when multi-functional. Confirm with reading stations and study/activity seats which may create higher density.
Min. Ceiling Ht.	9 ft (2.7 m) minimum.
Finishes	**Walls.** Provide a low-maintenance, durable finish. **Floors:** Flooring should be sound-absorptive, durable, and easy to replace in sections. **Ceiling:** Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-2.8.
Fire Protection	Provide system per paragraph 3-2.7.
Power	Provide outlets per paragraph 3-2.9.
Lighting	Provide system per paragraph 3-2.9.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** None required. **Telephone.** None required. **Data.** Coordinate with installation needs, processes, and equipment. **Security.** None required.
Acoustics	Meet library criteria in UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	Seating and tabletops optional for minor reading areas (or FF&E).
Furnishings Fixtures & Equipment (FF&E)	Seating, tables, and activity support furniture should be mobile and multi-function.
User-provided Equipment	TBD by the installation.
Special Requirements	Multi-use space and multi-function amenities.

Table 4-8 Community Technology Room

Description/Usage	Space dedicated for equipment or technology-based crafting, art, and individual project production. Often called “maker space.”
Occupancy Density	20 to 25 per 1000 ft^2 (93 m^2) as wood/metal shop or computer lab. Confirm with workstations and/or classroom seats, which may create higher density.
Min. Ceiling Ht.	9 ft (2.7 m) minimum.
Finishes	**Walls:** Provide a low-maintenance, durable finish. Coordinate with equipment in the room for appropriate finishes that can withstand the function of the room. **Floors:** Flooring should be durable, easy to clean, and abuse-resistant. **Ceiling:** Ceiling should be durable, cleanable, and give maintenance staff and equipment installers access to systems above. Provide acoustic absorption (NRC) and light reflectance (LRV) in support of room functions and lighting.
Plumbing	None required.
HVAC	Provide system per paragraph 3-2.8.
Fire Protection	Provide system per paragraph 3-2.7.
Power	Provide outlets per paragraph 3-2.9.
Lighting	Provide system per paragraph 3-2.9.
Communication	**CCTV.** None required. **CATV/Internal Video.** None required. **PA/Audio.** Coordinate with installation needs, processes, and equipment. **Telephone.** None required. **Data.** Coordinate with installation needs, processes, and equipment. **Security.** Coordinate with installation needs, processes, and equipment.
Acoustics	Meet library criteria in UFC 3-101-01 and provide an area of finishes with NRC of 0.70 or higher to equal or exceed the floor area of this room/area.
Casework/Built-in Equipment	Coordinate to support maker equipment and tools planned by installation.
Furnishings Fixtures & Equipment (FF&E)	Coordinate to support maker equipment and tools planned by installation.

User-provided Equipment	Coordinate with installation for maker equipment and tools. Task lighting.
Special Requirements	Confirm ventilation, plumbing, power and security with equipment and tools planned by installation.

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APPENDIX A BEST PRACTICES

The Best Practices Appendix is considered to be guidance and not requirements. Its main purpose is to communicate proven facility solutions, systems, and lessons learned, but may not be the only solution to meet the requirement.

A-1 GENERAL.

The architectural design and construction industry has produced a number of strategies for coordination, lean project design, or integrated project delivery. The following paragraphs identify good design practices for libraries. The designer is expected to interpret this guidance and configure the design for the needs of the project.

A-1.1 Active Design.

Design for active occupants to encourage circulation or make the stairs a prominent feature in the building (if multi-story); encourage physical activity within the building.

A-1.2 Acoustic Control.

Acoustic modeling and testing are best practices but may not match the budget or schedule of library projects. Teams should consider the extent of acoustic control, design, testing, and mitigation to best serve the project.

A-1.3 Adaptability for Technology.

Modular flooring should be used where appropriate. Underfloor air distribution (UAD) and power access can be combined for advantage in layout flexibility and improved comfort, and is very effective for cable management. UAD systems not only allow fresh conditioned air to be delivered near the occupants, but also provides an opportunity for occupants to have control over this air flow. This is advantageous for multi-purpose and administration type spaces. However, stack shelves and collection spaces with additional structural requirements and that do not benefit from layout flexibility are not appropriate for UAD or power access floor. Refer to UFGS 09 69 13, *Rigid Grid Access Flooring*, for system criteria, requirements, and considerations. The same floor system and construction providing both air and cabling systems are similar, reducing the construction costs associated with conventional practices of separating overhead air and standard methods of cable management.

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APPENDIX B GLOSSARY

A/E	Architect/Engineer
A/V	Audio/Visual
ABA	Architectural Barriers Act
AFI	Air Force Instruction
AFMAN	Air Force Manual
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
AT/FP	Antiterrorism/Force Protection
BEC	Base Education Center or Learning Center
CATV	Cable Television
CCTV	Closed Circuit Television
DoD	Department of Defense
DoDI	Department of Defense Instruction
FF&E	Furnishings Fixtures & Equipment
ft	Foot
ft^2	Square Foot
HVAC	Heating, Ventilating, and Air Conditioning
ILS	Integrated Library System
IT	Information Technology
LRV	Light Reflectance Value
m	Meter
m^2	Square Meter
mm	Millimeter

NARA	National Archives and Records Administration
NFPA	National Fire Protection Association
NISO	National Information Standards Organization
NRC	Noise Reduction Coefficient
OCONUS	Outside Continental United States
OPAC	Online Public Access Catalog
PA	Public Address
RFID	Radio-frequency Identification
TBD	To Be Determined
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specification
WBDG	Whole Building Design Guide

APPENDIX C REFERENCES

C-1 GOVERNMENT.

DEPARTMENT OF DEFENSE (DOD)

DoDI 1015.10, *Military Morale, Welfare, and Recreation (MWR) Programs*, Enclosure 10, https://www.esd.whs.mil/directives/issuances/dodi/

AIR FORCE

https://www.e-publishing.af.mil/

AFMAN 32-1084, *Standard Facility Requirements*, CC 740675 Base Libraries 7416

NAVY

OPNAV M-5100.23, *Navy Safety and Occupational Health Manual,* https://www.secnav.navy.mil/doni/manuals-opnav.aspx

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 1-200-01, *DoD Building Code*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

UFC 3-101-01, *Architecture*

UFC 3-120-10, *Interior Design*

UFC 3-201-01, *Civil Engineering*

UFC 3-201-02, *Landscape Architecture*

UFC 3-210-10, *Low Impact Development*

UFC 3-220-01, *Geotechnical Engineering*

UFC 3-301-01, *Structural Engineering*

UFC 3-410-01, *Design: Heating, Ventilating, and Air Conditioning Systems*

UFC 3-410-02, *Direct Digital Control for HVAC and Other Building Control Systems*

UFC 3-420-01, *Plumbing Systems*

UFC 3-520-01, *Interior Electrical Systems*

UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*

UFC 3-580-01, *Telecommunications Interior Infrastructure Planning and Design*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 3-601-02, *Fire Protection Systems Inspection, Testing, and Maintenance*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems*

UFC 4-022-01, *Security Engineering: Entry Control Facilities / Access Control Points*

UFC 4-023-10, *Safe Havens*

UFC 4-026-01, *Design to Resist Forced Entry*

FC 4-760-10N, *Navy Museums and Historic Resource Facilities*

UNIFIED FACILITIES GUIDE SPECIFICATIONS

https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs

UFGS 09 69 13, *Rigid Grid Access Flooring*

FEDERAL HIGHWAY ADMINISTRATION

Manual on Uniform Traffic Control Devices for Streets and Highways, https://mutcd.fhwa.dot.gov/

INTERNATIONAL TRADE ADMINISTRATION (ITA)

Electric Current Worldwide, https://legacy.trade.gov/mas/ian/ECW/index.html

NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

NARA 1571, *Archival Storage Standards*, https://www.archives.gov/foia/directives/nara1571

UNITED STATES ACCESS BOARD

Architectural Barriers Act (ABA) Accessibility Standards, https://www.access-board.gov/aba/

C-2 NON-GOVERNMENT.

AMERICAN LIBRARY ASSOCIATION (ALA)

Facilities, https://www.ala.org/pla/resources/tools/directors-managers-administrators/facilities

AMERICAN SOCIETY OF HEATING AND REFRIGERATION ENGINEERS (ASHRAE)

https://www.ashrae.org/

ASHRAE Standard 55, *Thermal Environmental Conditions for Human Occupancy*

INTERNATIONAL CODE COUNCIL (ICC)

http://www.iccsafe.org

International Building Code (IBC)

International Mechanical Code (IMC)

NATIONAL FIRE PROTECTION ASSOCIATION

http://www.nfpa.org

NFPA 70, *National Electric Code*

NFPA 101, *Life Safety Code*

NATIONAL INFORMATION STANDARDS ORGANIZATION (NISO)

http://www.niso.org/

NISO TR01-1995, *Environmental Guidelines for the Storage of Paper Records*

ANSI/NISO Z39.73-1994 (R2012), *Single-Tier Steel Bracket Library Shelving*

SOCIETY OF AMERICAN ARCHIVISTS (SAA)

Standards Portal, https://www2.archivists.org/standards

WHOLE BUILDING DESIGN GUIDE (WBDG)

Design Objectives, https://www.wbdg.org/design-objectives/productive

UFC 4-750-07
20 April 2020

UNIFIED FACILITIES CRITERIA (UFC)

RECREATIONAL AQUATIC FACILITIES



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UNIFIED FACILITIES CRITERIA (UFC)

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes Air Force Pamphlet (AFP) 88-52 *Swimming Pools*, dated 1984.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Document: UFC 4-750-07, *Aquatic Facilities*

Superseding: Air Force Pamphlet (AFP) 88-52 *Swimming Pools*, dated 1984.

Description: This UFC 4-750-07 provides minimum requirements for natatoria, outdoor swimming pools, wading pools, spas, spray grounds, pool decks and all other functional building areas associated with recreational aquatic facilities.

Reasons for Document: This document provides minimum unified requirements and coordinating guidance for planning, designing, constructing and renovating recreation level aquatic facilities and will enhance DoD aquatic recreation facilities by:

- Providing application of existing aquatic model codes and industry standards to DoD facilities.
- Creating an interactive space program to quickly develop sizes of functional areas for each Service.
- Providing material criteria specific to aquatic facilities to increase facility longevity and decrease maintenance.

Impact: There are negligible cost impacts. However, the following benefits should be realized.

- Elimination of ambiguities that could lead to design and construction conflicts.
- Enhanced communication between disciplines involved in the design of aquatic facilities.
- The incorporation of existing model codes and industry standards improves the ease of updating and revising this reference document as technological advances occur in the industry.

Unification Issues:

- Army, Navy and Air Force have Service-specific documents related to design, construction and operation of natatoria and outdoor swimming pools. There are differences noted in this document that are attributed to specific functional spaces or systems. Service exceptions to the requirements of this UFC are written into the applicable section of the document.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

UFC 4-750-07 was originally drafted in 2006 by the Air Force to develop a new unified facility criterion for use in the design of aquatic facilities primarily used for recreation; however, the draft document was not finalized for implementation. Continued developments in the aquatic industry have resulted in advances in disinfection and recirculation technology, the introduction of unique programming and design elements, the passing of the Virginia Graeme Baker Act, development of the Model Aquatic Health Code, and development of the International Swimming Pool and Spa Code as part of the International Building Code. UFC 4-750-07 provides applicability of model building codes and government-unique criteria for aquatic facilities (including swimming pools, natatoria, non-medical spas, wading pools, spray grounds and pool decks), typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, sustainability, and safety.

1-2 PURPOSE AND SCOPE.

Unified Facilities Criteria (UFC) 4-750-07 provides technical criteria and requirements for planning, designing, and constructing natatoria and outdoor aquatic facilities for recreational use. Alteration and renovation projects should update existing facilities to meet this criteria within budgetary constraints. This UFC is intended to promote innovative designs that are functional, economical, safe, aesthetically pleasing, and meet the expectations for modern aquatic facilities. Each design should satisfy the unique requirements of each Installation and at the same time be compatible with the local environment and specific site conditions.

Customized, individual solutions meeting the needs of each project is the primary objective of this UFC. Use this UFC in conjunction with Department of Defense (DoD) criteria, service-specific documents, aquatic industry publications, and regulatory agencies, as applicable. Obtain additional information on the unique program and design requirements of local projects from the Installation points of contact.

1-3 APPLICABILITY.

This UFC applies to all military services and contractors involved in planning, programming, design, and construction of aquatic facility projects, including additions, alterations, and renovation projects worldwide.

1-4 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-5 CYBERSECURITY.

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service Implementation Policy.

1-6 GLOSSARY.

APPENDIX B contains acronyms, abbreviations, and terms used in this UFC.

1-7 REFERENCES.

APPENDIX C contains a list of references used in this document. The publication date of the code or standard is not included in this document. In general, the latest available issuance of the reference is used.

1-8 BEST PRACTICES.

APPENDIX A identifies background information and practices for accomplishing certain aquatic facility design and engineering services. The Designer of Record (DoR) is expected to review and interpret this guidance as it conforms to criteria and contract requirements, and apply the information according to the needs of the project. If a Best Practices document has guidelines or requirements that differ from any UFC or the Unified Facilities Guide Specifications (UFGS), the UFC and the UFGS must be given a higher order of precedence.

1-9 AQUATIC FACILITY CLASSIFICATIONS.

Two general types of aquatic facility classifications include outdoor pools and natatoria (indoor pools).

1-10 OPERATIONAL IMPLICATIONS.

Procedures for Installation level recreation programs, aquatic activities, operation, and maintenance of pools, including natatoria, are provided in the following documents:

- AFI 34-101
- AFI 32-1067
- AFMAN 48-114
- UFC 3-230-02
- MAHC
- TB Med 575
- TM 5-662
- Technical Criteria for US Army Physical Fitness Facilities

- NAVMED P5010-4

Consider operational and procedural issues during the design process. Include the facility user groups in determining operational, procedural, and program requirements, since project requirements vary, and successful incorporation is critical to the design of the project.

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CHAPTER 2 PLANNING AND PROGRAMMING

2-1 PLANNING CONSIDERATIONS.

Chapter 2 provides requirements and information for planning and programming DoD aquatic facilities and the infrastructure to support them. Aquatic facility development planning and the programming of facility space are different for every project depending upon the unique factors regarding each Installation. Consider local requirements concerning building programs, design criteria, technical systems and the adequacy of existing facilities to meet current and future needs.

2-1.1 Operating Policies.

Selected programs and spaces for each facility may vary widely depending on the anticipated operating policies of each facility. Determine early in the planning process the preferred operating procedures for the types of programs and activities to be provided.

2-1.2 Programs and Activities.

Analyze the activities to be provided to determine facility requirements. Coordinate with Installation personnel to identify specific requirements for the programs and activities they plan to implement (e.g. open swimming, diving, water polo, wading, aquatic fitness/therapy, swimming/life-saving instruction, and Morale, Welfare, and Recreation (MWR) specialty programming). Consider building related requirements (e.g., access, security, and lighting) for pools where activities will be offered outside normal operating hours.

2-1.3 Competitive Swimming.

Consider the impact of specific institutional and host nation requirements if competitive swimming will be a part of the program requirements. Major sport swimming sanctioning organizations include:

- AAU – Amateur Athletic Union
- FINA –Federation Internationale de Natation
- NCAA – National Collegiate Athletic Association
- NFSH – National Federation of State High School Associations
- USA Swimming

2-1.4 Toilet/Shower/Clothing Storage.

Locate toilet and shower fixtures adjacent to changing areas. Position changing area entries to be accessible and visible from facility check-in point and to pool deck.

Provide half or full-height lockers located within the dressing room area or on the pool deck.

2-1.5 Supervision and Observation.

A strict system of observation and control is crucial in an aquatic facility. Organize the customer spaces to facilitate surveillance requirements to minimize staff numbers and customer movement. Surveillance of three activities is essential:

- Check-in and check-out system – ensures entry by approved users only.
- Storage of clothes – reduces opportunity for theft.
- Pool and pool deck activity – ensures proper safety for customers.

2-1.6 Check-In and Check-Out Procedures.

Design the entrance with clear line of sight and a means for controlling the entry to and exit from the facility. Considerations for entry control design include: type of identification required, method of verification, payment (if required), and supervision (e.g., if payment is required, provide sufficient counter space for payment processing and storage).

2-1.7 Scheduling.

Consider the preliminary program schedule in designing aquatic and support spaces. Identify programs that must occur simultaneously and the impacts this will have on pool design. For example, if competitive swimming and diving are required to occur concurrently at a specific Installation, consider “L” shaped pools, bulkheads, or separate pools.

2-1.8 First Aid.

Provide a location where first aid can be performed and associated equipment can be stored (e.g., first aid kit, personal protective equipment). Provide space for a cot and storage. Provide direct access from the pool deck to the first aid location.

2-1.9 Employee Training.

Provide a training room or multipurpose room for regular employee training. Visually isolate the training/multipurpose room from the pool area to limit distractions during training. Provide storage for training-specific items.

2-1.10 Food and Beverage Service.

Policies on food service may vary from no food permitted, vending machines, or a snack bar. Coordinate with Installation personnel to determine adjacencies and design considerations relating to location, trash removal, and types of food and beverage containers anticipated.

2-2 SPACE PROGRAM.

The space program for new aquatic facilities is developed using an interactive worksheets. It is completed by first entering the appropriate Service and then selecting the appropriate size basis for the facility. These selections generate the default space program. In some cases, there are options to modify the default numbers or to add optional spaces. This worksheet is available for download as a Microsoft© Excel© file from the Whole Building Design Guide (WBDG) Website under the DoD page, then Unified Facilities Criteria page and selecting this UFC title to view the attachment under the 'Related Materials' field. In developing the space program for an individual facility, consider the issues of overall facility design and the functional relationships described in this UFC.

Each Installation may also determine that different or additional requirements are relevant to its local program. These considerations can affect the functional areas and spaces included in the program and their relative sizes. Space allowances for aquatic facilities are based on standards developed for each DoD service component.

2-2.1 Facility Size.

Determine the overall facility size by analyzing the particular needs of each Installation, including the following factors:

- Size of the U.S. and host nation military population in the area served by the Installation.
- Number of youth and children served by the Installation. These are typically the most frequent users of aquatic facilities and associated activities.
- Number of dependent spouses, retirees, host nation personnel, contractors, and other authorized users to be served by the facility.
- Availability of other aquatic facilities on, or near, the Installation.
- Anticipated need for conducting competitive swimming events.
- Anticipated need for pool use in training activities, such as SCUBA and deep-water survival training.

2-3 FACILITY REQUIREMENTS.

Consider the parameters affecting overall facility design and the functional relationships discussed in paragraph DESIGN and paragraph FUNCTIONAL AREA TECHNICAL REQUIREMENTS when developing the space program for an individual facility. Facility requirements are based on local conditions and identified requirements of the community served.

2-3.1 Core Functional Areas.

Most aquatic facilities will need four core functional areas while allowing for local variation in the scope of operation under each category. Provide the following four core functional areas in the design of the aquatic venue:

- Water areas
- Pool deck
- Bathhouse (outdoor facilities) / Changing/Restroom (natatoria)
- Filtration, circulation, and chemical equipment

2-4 SITE SELECTION.

Locate aquatic facilities near the center of Installation activities and facilities such as the physical fitness center and the youth center, where possible. Aquatic facilities should be located with compatible functions as defined by the Installation Master Plan. Avoid locations near busy intersections, roadways or roads, airfields, and industrial facilities. Evaluate the potential impact of natural site features on the proposed facility design, in accordance with UFC 1-200-01, 2-100-01, and 3-201-02. Existing natural site features may be incorporated into required site elements like Antiterrorism/Force Protection (ATFP) standoff distances provided in UFC 4-010-01 or vehicle barriers that may help to blend the facility into the natural setting of the site. Select potential sites for aquatic facilities to minimize or eliminate problems in design, construction cost, and pool function.

2-4.1 Site Size.

Select a site large enough to accommodate all the components of the facility and anticipated future expansions. These components may include vehicle access, parking, pedestrian access, open areas that can be used for playing fields (e.g., throwing Frisbees, horseshoes, and similar recreational activities). Consider each site component as it relates to each specific project. In addition, size the site to allow for open or landscaped spaces around these components as required in UFC 3-201-02. For initial planning purposes, a site size can be considered satisfactory if the area of the site is at least the sum of the following:

- Exterior circulation and parking areas.
- Fire Lane with required fire truck turning radius.
- Stormwater management areas.
- The area of the swimming pool, surrounding pool deck, and internal circulation areas.
- The area of the spray ground, wading pool, or spa and surrounding deck.
- The gross area required for changing areas, storage areas, offices and support spaces, spectator areas and other building support areas.

- The gross area needed for water circulation, filtration, and chemical equipment facilities.
- Required easements, setbacks, and standoff distances.

More area may be needed if the site has any special features, such as irregular contours or perimeter, existing trees, or unusual landscape conditions. Accommodate the required number of parking spaces and AT/FP setback requirements in accordance with UFC 4-010-01. Provide for future expansion in site size determination, if practical.

2-4.2 Site Considerations.

Select sites for aquatic facilities in accordance with UFC 1-200-02 and the following criteria:

- Approach the site by sidewalk, without requiring pedestrians to cross heavily traveled streets or circulation areas within the parking lot.
- The necessary utilities, water, sanitary sewer, natural gas, and electricity are readily available.
- The topography is level enough for constructing the pool.
- The soil is stable and free of rock, which is costly to excavate.
- The site is not close to heavy industrial smoke or other unpleasant or harmful pollutants.
- The site is near other recreational activities, such as youth centers, clubs, and athletic facilities.
- Facility should be sited in accordance with compatibility guidelines as defined by the Installation Master Plan.
- Select a site that minimizes wind-blown debris and reduce wind damage to structures, furnishings, and equipment.

2-4.3 Site Access.

Provide easy access by pedestrians, automobiles, and Installation public transportation. Address accessibility issues for people with disabilities in accordance with the accessibility requirements identified in paragraph ACCESSIBILITY. A facility easily identifiable from approaching cars and pedestrian pathways is desirable. Provide a dedicated service drive near the filtration and chemical storage areas for maintenance vehicle access. Provide a service drive with convenient access to the pool deck areas, to be utilized by emergency responders for evacuation of injured customers without exiting through the bathhouse or locker rooms.

2-4.4 Site Utility Requirements.

Evaluate potential sites to determine the availability of utility services and conformation of easement and property lines. Locate aquatic facilities where access to major utilities is readily available (e.g., water, sewage, electricity, telecommunications (voice and

data), and natural gas). Provide storm or sanitary sewer systems capable of handling large-volume water discharge in accordance with local codes and pool filtration equipment selections. Provide water service, natural gas, steam service or fuel oil system (whichever is used), electricity, security, and fire alarm service to the building in accordance with UFC 1-200-01 and Installation requirements.

2-4.5 Topography and Sub-Soil Conditions.

Evaluate existing topography of potential sites to determine the impact of existing conditions on construction. Conduct geotechnical investigations to identify sub-soil conditions, the elevation of the water table, and the bearing capacity of the soil in accordance with requirements in UFC 1-200-01. Solicit recommendations regarding the locations of soil borings from the A/E. Evaluation of the geotechnical report should be a primary consideration of potential sites. Determine the most effective foundation system based on evaluation of the geotechnical data. Consider the impact of existing subsurface rock on the position of the pool, buildings, parking areas, and other structures so excavation can be minimized.

2-5 ACCESSIBILITY.

Design and construct new facilities, additions, and renovations of existing facilities in accordance with the Architectural Barriers Act (ABA) and UFC 3-101-01.

Provide one or more accessible entry into pools utilizing primary and secondary means established in the ABA requirements.

2-6 BUILDING CODES.

Provide all aquatic facilities in accordance with DoD criteria and Installation design guides. These criteria are based on national standards, private sector consensus standards, and model codes. Refer to UFC 1-200-01, *Design: General Building Requirements* for specific guidance. In the event of conflicts between codes and DoD criteria, use DoD requirements. For OCONUS situations where there is a conflict between mandatory code requirements, the most restrictive code takes precedence. Consider local codes where design choice impacts the exterior of the Installation.

2-7 AQUATIC INDUSTRY CODE COMPLIANCE.

For all new pool construction and renovations to existing pools, conform to the current version of the following documents:

- International Swimming Pool and Spa Code (ISPSC)
- Model Aquatic Health Code (MAHC)
- Federation Internationale de Natation (FINA) Standards; Facility Rules
- Local, State, Military Agency, Federal, and host nation codes, if applicable

In cases of conflict between the code documents, utilize the more stringent requirement.

2-8 ANTITERRORISM/FORCE PROTECTION.

Design the facility to comply with UFC 4-010-01 and UFC 4-020-01.

2-9 SUSTAINABLE DEVELOPMENT.

Design and construct new construction, additions, and renovations in accordance with UFC 1-200-02. Use an integrated approach to the planning and design of aquatic facilities in accordance with UFC 1-200-01.

2-9.1 General Sustainability Requirements.

Apply sustainable development concepts in the planning, design, construction, environmental management, operation, maintenance, and disposal of facilities and infrastructure projects that are consistent with budget and mission requirements. Comply with guidance for High Performance Sustainable Buildings compliance, tracking and policies in accordance with UFC 1-200-02.

2-9.2 Energy and Water Conservation.

Design new construction and renovation projects in accordance with UFC 1-200-02. The MAHC states that the IAQ proper removal of the chemical, biological, and physical contaminants, is the top priority, Treat the water filtration systems dedicated to the natatoria area as a process load

Provide pool covers in accordance with ISPSC and ASHRAE Standard 90.1. Include water conservation features such as manual and automatic stopping of aquatic features such as waterfalls and play features to reduce evaporative losses. Design spray grounds as recirculated systems or capture used, untreated water for irrigation or similar purposes requiring non-potable water. Employ other aquatic-specific sustainable practices on a project-specific basis where warranted by design and budget.

2-10 ENVIRONMENTAL ISSUES.

Aquatic facilities have specific environmental considerations, such as backwashing of filters and the disposal of waste water. Dispose of all chemically treated water in accordance with State and local code requirements. Incorporate safe provisions for storing and handling of pool chemicals.

Require procurement of construction materials and building supplies that have a lesser or reduced effect on human health and the environment over their lifecycle, when compared with competing products or services that serve the same purpose, in accordance with UFC 1-200-02.

2-11 MODIFICATION OF FACILITIES AND EQUIPMENT.

The configuration of existing facilities may limit the ability to meet the requirements for aquatic facilities at the Installation. Provide modifications of facilities and equipment that conform to these requirements to the greatest extent possible.

2-11.1 Renovation and Repairs.

Leaking pools and piping systems may require significant renovation and repairs. Low capital investment options, such as vinyl liners, are acceptable. Gutter systems may be replaced with stainless steel gutter systems. New gutter systems may be designed to handle the surge capacity requirements and eliminate the need for adding a surge tank system or additional underground piping.

2-11.2 Restoration and Preservation.

Older DoD aquatic facility renovations may require restoration of pool and deck surfaces. Use cost comparisons to determine if restoration or replacement is the most cost-effective option.

2-11.3 Upgrades and Additions.

Improvements to existing aquatic facilities may include replacing wading pools with spray grounds or adding play amenities detailed in this UFC. Typical upgrades to existing facilities may also include new gutters, surge control systems, circulation/filtration systems, energy upgrades, ABA compliance, or APSP-16 compliance. Give priority to upgrades and additions that enhance the safety of the existing aquatic facility over upgrades to enhance recreational value.

CHAPTER 3 DESIGN

3-1 GENERAL.

Chapter 3 provides general design and material requirements, including detailed requirements for the site, infrastructure, water areas, pool deck, bathhouse, and other buildings or structures. These criteria address design requirements for site and building layout, architectural character, function, circulation, and facility systems. Information is provided regarding the preferred materials and finishes that deliver the required durability yet while remaining functional and aesthetically pleasing.

Facility system requirements for circulation, filtration, chemical storage, structural considerations, HVAC systems, plumbing, electrical, fire protection, life safety, telecommunications, alarm/security systems, and acoustical requirements are included in this chapter. Special considerations for operational requirements, Installation-specific programs, and the renovation of existing facilities are addressed in APPENDIX A.

3-1.1 Design Development.

Provide designs that comply with the general criteria and provide a compatible solution for the specific project requirements. Provide individual designs that enhance the surrounding built environment and natural character of the Installation. Other factors that determine the success for the design include:

- Value and Cost: Design facilities than can be constructed within the project budget and economically maintained.
- Operating Efficiency: Arrange individual spaces to meet specific needs of the user population and allow for maximum staff efficiency.
- Project Cost: Design to minimize construction and operating costs. Use a compact floor plan that minimizes floor area for personnel circulation, walls, and structure. Reduce structural, architectural, and mechanical costs through compact building volume and careful placement of mechanical and filter rooms to reduce the length of pipe runs.
- Simplified Construction: Use familiar building assemblies and terms that do not require a specially qualified labor force or special construction equipment for installation. Include durable, water-resistant materials that have a low life-cycle cost. Minimize the number of different materials used and select materials that are locally available. Consider the use of pre-engineered building systems where they are locally available and architecturally compatible with the Installation building standards. Use systems that can be supplied and maintained economically, especially for natatoria.
- Energy Management: Reduce operating costs for natatoria by applying the principles of passive solar design, optimizing the effective use of insulation based on a life-cycle study, and using fuels that can be provided

economically for the life of the facility.

- Environmental Influences: Design for the specific climate of each Installation. Where unheated pools and open-air bathhouses are planned, environmental considerations include the control of sunlight and wind by shading, tunneling, blocking, or other methods.

3-1.2 General Design Process.

Prepare designs through an iterative process of submittals, user reviews, and discussions to reconcile comments in accordance with A/E Statement of Work and service-specific design procedures (e.g., FC 1-300-09N).

3-2 SITE DESIGN.

Site the aquatic facility so the main entrance is clearly visible, and the architecture provides intuitive wayfinding cues to guide visitors to the main entrance. Preserve and utilize natural site features, such as topography, trees, greenery, and unusual landscape features to help define the site and accent the building. Use landscape elements to provide definition, screening, and focus for the site. Locate the pool, spray ground or wading pool, spa, bathhouse, and non-aquatic outdoor recreational areas to reflect local climate and micro-climate conditions. Provide protection from wind and glare for aquatic elements.

3-2.1 External Circulation.

Provide an external circulation system to include an access road, vehicle drop-off, parking lot for staff and customers, connections to on-site walkways, service drive with gate for easy access to the circulation/filtration equipment and chemical storage, and emergency responder vehicle access to the pool deck. Pave paths or walkways leading into the pool area with concrete, pavers, brick, stone, or other hard surface to eliminate tracking loose materials onto the pool deck. Provide a concrete apron for garbage dumpsters and recycling containers adjacent to the service drive.

3-2.2 Vehicle Circulation.

Provide a loop road or similar drop-off area in front of the aquatic facility that will accommodate buses and vans. Consider a one-way, double-lane width drop-off area to allow loading and unloading of buses and vans onto adjacent sidewalks, yet still allow privately owned vehicles (POV) to pass and drop-off or pick up customers. Locate bus stops and shelters conveniently near the aquatic facility with direct sidewalk access to the main entrance. Coordinate with the Installation to incorporate any additional requirements in accordance with Installation design guides.

Locate parking areas to the side of the entry building, where possible.

3-2.3 Building Access.

Provide clearly identified pedestrian access to the main entrance. Reinforce

connections to related Installation facilities with clear, direct pathways. Provide separate vehicular access for a main entrance drop-off area and for the service/emergency responder vehicle entrance.

3-2.4 Zoning.

Zone the pool deck, associated pools, spray grounds, sunbathing, recreation, and food service areas for maintenance and safety. Segregate children's play areas, spray grounds, and wading pools from the main pool by low fencing. If permanent spectator seating is provided, utilize low, transparent barriers to segregate the seating area from the pool area. Provide a separate entrance from an external pedestrian walkway system for spectators. Segregate food service areas with landscaping, low barriers, or fencing to provide controlled access between the pool and food service area. Place trash receptacles at the access point.

3-2.5 Landscaping.

Provide landscaping for the facility in accordance with UFC 3-201-02. Depending on project location, minimize the use of deciduous trees and plant varieties that shed materials around an outdoor pool to minimize deck and pool maintenance. Do not use bark mulch, small rocks, or similar ground covering materials near the pool deck or in areas where these materials may get washed into the pool or scattered about the pool deck area.

Coordinate with the Installation to incorporate any additional requirements in accordance with Installation design guides.

3-2.6 Site Signage.

Provide an exterior signage system in accordance with UFC 3-120-01. Coordinate exterior sign programs with the exterior design of the building and Installation requirements. Also, provide site signs that identify dedicated parking areas, service areas, accessible entrances, and other facilities for the disabled. Provide information regarding the facility's hours of operation and force protection condition (FPCON) on exterior signage located near the main entrance that is visible to customers from their vehicles.

3-2.7 Sunlight and Glare Control.

Outdoor aquatic facilities require special consideration to minimize excessive sunlight and control the effects of glare on patrons and staff. Provide accommodations for moveable lifeguard stations that can be easily relocated throughout the day to minimize the effect of glare on the water from sunlight or facility lighting. Provide shade for children's areas, patrons on the pool deck, lifeguard stations, food service areas, and for staff members at the check-in area and administrative areas. Provide portable shade accommodations at each lifeguard station.

For natatoria, orient the building and windows to reduce sunlight and glare throughout

the day.

3-2.8 Exterior Lighting.

Provide exterior lighting and controls for parking lots, building entrances and exits, pedestrian walkways, wheelchair ramps and plazas, vehicle roadways, streets and driveways in accordance with UFC 3-530-01. Design the exterior lighting system for the lighting zone in which the aquatic facility will be constructed. Provide a wall-mounted sign light to illuminate the building sign from above. Refer to paragraph POOL LIGHTING for detailed specifications for pool deck and underwater lighting.

3-3 WATER AREA DESIGN.

Water areas include swimming pools, diving pools, wading pools, spray grounds, non-medical spas and all spaces or equipment within these areas.

3-3.1 Pool Size and Capacity.

The maximum allowable pool size is determined by paragraph SPACE PROGRAM. The size of pools depends upon the unique program requirements at each Installation. The main pool may be a free-form general use pool, a lap swimming pool, or a combination of these two, depending on Installation-specific programming.

3-3.2 Shape, Slope, and Depth.

Design pool floor slopes and depths to the most stringent requirement in MAHC, ISPSC, ABA or in accordance with the event sanctioning body, unless paragraph FUNCTIONAL AREA REQUIREMENTS requires otherwise.

3-3.3 Lap Swimming Pool Size Standards.

These requirements cover pools for swimming laps, or competitive swimming events.

- Limit pools programmed for lap or competitive swimming to rectangular shape. Where diving is also a required program, diving may be incorporated into the deep end of the pool in a stretch or “L” configuration, when topographic conditions, site shape, natatorium enclosure challenges, or budget limit design options. The shape of training, recreation or wading pools is optional, with much more flexibility for unique shapes and configurations.
- Pool Lengths: 25 meters (82 feet, 1/4 inch) or 50 meters (164 feet, 1/2 inch). Provide an additional 0.03 meter (1-3/16 inches) of length to competitive pool nominal lengths to allow for electrical timing touch pads.
- Pool Widths: Six lanes – 18 meters (59 feet); eight lanes – 22.86 meters (75 feet). When pool width will be used for cross-course competitive swimming, provide an additional 0.03 meter (1-3/16 inches) to allow electrical timing touch pads.

- Lane Widths: Design all lanes equal width with lane lines in place. Provide additional space adjacent to the outside lanes, commonly referred as “buffer lanes”, to accommodate the overall width of the pool.
- Pool Depths: Pool depth requirements vary depending upon different levels of competition and the anticipated intended use or programs. Exceed depth requirements specified by sanctioning organizations at starting platform locations. Provide a depth of 3 feet, 6 inches to 4 feet, 0 inches (1.1 to 1.2 meters) at the shallow end of the pool for a minimum of 800 square feet (74.3 square meters). Coordinate with Installation point of contact for program specific requirements.

3-3.4 Diving.

For pools provided with spring boards or platform diving, provide the minimum dive envelope (length, width and depth) required by FINA*, unless the Installation-specific competitive diving sanctioning standards are more stringent.

*For Navy facilities: Provide the minimum pool length ahead of the plummet in accordance with NAVMED P-5010-4, Chapter 4.

3-3.5 Deep Water Activities.

For pools with drop-style slides or play features requiring deep water, provide the minimum pool dimensions required by the manufacturer of the play equipment.

3-3.6 Pool Construction.

Design and construct pools and spray pads of impervious and structurally sound material(s), which provide a smooth, yet slip-resistant, easily cleanable, watertight structure. The following construction types are approved for use:

- Reinforced concrete walls and gutter:
  - Cast-in-place concrete; or
  - Shotcrete (pneumatically-applied concrete).
- A combination of reinforced concrete walls with a metal gutter system.
- Metal (aluminum or stainless steel)

3-3.6.1 Metal Pools and Gutters.

Provide corrosion-resistant metal pools and gutters constructed of type 304 or 316 stainless steel. Provide aluminum pools with a system for minimizing corrosion (e.g., provide sacrificial anodes).

3-3.7 Pool Finishes.

For concrete construction, provide a ceramic tile pool interior or a combination of

ceramic tile and quartz aggregate interior. Provide ceramic tile at the perimeter waterline, freeboard, racing course markings, end wall targets, slope line break, and at stair and bench nosing. Provide a painted finish for metal pools.

Provide a white or light blue pool finish color in accordance with the MAHC. Provide contrasting finish color for depth markers, racing course markings, end wall targets and stair and bench nosing. Provide a pool coping or gutter system that contrasts in color from the surrounding deck color or provide a contrasting perimeter tile band between the gutter/coping and deck finish. Provide slip-resistant finishes on all horizontal surfaces and on vertical surfaces in competition or lap swimming pools. Provide a hand hold on all portions of the pool deeper than 2 feet (0.61 meters).

3-3.8 Surface Skimming.

Provide all pools with a means of surface skimming in accordance with the ISPSC, MAHC and Service-specific requirements.*

*For Army facilities: Provide only fully or semi-recessed overflow systems sized to provide the required surge volume. Where skimmers are used, provide an equalization fitting in accordance with TB MED 575.

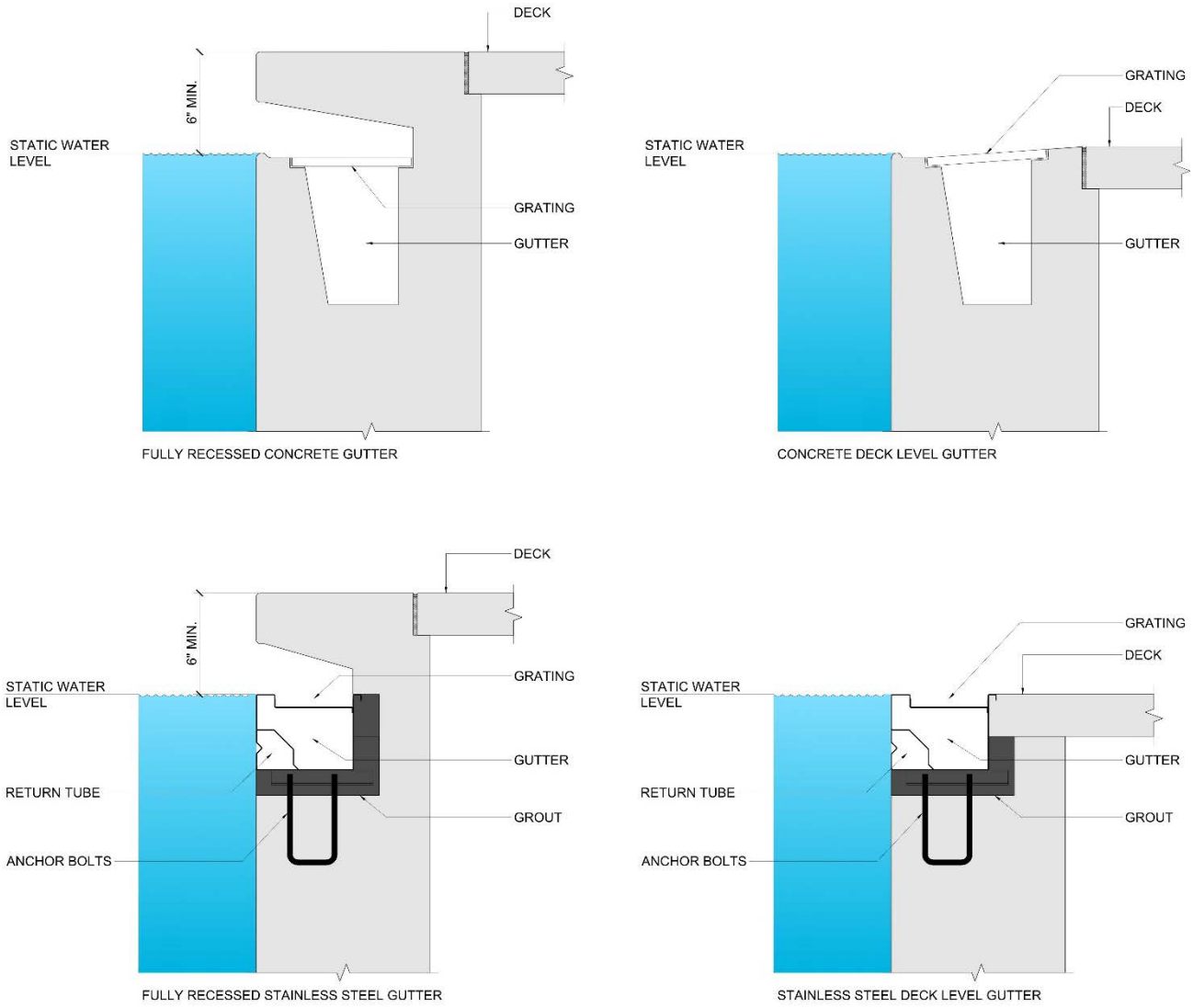
3-3.8.1 Overflow Systems.

Provide continuous perimeter overflow systems in accordance with the MAHC. Allowable overflow systems include fully recessed and deck level gutters as indicated in Figure 3-1: Overflow Systems. Cover overflow systems with a corrosion-resistant, structural grating. Fully recessed overflow systems may be provided without grating if the maximum opening does not exceed four inches (.01 meters). Design overflow systems to drain to the surge tank via gravity.

3-3.8.2 Skimmers.

Pools not required to have a complete perimeter overflow system may utilize manufactured skimmer systems in lieu of overflow systems.

Figure 3-1 Overflow Systems



3-3.9 Recirculation and Filter Systems.

Use air gap fittings to supply potable water into the pool, either directly or into the recirculation system. Provide air gap fittings between the swimming pool recirculation system and the sanitary or storm sewer system such that there is no direct physical connection. Provide complete, continuous recirculation of water through all parts of the swimming pool by appropriately sized, non-corrosive pipes. Use Schedule 40 polyvinyl chloride (PVC) or Schedule 80 PVC for most recirculation and activity pump piping requirements. For heater and heat exchanger piping, provide copper or chlorinated polyvinyl chloride (CPVC) pipe. Size the valves and draining system for the pool to prevent flooding (surcharging) of the sanitary or storm drainage system. Provide a centrifugal recirculation pump with capacity to achieve the minimum turnover rate of the pool, plus an additional allowance of 30 percent. Provide a pool turnover rate in accordance with the more stringent requirement between ISPSC and MAHC for all

venue and pool types.

3-3.9.1 Recirculation System Minimum Requirements.

Provide a recirculation system consisting of pumps, piping, filters, feeders, water-conditioning equipment, city water make-up, surge tank, and other accessories to filter and disinfect the swimming pool volume of water in the turnover time required in paragraph RECIRCULATION AND FILTER SYSTEMS. Recirculate water from the main drains and overflow system into the circulating pumps via the surge system under normal operating conditions. Size overflow gutter piping and main drain piping according to the requirements in the MAHC. Provide valves and regulating devices that allow for adjustment of the ratio of water through the main drains and overflow gutter.

3-3.9.2 Surge Tanks and Surge Control.

Equip recirculation systems with concrete, cast-in-place surge tanks, unless the maximum surge requirements of the pool are handled by surge contained in the gutter or freeboard. Provide the minimum surge capacity required by ISPSC and MAHC. Provide flow control valves to modulate water flow from the main drain and from the surge tank.

3-3.9.3 Motor Controls and Auxiliaries.

Provide magnetic starters for the control of the recirculation pump, including corrosion-resistant enclosures. Use NEMA 4X fiberglass-reinforced polyester (FRP) components for all electrical and control items subject to corrosion. Provide integral capacity motors that meet the requirements for Premium Efficiency Motors in accordance with EPAct05.

Provide variable frequency drives (VFDs) for all filter pump motors and for activity pump motors greater than 10 HP. For filter pump motors, interlock the flow meter with the VFD to maintain constant design flow regardless of system variables.

3-3.9.4 Pumps.

Provide centrifugal style pumps for all recirculation and activity pumps. Provide basket strainers immediately in front of all centrifugal pumps to protect the internal components of the pump. Provide an extra basket strainer for each pump system. Provide a pump pit adjacent to the surge tank or pool to provide a flooded suction condition*. If a pump pit cannot be included, provide self-priming pumps or other means for pump priming. Provide a flow control valve on the pump effluent pipe for manual control of flow and isolation for system testing and maintenance.

*For Army facilities: Provide flooded suction design for all pumps except fractional or small horsepower pumps for special uses.

3-3.9.5 Flow Meters.

Provide a flow meter in each main line serving a pool. Provide flow meters on a straight, uninterrupted section of pipe at least 10 pipe diameters downstream from the

last fitting and five diameters distance beyond. In addition, provide a mercury-type manometer flowmeter or magnetic flowmeter at the discharge of the recirculation pump to monitor primary flow and backwash.

3-3.9.6 Filters.

Acceptable types of pool filters are sand filters* and regenerative media filters. Provide a filtration rate for high rate sand filters that does not exceed 13 gallons per minute per square feet of filter bed (32 cubic meters per hour per square meter of filter bed). Provide a filtration rate for regenerative media filters of 1.3 gallons per minute per square feet of filter bed (3.2 cubic meters per hour per square meter of filter bed) or less. Provide pearlite media for regenerative media filters. Discharge backwash water and regenerative media drain water via an air gap fitting into the sanitary or storm sewer where allowed by code. Diatomaceous earth for filter media is not allowed.

*For Army facilities: Provide only regenerative media filters.

3-3.9.7 Drains and Inlets.

Provide main drain and outlet systems in accordance with ANSI/APSP/ICC 7 and ANSI/APSP-16. Provide at least one main drain in the deepest part of the swimming pool. For pools at least 30 feet (9.1 meters) wide, space multiple drains no more than 15 feet (4.5 meters) from a side wall, but no greater than 20 feet (6.1 meters) apart. Provide hydrostatic relief valves in each drain. Provide flat, not domed, drain grating in pools where the water depth at the main drains is less than five feet (1.5 meters). Provide drains flush with the pool floor.

Provide a minimum inlet quantity as required by ISPSC, spaced in accordance with MAHC. For wall inlets, use butterfly ball-and-globe-style inlet valves made partially or completely of PVC or other high-quality plastic for new pools and renovations. For stainless steel gutter pools, provide wall inlets integral to the pool gutter and floor inlets in accordance with MAHC. Provide an automatic fill system with manual bypass. Supply fresh water through an air gap at least 6 inches (150 millimeters) above the pool deck elevation. Locate fill spout and controls in a location that is inaccessible to users.

3-3.10 Heating and Water Temperature.

Provide a means for heating for all indoor pools and for outdoor pools where the climatic conditions warrant their use. Provide water heaters and heat exchangers specifically designed for use with swimming pool water and sized to bring the pool up to temperature within 24 hours (main pool) or 4 hours (spa pool or wading pool) or less, if required by the local Installation or pool program. Provide a heater or heat exchanger that can maintain the temperature range required for the anticipated programming of the pool. Where gas-fired pool water heaters are specified, provide direct vent/sealed combustion.

Provide an insulated pool cover in accordance with ISPSC, UFC 1-200-02, and paragraph SUSTAINABLE DEVELOPMENT.

3-3.11 Water Quality.

Coordinate design and method for pool disinfection with the Installation's agency responsible for water quality testing and certification. Use of chlorine gas is not allowed at new construction. Allowable sanitizers include sodium hypochlorite (liquid chlorine), calcium hypochlorite (solid chlorine), and on-site generation of chlorine from sodium chloride (salt). Pipe filtered water to chemical rooms for introduction of chemicals rather than running chemical lines through occupied spaces.

Provide automatic chemical controllers to analyze pool water and automatically feed chemicals. Provide supplemental disinfection/sanitization utilizing an ultraviolet (UV) light disinfection system or ozone generator in accordance with the MAHC and ISPSC*. Supply fresh make-up water to the pool automatically utilizing an automatic water level control system.

*For Army facilities: Provide supplemental disinfection on all indoor pool filtration systems.

3-3.12 Pool and Deck Lighting.

Lighting is required for swimming pools and pool deck areas. Provide lighting systems as described below and in accordance with UFC 3-530-01, MAHC, and ISPSC.

Provide artificial lighting for swimming pools that will be used at night, or which do not have natural lighting, so that all portions of the pool, including the bottom and drains, are readily seen without glare.

3-3.12.1 Overhead Lighting Criteria.

Provide overhead luminaires installed along the pool edge, not over the water, for ease of maintenance from the pool deck with the aid of portable ladders or scaffolding. Arrange overhead luminaires to provide uniform distribution of illumination. Where pool size or geometry requires overhead luminaires to be installed over the pool water surface, or where they cannot be maintained from the pool deck, they must be arranged so that they are readily accessible from permanently-installed catwalks.

For recreational pools, provide a minimum of 30 horizontal foot candles overhead illumination on the water surface when underwater lighting, in accordance with paragraph UNDERWATER LIGHTING CRITERIA, is used. Without underwater lighting, provide a minimum of 50 horizontal foot-candles on the water surface. Provide a minimum of 10 horizontal foot-candles overhead illumination on the pool deck surface.

3-3.12.2 Overhead Lighting Controls.

For indoor pools, where artificial lighting is used to meet the light level requirements, provide manual means to control the overhead luminaires. Separately control luminaires in daylighted areas through continuous dimming photocontrol to reduce light output when natural light is available. For outdoor pools, where natural lighting methods

are used to meet the light level requirements, provide automatic lighting controls based on light levels or time of day to turn lights on and off.

3-3.12.3 Emergency Lighting.

In the pool area, provide emergency illumination in accordance with ISPSC. In addition to the prescriptive requirements of ISPSC, provide emergency egress lighting that produces a minimum of 0.5 foot-candles along the path of egress in the pool area. Avoid placing emergency light fixtures over the pool water surface area or in areas where they cannot be maintained from the deck.

3-3.12.4 Underwater Lighting Criteria.

Provide underwater lighting systems to meet the performance requirements of the ISPSC and MAHC, and the installation requirements of NFPA 70. Use non-dimmable light-emitting diode (LED) luminaires for underwater lighting. Where LED luminaires are prohibited or not practical, use incandescent luminaires for underwater lighting. Provide underwater light fixtures in standard voltage (120 volts) or low voltage (12 volts). When low-voltage light fixtures are specified, locate the transformer in accordance with NFPA 70. Either wet niche or dry niche fixtures may be used.

Consider pool use, agitation of water, and overhead lighting design when designing the underwater lighting system. For competition swimming, provide lights on the side walls and, for competitive pools with cross-course swimming, centered under lane anchors on the start and turning ends of the pool. If lights are provided at the start and turning ends of a pool used for competitive events, provide a turn-off switch for racing.

3-3.12.5 Underwater Lighting Controls.

Provide manual lighting controls to turn underwater luminaires on and off. Dimming controls are not permitted.

3-4 POOL DECK DESIGN.

Provide impervious, slip-resistant deck area around each pool to serve as a circulation path and lounging area for pool users. For outdoor pools, shade areas of the pool deck to provide protection from the sun for customers and staff. Optional amenities, such as concession areas and spectator seating areas, may require additional deck space to accommodate the desired programs.

3-4.1 Deck Size and Capacity.

Provide deck area for outdoor pools at a ratio of two to three times the pool water area. Locate spray grounds for children on the pool deck and consider additional space to accommodate these areas. Provide deck space for natatoria at a ratio of 0.75 to 1.5 times the pool water area. Provide separation of deck spaces into walkways and other uses. Provide minimum walkway clearance in accordance with ISPSC.

Provide the following minimum clear pool deck widths:

- SIDES: 10 feet (3.05 meters) Indoor Pools, 12 feet (3.6 meters) Outdoor Pools
- SHALLOW END: 15 feet (4.6 meters) Indoor Pools, 20 feet (6.1 meters) Outdoor Pools
- DEEP END: 20 feet (6.1 meters) Indoor Pools, 20 feet (6.1 meters) Outdoor Pools

3-4.2 Slope and Drainage.

Slope the pool deck away from the pool so that water on the deck (either from pool overflow, splashing, rain or surface water run-off) is not allowed to flow into the pool. Provide a minimum deck slope of 0.25 inch (6 millimeters) per 1 foot (0.30 meter) and not more than 0.5 inch (12 millimeters) per 1 foot (0.304 meter). Provide deck drains such that all areas of the deck slope to a drain to eliminate ponding on the deck. For natatoria designs, locate deck drains between the pool and building wall and slope all areas to drain. Route piping from the deck drainage to the sanitary sewer (indoor pools) or storm sewer (outdoor pools) unless required otherwise by State and local codes where drainage leaves the Installation.

3-4.3 Materials and Surface Finishes.

Provide pool decks of a long-lasting, easily cleanable, UV-resistant and impervious material. Acceptable materials include concrete, ceramic tile, or equivalent materials. Provide all deck surfaces with slip-resistant finish. Where appropriate for outdoor pools, use cool decking materials that do not build up excessive heat when exposed to direct sunlight. Provide slip-resistant, permanent depth makers in the pool deck at the edge of the pool.

3-4.4 Spectator Seating.

Provide seating for spectators according to the program requirements and separated from walking paths.

3-5 BATHHOUSE AND NATATORIUM DESIGN.

Provide structures and finishes capable of resisting corrosion from moisture and chemical vapor. Provide interior and exterior walls of masonry construction with brick, block, composite material siding, metal panels, stucco, or similar materials that are architecturally compatible with the Installation-specific guidelines. Provide moisture- and mildew-resistant, easily cleaned surfaces. Dressing rooms, shower rooms, drying areas, and toilets are considered wet areas. Provide materials for stalls, walls and floors in wet areas that are impervious to water and able to be hosed down for cleaning. Provide slip-resistant wet area floors pitched to floor drains. Provide elevated concrete pads for lockers and other equipment to facilitate cleaning and reduce the corrosive effects of frequent exposure to water.

3-5.1 Natatoria Design.

Select building materials to economically span the pool and deck width with moisture-resistant materials such as concrete, galvanized steel, and laminated wood. Coat all exposed metal surfaces to resist the corrosive climate within the natatorium. Design exterior walls and openings for climate impact. Evaluate seasonal impact of indoor and outdoor humidity to properly locate vapor barriers. Conduct dewpoint analysis on exterior walls and roofs. Provide thermal breaks in window -and door-frame openings. Provide acoustic control of natatorium space through use of natatorium specific baffles or panels. Comply with dimensional requirements detailed in FINA for minimum ceiling heights in natatoria with diving. Provide minimum 16-feet (5 meters) clearance for facilities without diving. Locate windows in the natatorium to avoid glare on the water surface. Provide fixed sun screens on southern exposures. Tint deck level windows if provided along the sides of the pool.

For enclosure of existing outdoor pools, evaluate existing deck slope. Provide deck drains to completely remove deck water.

3-5.1.1 Vestibules and Airlocks.

Provide vestibules and airlocks in natatoria based upon the climatic issues at each Installation. When designing entry vestibules, provide double sets of entrance doors to create an airlock. Comply with accessibility requirements identified in paragraph ACCESSIBILITY. Provide walk-off mats inside the airlock and removable rugs in lobby areas. Consider built-in drains inside recessed walk-off mats in foyers to allow water to drain off, and heated mats in cold-weather climates. Provide ventilation or climate control to prevent moisture accumulation or condensation.

3-5.2 Building Organization and Circulation.

Organize bathhouse and natatorium spaces to take advantage of local climate conditions, such as prevailing winds and sunlight. Consider the desired flow of customer traffic from the entry control point to the pool deck and the need to provide convenient access to the shower areas to encourage customers to shower before entering the pool. Provide a pool office located with direct visual access to all pools.

For natatorium designs, separate wet and dry areas. Provide a dry circulation path from the entry to the control point and locker rooms. Provide a wet circulation path from the locker rooms, through the shower area, and onto the pool decks. Where spectator seating is provided, provide access to that seating on the dry circulation path. Provide an entry lobby with waiting/display, control desk, equipment storage and vending space. Provide a control desk in lobby for customer check-in. Provide a training/classroom accessible from both the dry and wet corridors.

3-5.3 Clothing Storage.

Provide lockers for storage of customer clothing and valuables. Determine appropriate locker size for local program and climate requirements. Locate lockers within changing rooms, on pool deck or a combination of both locations.

3-5.3.1 Locker Systems.

Provide non-corrosive, moisture-resistant, vented lockers, that are durable, easily cleaned, and do not accumulate water. The optimal arrangement of lockers is two tiers to permit the hanging of adult street clothes. Increase the number of lockers to meet the authorized capacity, but do not exceed the comfortable reach limits for an averaged sized person or reach limits required by the ABA for accessibility. The most efficient locker arrangement is a back-to-back layout with alcoves off of circulation aisles. Provide locker systems capable of use with user-provided locks.

Provide a 16 inch (410 millimeter) high bench in the middle of each aisle for the entire length of the aisle minus circulation clearance where an aisle meets a wall.* Locate benches a minimum of 2 feet, 8 inches (810 millimeters) clear of locker doors, in the open position, or as to comply with ABA accessibility requirements. When a row is more than 16 lockers long, provide a 3 foot (910 millimeter) long break every 15 feet (4.6 meters). Alternatively, provide 16 inch (400 millimeter) wide benches integral to the locker system. Lockers required to comply with ABA must have benches a minimum of 20 inches (500 millimeters) to maximum 24 inches (600 millimeters) in depth; 42 inches (1050 millimeters) minimum in length; seat height of 17-19 inches (425-475 millimeters) above floor. Provide a minimum 6 inches (150 millimeter) concrete base. Provide a recessed toe kick at the base.

*For Army facilities: Provide benches that are integral with the locker base.

3-5.4 Pool Equipment Storage.

An extensive amount of equipment is required for the operation and safety of the pool and other components of the facility. Carefully size and design storage areas to accommodate required equipment. Provide ventilation and a drain in the pool equipment storage room. Provide storage for lifesaving equipment in the pool area (e.g., hang life hook/pole and backboard on building wall) in a location that facilitates instant access to those items related to lifesaving procedures.

3-5.5 Surveillance and Security.

Orient bathhouse or natatoria and overall site to allow effective, continuous monitoring of the facility with a limited staff. Locate a prominent check-in/check-out counter near the main entrance with unobstructed views of all entrances and exits. Locate the pool office with complete and unobstructed surveillance of the entire deck and pool area. Lifeguard stations have specific surveillance requirements depending upon the configuration of the pool and other facilities. Refer to paragraph LIFEGUARD STATIONS for detailed information regarding location and quantity requirements.

Where direct visual contact of the lobby, entrances into locker rooms, and pool areas cannot be made from the check-in/check-out counter, or other designated control desk location, provide security cameras to facilitate surveillance of those areas from the designated control desk location*

*For Army facilities: Provide surveillance infrastructure, including conduit, cabling, raceways, wires, conductors, power, and junction boxes for a complete and operational system. Provide 2-inch empty conduit routed from security camera sources to control counter base cabinets and continue into ceiling cavity above counter for present and future video cabling. Conduit system to be concealed. Place a surveillance-system CCTV monitor connection in the staff office or check-in counter where it can be easily viewed by the facility director and staff. Provide a surveillance-system CCTV monitor connection in the director's office and ensure the system can record and back-up information. Provide waterproof surveillance-system equipment when located within the pool deck envelope or natatorium.

3-5.6 Architectural Character.

Bathhouse and building designs express the recreational role the aquatic facility plays in the life of the community and should project a feeling of informality. Although there is no single mandatory style, the design respect of the style, scale, and character of the surrounding area is desirable. Coordinate material selections, course lines, roof slopes, scale of windows, and other building elements to ensure the building style complies with the Installation-specific architectural compatibility guidelines and better buildings in the local area. Bathhouses that are removed from surrounding structures offer opportunity for a more unique architectural form, while remaining compatible with the overall styling and character of the Installation, as well as the geographic region. Locate unsightly elements, such as pool equipment and garbage dumpsters, at the back of the facility where they are not visible from roads and parking areas. Screen these items and similar elements, when needed, with landscaping, walls, fencing, and other architecturally compatible materials.

Provide architectural and interior design of aquatic facilities that is integral and related. Both involve functional analysis and consideration of the appropriate environmental character, building organization, circulation, supervision, and flexibility requirements, as well as finishes and furnishings. Present an open, inviting image while providing visibility of attractive activities from the approach and entrance. Admit only controlled, indirect daylight into dressing rooms and administrative areas through clerestories, skylights, or windows.

3-6 INTERIOR DESIGN.

Use NCIDQ-certified interior designers with experience in aquatic facility design to prepare the Comprehensive Interior Design. Provide interior surface materials, finishes and designs that are suitable for use in aquatic facilities and that enhance the overall architectural theme and aesthetic of the facility. Carefully select interior surfaces, details, finishes, fixtures, and fittings for resistance to wear, impact, and vandalism.

Select materials that are resistant to water and mildew due to the high humidity and corrosive environment associated with pools and showers. Base interior design selections on consideration of anticipated use, maintenance characteristics, life-cycle cost, fire protection, and other safety requirements. Coordinate with Installation personnel to incorporate local interior design requirements.

3-6.1 Interior Finishes.

Consider the safety and hygiene of customers in every aspect of the design development. Provide slip-resistant floor and deck surfaces in wet areas. Select wall surfaces to minimize abrasions in case of accidents or stumbles by customers and staff. Coordinate material, finish, color, texture, and furniture selections to complement the overall building design and image. Use colors, textures, and finish materials on the walls and floors to support circulation patterns. Select surface materials and furnishings that are moisture-and mildew-resistant and express a warm, intimate, and relaxed atmosphere. Use local materials to the greatest extent practicable to reinforce the user's sense of place or region.

3-6.2 Flooring.

Use slip-resistant ceramic tile, concrete, or other slip-resistant material for bathhouse or natatorium floors and in other administration areas. Select walking surface finishes with a minimum wet dynamic coefficient of friction (DCOF) as dictated by MAHC. Ensure that flooring materials, such as rubber, comply with applicable service and installation criteria. Slope floors to drains to prevent standing water. Provide coved tiles at wall to floor intersection in wet areas (e.g., dressing rooms, showers, toilet areas, etc.) to minimize dirt accumulations and for ease of cleaning.

3-6.3 Interior Walls.

For wet areas, construct walls with nonabrasive materials, like smooth block or brick. Dry area walls may be painted concrete masonry unit (CMU) block, painted masonry, moisture-resistant gypsum board, Portland cement plaster, or high-strength gypsum plaster. Construct dry area non-concrete or masonry cavity walls with galvanized metal studs raised upon a 6-inch concrete curb. A protective ceramic tile finish may be installed either full height or as a wainscot. Provide doors and frames that comply with SDI/Door A250.8, physical performance Level B, and be 316L stainless steel or fiberglass at wet area service. Door hardware must be 316L stainless steel.

3-6.4 Ceilings.

Provide a ceiling clear height of least 9 feet (2.75 meters).

3-6.4.1 Public Spaces.

For wet areas, provide moisture-resistant, sound absorbent, light reflective ceiling materials such as moisture-resistant gypsum board, plaster, galvanized metal, or other finishes impervious to moisture and mildew. For dry areas, provide moisture-resistant,

sound absorbent, light reflective ceiling materials such as moisture-resistant gypsum board, plaster, tegular acoustical tile, galvanized metal, or other finishes resistant to water and mildew.

3-6.4.2 Natatorium Ceilings.

Provide moisture-resistant materials such as galvanized metal, or other finishes impervious to moisture mildew. Suspended ceilings of any type are not allowed in the natatorium.

Provide a clear ceiling height over diving boards in accordance with FINA, unless the Installation-specific competitive dive standards are more stringent.

3-6.5 Furniture, Fixtures, and Equipment.

Provide furnishings and equipment with materials, finish selections, manufacturing methods and usage suitable for use in aquatic facilities for both indoor and outdoor furnishings, and that enhance the overall architectural theme and aesthetic of the facility. Choose interior furniture, fixtures, and equipment (FF&E) that is durable, comfortable, attractive, water and mildew-resistant. Consider modular components that match the office, staff break area, and training room. Provide highly durable surfaces for check-in and concession counter fronts, as they are subject to heavy use. Consider metal, solid-surface composite materials or stone for the front counter panels and counter tops. Provide corrosion-, moisture- and graffiti-resistant furniture and materials in dressing rooms.

3-6.6 Interior Signage.

Interior signage is important to support the functionality of the facility and for wayfinding. Provide interior signage system in accordance with UFC 3-120-01 and ABA requirements. Coordinate with Installation personnel to meet additional local design criteria requirements.

3-7 FACILITY SYSTEMS.

Facility systems include specific guidelines for core building systems, such as structural, mechanical, electrical, plumbing, lighting, fire protection, life safety, security, and acoustics. For natatoria, provide facility systems, components, and finishes and hardware that are moisture- and corrosion-resistant.

3-7.1 Structural.

Select an economical structural system based on facility size, projected load requirements, local availability of materials and labor, and wind, snow, seismic, geologic, and permafrost conditions. Select and design the structural system based on analysis of projected future needs to accommodate future expansion requirements easily and economically. However, do not over-design the initial construction. Structural bay sizes should reflect space requirements, economy, and subsystem

dimensions, such as masonry units and ceiling grids. Coat all exposed metal surfaces with appropriate coating to resist the corrosive environment within the natatorium. Provide structural bay sizes compatible with standard shelving and locker unit sizes and standard row-to-row dimensions.

Buildings should be limited to one or two stories to avoid the additional costs associated with AT/FP progressive collapse requirements.

3-7.2 Heating, Ventilation, and Air Conditioning (HVAC).

3-7.2.1 General.

Provide HVAC systems in accordance with UFC 3-410-01, UFC 3-410-02, UFC 4-010-01 and other applicable UFCs. Additional criteria specific to aquatic facility HVAC systems is included herein*

*For Army facilities: Provide designs in accordance with Technical Criteria for US Army Physical Fitness Facilities, Chapter V Natatorium and Technical Bulletin 575, Recreational Water Facilities.

**For Air Force facilities: Provide designs in accordance with AFMAN 48-114, Recreational Waters & Mission Training Pools.

3-7.2.1.1 Determine heating and cooling system design loads for sizing systems, appliances, and equipment in accordance with UFC 3-410-01. Include analysis of UFC 1-200-02, ASHRAE 189.1, ASHRAE 62.1 and ASHRAE 55 for thermal environmental conditions for human occupancy in the HVAC design.

3-7.2.1.2 Natatorium/indoor pool spaces must be on a separate ventilation system from the rest of the facility, including administrative space, showers, toilets and locker rooms. Provide HVAC systems for natatorium/indoor pool environments that comply with the recommended natatorium practices in the 2015 ASHRAE Handbook – HVAC Applications (Chapter 5 Places of Assembly – Natatoriums) for humidity control, room pressure control, ventilation requirements (outdoor and exhaust air) for indoor air quality (IAQ), air distribution, duct design, pool water chemistry and evaporation rates.

3-7.2.2 Outdoor Environmental Conditions.

Size equipment and all system components to maintain and control indoor design conditions at the outdoor conditions in accordance with UFC 3-410-01.

3-7.2.2.1 Natatorium/Indoor Pool Environments: These spaces are to be considered Spaces Conditioned for Specialized Technical Requirements in accordance with UFC 3-410-01. Due to the significant ventilation load requirements for these spaces, pay close attention to the 1.0 percent humidity ratio and corresponding Mean Coincident Dry Bulb (MCDB) condition.

3-7.2.3 General Indoor Environmental Conditions.

Size equipment and all system components to maintain the following indoor design conditions. Provide design conditions, including temperature, humidity, filtration, ventilation and air changes required.

3-7.2.4 Administrative/Office/Restroom/Locker Room Environments.

Maintain indoor heating and cooling design conditions for both occupied and unoccupied hours in accordance with UFC 3-410-01.

Bathhouses for outdoor pools are not heated or air-conditioned except for administrative areas. Because of the high humidity produced in the shower and dressing areas, as well as the potential odor associated with locker storage, provide the bathhouse with a ventilation system in accordance with the International Mechanical Code, ASHRAE 62.1 or a minimum of six air changes per hour, whichever is greater. Provide mechanical ventilation fans in dressing rooms, showers, and toilets to help reduce excessive humidity and odor.

3-7.2.5 Natatorium/Indoor Pool Environments.

3-7.2.5.1 Maintain indoor air temperature at the pool and wet deck 2 to 4 degrees Fahrenheit (1.1 to 2.2 degrees Celsius) above the water temperature at a relative humidity of 50-60%.

3-7.2.5.2 This paragraph applies to Army and Air Force facilities. Provide a separate direct outside air system (DOAS) for the pool deck that delivers the greater of 2.2 CFM per square foot (of pool surface area) or the recommended air changes per hour (ACH) per the current ASHRAE Handbook, HVAC Applications, “Places of Assembly.” This criterion will insure sufficient ventilation air to maintain healthy IAQ and control the build-up of toxic chloramines, such as dichloramine and trichloramine, that off-gas into the air due to water treatment. Add occupancy and other ventilation air requirements per ASHRAE Std 62.1 as necessary. See paragraph NATATORIUM/INDOOR POOL ROOM HVAC SYSTEMS for specific HVAC system design strategies/requirements for these spaces.

3-7.2.5.3 This paragraph applies to Navy and Marine Corps facilities. Provide sufficient supply air delivery rate and outdoor ventilation air to maintain healthy IAQ and control the build-up of toxic chloramines, such as dichloramine and trichloramine, that off-gas into the air due to water treatment. See paragraph NATATORIUM/INDOOR POOL ROOM HVAC SYSTEMS for specific HVAC system design strategies/requirements for these spaces.

3-7.2.5.4 Maintain a supply air delivery rate of 4-6 air changes per hour for recreational pools with no spectator areas, 6-8 air changes per hour for competition pools with spectators, and 4-6 air changes per hour for therapeutic pools. The supply air rate must be adjusted to meet space sensible loads while maintaining a comfortable supply air temperature for swimmers; 65 degrees Fahrenheit (18.3 degrees Celsius) is a

practical minimum supply air temperature.

3-7.2.5.5 This paragraph applies to Army and Air Force facilities. Provide minimum outside air for ventilation of 2.2 CFM per square foot (of pool surface area) at all times unless an increase in the ventilation rate is determined to be required by the recommendations of the current ASHRAE HVAC Applications Handbook (chapter on "Places of Assembly"). The minimum requirement at the breathing zone of the swimming pool and wet deck area (3 inches to 72 inches above the deck) is 0.48 cfm per square foot (2.4 l/s per square meter). The breathing zone is 3 inches to 72 inches (75 millimeters to 1830 millimeters) above the deck. Adjust this requirement based on the ASHRAE activity factor for the facility type in accordance with the procedure detailed in the ASHRAE Applications chapter on natatoriums. The minimum for spectator areas and deck areas not considered to be wet is 0.06 cfm per square foot (0.3 l/s per square meter) with an additional 7.5 cfm/person (3.8 l/s per person).

3-7.2.5.6 This paragraph applies to Navy and Marine Corps facilities. Provide minimum outdoor air for ventilation in accordance with ASHRAE 62.1, unless an increase in the ventilation rate is determined to be required by the recommendations of 2015 ASHRAE Applications Handbook, Chapter 5. The quantity of outdoor air must provide adequate dilution of contaminants generated by the pool water. The minimum requirement at the breathing zone of the swimming pool and wet deck area (3 inches to 72 inches above the deck) is 0.48 cfm per square foot (2.4 l/s per square meter). The breathing zone is 3 inches to 72 inches (75 millimeters to 1830 millimeters) above the deck. Adjust this requirement based on the ASHRAE activity factor for the facility type in accordance with the procedure detailed in the ASHRAE Applications chapter on natatoriums. The minimum for spectator areas and deck areas not considered to be wet is 0.06 cfm per square foot (0.3 l/s per square meter) with an additional 7.5 cfm/person (3.8 l/s per person).

3-7.2.5.7 Maintain pool and spa areas at a negative pressure of 0.05 to 0.15 inches of water (12.5 to 37.4 pascals) relative to adjacent spaces and the outdoors; implement active pressure control if feasible. Design system so exhaust air rate exceeds the supply air delivery rate such that the excess exhaust is 10% of the supply air volume; acceptable range for excess exhaust is 2% to 10%.

3-7.2.6 Administrative/Office HVAC Systems.

Heating, ventilating and air conditioning systems must be separate from those serving the natatorium/indoor pool environment. Fully duct all supply and return air distribution systems. Provide zoning to maintain different environmental conditions in each required functional area.

3-7.2.7 Natatorium/Indoor Pool Room HVAC Systems.

3-7.2.7.1 Deterioration of materials from condensation should be anticipated and minimized with mechanical design and construction material selection resistant to chemical corrosion from the pool atmosphere. Construct metal ductwork, diffusers, registers and grilles of aluminum. Fabric ductwork with grilles sewn in may be

acceptable for exposed ductwork in pool areas. Use of duct liner is prohibited. Steel hangers and supports must be painted with an epoxy-based paint or other durable finish suited to protect the metal from corrosion in a natatorium environment. Aluminum is the preferred material of construction for interior walls and floors of air handling sections of air conditioning units, including drain pans, dampers, fan wheels and heat exchangers; provide phenolic or baked epoxy coating for coils. Any steel components must have a phenolic or baked epoxy coating. Provide filters that are resistant to moisture degradation.

3-7.2.7.2 Do not locate equipment requiring maintenance above the pool or spa.

3-7.2.7.3 Direct supply air to building envelope surfaces, particularly glass, to prevent condensation. Direct supply air over the water surface toward low return/exhaust intakes to remove chloramines from the breathing zone of swimmers. Limit the air velocity over the water surface to 30 fpm (0.15 m/s) or less. Locate high and medium return intakes to capture warm, humid air for return to the ventilation system, minimize short-circuiting of supply air, and limit chloramine recirculation. Locate low exhaust intakes to optimize the capture of chloramines and limit their recirculation. Locate return and exhaust intakes at the warmest bodies of water and those with the most agitation, as these areas off-gas at higher rates than traditional pools; always provide exhaust intakes directly over spas.

3-7.2.7.4 For pools with spectator areas physically separate from pool area, the preference is to provide a dedicated air handling unit to provide supply air to the space at a temperature more comfortable for spectators and separate spectator ventilation requirements from pool area ventilation requirements for improved ventilation/energy efficiency. If a single unit is provided to serve both the spectator viewing and pool areas, then it must be sized to include the spectator ventilation load at full occupancy during swim meets and events.

3-7.2.7.5 Provide system with method of air-to-air energy recovery between exhaust and outdoor air streams. Justification must be provided to not include this energy recovery feature (economically unfeasible due to existing conditions, system size, etc.). Desiccants are broken down by chlorides and are not to be used.

3-7.2.7.6 HVAC system serving the pool area must include a purge mode to replace indoor air with outdoor air after chemical treatment process of “shocking” the pool as recommended by the Model Aquatic Health Code. Design the system to provide 100% outside air during this operation.

3-7.2.7.7 Consideration must be given to energy saving strategies such as, but not limited to, the following:

- Use of increased outdoor air ventilation for dehumidification and increased IAQ in conjunction with air-to-air energy recovery
- Use of waste heat from air conditioning and dehumidification to heat pool water

3-7.2.8 Chemical Storage Rooms.

Space must be kept at a negative pressure with dedicated exhaust air system meeting the requirements of the MAHC. Each chemical storage room must have an independent, dedicated exhaust system to prevent mixing of acid and chlorine vapors. Provide exhaust air intakes within 6-inches (150 millimeters) of the floor to capture chemical vapors heavier than air. Minimum flow rate to be the greater of 1.5 cfm per square foot (7.5 l/s per square meter) or 10 air changes per hour, unless the MSDS or manufacturer of the chemicals being stored requires a higher rate. Materials of construction must be resistant to corrosion. Construct ductwork, registers and grilles of aluminum or fiber-reinforced plastic (FRP). Provide exhaust fan(s) made of aluminum or FRP construction. Steel elements, such as hangers and supports, must be painted with an epoxy-based paint or other durable finish suited to protect the metal from corrosion in this environment.

3-7.2.9 Pump and Water Treatment Equipment Rooms.

Keep space at a negative pressure with dedicated exhaust air system meeting the requirements of the MAHC. Provide exhaust air intakes within 6-inches (150 millimeters) of the floor to capture chemical fumes heavier than air. Meet the minimum flow rate requirements of ASHRAE 62.1 or other applicable standards for chemicals and equipment being utilized, as well as heat gain from equipment. Ventilation system must be capable of accommodating venting of surge tanks, if applicable. Materials of construction must be resistant to corrosion. Construct ductwork, registers and grilles of aluminum or fiber-reinforced plastic (FRP). Provide exhaust fan(s) made of aluminum or FRP construction. Paint steel elements, such as hangers and supports, with an epoxy-based paint or other durable finish suited to protect the metal from corrosion in this environment.

3-7.2.10 Pool Equipment Storage Rooms.

Keep space at a negative pressure with dedicated exhaust air system providing a minimum flow rate of 1.0 cfm per square foot (5 l/s per square meter) or 10 air changes per hour, whichever is greater. Materials of construction must be resistant to corrosion due to chlorides. Construct ductwork, registers and grilles of aluminum or fiber-reinforced plastic (FRP). Provide exhaust fan(s) made of aluminum or FRP construction. Paint steel elements, such as hangers and supports, with an epoxy-based paint or other durable finish suited to protect the metal from corrosion in this environment.

3-7.2.11 HVAC Controls - General.

If facility is provided with a direct digital control (DDC) system, it must comply with UFC 3-410-02, Direct Digital Control for HVAC and Other Building Control Systems and UFC 4-010-06 Cybersecurity of Facility-Related Control Systems. If connecting to Installation BAS/UMCS system, UFC 3-470-01 Utility Monitoring and Control System (UMCS) Front End and Integration is applicable.

Do not locate thermostats and temperature sensors on exterior walls or adjacent to windows, doors, water or other features that would influence an inaccurate reading.

3-7.2.12 Administrative/Office HVAC Controls.

Provide night and weekend setback capability for the HVAC system and zone control for maintaining different environmental conditions in each required functional area. If facility is not provided with a DDC system, then provide 24-hour/7-day programmable thermostats. Utilize security features so that thermostats are only accessible to authorized personnel.

3-7.2.13 Natatorium/Indoor Pool Environments HVAC Controls.

3-7.2.13.1 HVAC system controls are to be integrated with swimming pool process control system, as applicable, for coordination of system operational functions such as supply air temperature set point vs pool water temperature, purge mode, etc.

3-7.2.13.2 Provide packaged pool room air conditioning and dehumidification equipment with microprocessor controls. If facility has a building Direct Digital Control (DDC) system, packaged equipment must have manufacturer-provided open protocol interface for communication with this DDC system.

3-7.2.13.3 Do not implement night temperature setback to reset the space temperature down; this increases pool water evaporation and possibility of condensation.

3-7.2.13.4 The strategy to shut off the ventilation air during unoccupied hours to save energy by reducing load on the dehumidification system may be implemented, however careful consideration must be made with regard to potential negative impact to air and water quality. For natatorium/pool environments with separate air handling units for the spectator area, the ventilation air to the spectator zone may be reduced to zero during unoccupied periods.

3-7.3 Plumbing.

3-7.3.1 General.

Provide toilet and bath facilities in accordance with ISPSC, MAHC and UFC 3-420-01. Provide automatic mixing valves on showers where hot water is over 105 degrees Fahrenheit (40 degrees Celsius). Provide shut-off valves at all plumbing fixtures. Provide floor drains in all dressing rooms, shower rooms, toilet areas, and custodial closets. Provide metering for gas service, if used. Supply hot and cold water to all restrooms, sinks, and custodial closets. Hot water temperature is not to exceed 105 degrees Fahrenheit (40 degrees Celsius) at the outlet. Provide frost-free hose bibs on exterior walls to enable hose access to the entire pool deck and locate interior hose bibs to enable hosing down of all wet areas within the bathhouse. Provide separate water service with meter for the pool. Provide a dedicated backflow preventer in the pool equipment room*

*For Army facilities: Provide designs in accordance with the requirements of Technical Criteria for US Army Physical Fitness Facilities, Chapter V Natatorium and Technical Bulletin 575, Recreational Water Facilities.

3-7.3.2 Surge Tanks.

Provide PVC vent pipe leading to the outdoors for surge tanks located below the pool deck, if applicable. Size vent for surge volume required by MAHC. Terminate vent at gooseneck with birdscreen.

3-7.4 Electrical.

Provide electrical service to the aquatic facility in accordance with UFC 3-550-01. Provide distribution equipment, wiring methods, receptacles, grounding, interior and exterior lighting, controls, and emergency lighting, in accordance with UFC 3-520-01 and the published Installation-specific design requirements. Provide voltages and frequencies for overseas locations in accordance with UFC 3-510-01. Coordinate with Installation personnel to determine the quantity of electrical outlets, and their placement, for specific equipment such as vacuums, public-address systems, timing devices, and score boards.

3-7.4.1 Wet and Corrosive Areas.

The chemical storage rooms and pool area are considered wet and corrosive. Design the electrical system within the chemical storage room using equipment and wiring methods that are drip-proof and corrosion-resistant.

Provide devices that are specification-grade, with stainless-steel cover plates within the pool area.

3-7.4.2 Service Entrance Equipment.

Provide service entrance equipment sized for the facility on the calculated load plus 15% empty (bussed) space and 15% spare capacity (ampacity), rounded up to the next standard service size. Provide metering for electrical power in accordance with the Installation's utility metering requirements.

3-7.4.3 Lightning Risk Assessment.

Conduct a lightning risk assessment and, if required, provide a lightning protection system in accordance with UFC 3-575-01.

3-7.5 Fire Protection and Life Safety.

Provide fire protection and life safety designs in accordance with the following standards and criteria:

- UFC 3-600-01
- Latest edition of the applicable National Fire Protection Association

(NFPA) Codes and Standards

3-7.6 Communications and Data.

Provide a minimum of one telephone and one data outlet with high-speed internet connection in the check-in and office area. Provide wireless local area network (LAN) connectivity for all office areas, and for pool areas for patrons. Because of the technical nature and rapidly changing communications and data requirements, refer to UFC 3-580-01 for detailed guidelines and specifications:

Provide junction boxes with rigid conduit within the ceilings and walls that includes the required infrastructure for telephone and data connections. Provide telecommunications outlets with stainless-steel cover plates within the pool area. Telephone and data outlets may be independent of each other or combined into a single junction box. If these connections can be combined into a single junction box, the cover plate to that junction box must allow for multiple connections. Coordinate with the Installation POC for Information Technology (IT) systems to determine if additional local requirements or preferences are applicable to the project.

3-7.7 Public Address System.

A centrally-controlled public address (PA) and two-way communication system is required for all pool facilities. Incorporate PA capability with the phone system to allow paging from all staff phones, where possible. All PA components located in the pool area must be suitable for installation in wet and corrosive environments.

Provide a PA system at the circulation desk if it cannot be incorporated in the phone system. Provide at least one PA speaker in each dressing room, office, check-in, public toilet, and lobby (at indoor pools). Provide one indoor speaker for every 800 sq. feet (74.3 sq. meters) of net floor area. Provide a minimum of two outdoor speakers for every 25-meter pool and at least three speakers for every 50-meter pool. Provide an interface between the PA system and the Installation Wide Area Mass Notification System (MNS).

3-7.8 Interior Lighting.

Provide interior lighting fixtures, design, materials, finishes, and placement that support the architectural and interior design function of each space and enhance the design aesthetic of the facility. Provide wet-area-rated light fixtures in wet areas like the natatorium, showers, dressing areas, and toilets. Provide light fixtures that minimize glare and shadowing.

Where artificial lighting is used to meet the light level requirements, provide manual means to control the luminaires. Separately control luminaires in daylighted areas through continuous dimming photocontrol to reduce light output when natural light is available.

3-7.9 Alarm Systems.

Provide an alarm system for intrusion detection to protect equipment and assets. Coordinate at the Installation level to provide alarm system equipment that is compatible with the systems used at each Installation. Provisions for an alarm system must be justified during the planning and programming process.

3-7.10 Cable Television (CATV) System.

For CATV service, provide the facilities and infrastructure to accommodate routing of the CATV service trunk-line entry from the nearest source on the Installation to the network headend in the facility telecommunications room (TR). Provide a distribution conduit pathway from the TR to one outlet in the office area. Coordinate with the Installation personnel to determine where additional CATV outlets are required.

3-7.11 Closed-Circuit Television (CCTV) System.

Coordinate with the Installation personnel to provide facilities and infrastructure for CCTV in the pool area for displaying messages, for instructional purposes, and for marketing announcements, for pool supervision, and for electronic surveillance. Provide distribution pathways to head-end equipment and connectivity to the LAN.

CHAPTER 4 FUNCTIONAL AREA TECHNICAL REQUIREMENTS

4-1 GENERAL.

Chapter 4 presents requirements specifically applicable to the design of each functional area and space of aquatic facilities. Specific criteria are provided concerning critical dimensions, storage requirements, furnishings, equipment, and technical requirements for each component space within each functional area. The technical requirements provided in this chapter address only items with special criteria for each individual space. General planning requirements are presented in paragraph DESIGN.

The requirements in this chapter apply to all sizes and types of aquatic facilities. Specific space allocation is provided in accordance with paragraph SPACE REQUIREMENTS.

4-2 SITE FUNCTIONAL AREA REQUIREMENTS.

Provides technical requirements for siting pools, structures, parking areas, pool deck, recirculation and filtration equipment, chemical storage, service drive, and non-water recreation areas.

4-2.1 Non-Water Recreational Areas.

Physically separate non-water recreation areas from the main pool with a low fence, wall, or barriers with a self-closing gate. Provide low barriers in accordance with the MAHC for barriers not serving as part of the aquatic facility enclosure.

Provide shaded areas and shelters for protection from the sun.

4-2.2 Outdoor Showers.

Provide a minimum of one outdoor rinse shower at the entrance to the pool deck. Locate drains to prevent water from outdoor showers from accumulating on the pool deck.

For natatorium, provide a minimum of two rinse showers in the pool enclosure, on the pool deck, near the entrance into the pool area.

4-2.3 Parking Areas.

Provide customer parking spaces in accordance with UFC 3-201-01 at peak capacity, plus one for each full-time staff member. Provide dedicated spaces for motorcycles and bicycle racks in accordance with LEED or sustainable design guidelines and Installation design requirements. Provide bicycle racks near the main entrance in a secure location. Provide artificial light levels at night in all parking areas in accordance with by UFC 3-530-01 for security and safety.

4-2.4 Fences, Gates, and Wind Screens.

Enclose the pool and surrounding deck area completely with a barrier. For pools where unauthorized access may be an issue, provide a minimum fence height of 8 feet (2.4 meters). Segregate areas within the deck (e.g., food service areas, spectator seating) with low barriers compliant with MAHC barriers not serving as part of the enclosure. Do not use chain-link fencing for internal segregation. Use fencing that is architecturally compatible with the fencing in nearby areas and is visually permeable, so Installation security personnel can easily monitor activities within the compound. Use fence materials that match or complement the exterior bathhouse and building materials. Use brick or masonry walls to screen equipment and provide protection from wind. Emergency access gates must be a minimum of 6 feet (1.83 meters) wide to accommodate emergency responder personnel and equipment. Provide MAHC-compliant gates in perimeter fencing for landscaping maintenance equipment.

4-2.5 Filtration, Recirculation, and Heating Systems.

Separate all pool mechanical equipment and chemical storage areas from public access. Pool mechanical systems may be located inside a building structure or outside within a fenced or enclosed exterior compound. Equipment includes pumps, pipes, filter tanks, water heaters, chlorine and disinfectant feeders, surge tanks, and control panels. Locate all equipment with convenient access for maintenance. Provide sufficient space for the placement, replacement, and servicing of each piece of equipment. Size doors or openings to permit future replacement of all equipment. Provide ventilation for motors and heaters.

4-2.6 Chemical Storage.

Provide chemical storage rooms or secured structures to house chlorine and other chemicals independent of the other pool mechanical equipment. Provide separate, independent rooms for oxidizing chemicals and pH adjustment chemicals. Locate the storage rooms within the mechanical equipment compound or adjacent to the pool equipment in a space that is not accessible to the public. Secure doors from break-ins and unauthorized access. Post warning signs in accordance with MAHC for chemical storage room doors and additional signs requiring protective clothing and equipment. Provide fire- and explosion-proof chemical storage rooms. Refer to paragraph HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) for air change and exhaust requirements. Provide an OSHA-approved drench shower and eye wash station, gloves, protective goggles, and gas masks in the pool equipment and all chemical storage areas. Do not provide floor drains in the chemical storage rooms.

For renovations of existing facilities utilizing gas chlorine, provide a storage space meeting the requirements of MAHC and provide an audible and visual alarm to alert of chemical leak.

4-2.7 Service Drives and Emergency Vehicle Access.

Coordinate with the Installation to determine the sizes and weights of required

emergency and service vehicles before planning the service access areas. Design all service and emergency drives for the weight of the vehicles anticipated and consider the inclusion of the pool deck as part of the emergency access drive. Provide direct access to the pool deck for emergency vehicles and do not cross outdoor activity areas with service/emergency access.

Avoid dead-end service drives and service drives that exceed 100 feet (30 meters) in length. Provide a backup spur for dead-end and service drives that exceed 100 feet (30 meters) in length. Provide a service drive access to the recirculation/filtration equipment and chemical storage area for chemical delivery, maintenance and waste removal. Screen or separate the service area from public use or traffic areas with attractive fences, walls, depressions, berms, or landscaping. Provide proper drainage if depressions are used. Asphalt or concrete access drives to the loading dock must be a minimum of 12 feet (3.6 meters) wide for access by trucks and emergency vehicles. Provide access for maintenance of overhead lighting, if provided. Comply with AT/FP standards as provided in UFC 4-010-01, particularly for dumpster separation and access control. Provide easy access to dumpsters or outside trash containers located on paved areas or a concrete pad.

4-3 WATER AREA REQUIREMENTS.

Water areas include the main pool swimming and diving areas, wading pool, spray ground areas, and spa areas. Locate the staff office to enable constant visual monitoring of the water areas. Locate access to the pool from the bathhouse or dressing room areas near the shallow end, wading pool, or spray ground area.

4-3.1 Lap and Competitive Swimming Areas.

Provide a dedicated area for lap swimming. Follow sanctioning agency detail requirements for competitive swimming facilities. Consult AAU, NCAA, NFHS, USA SWIMMING or FINA regulations for detailed requirements and additional information since these requirements are subject to annual review and change. Default to FINA requirements when sanctioning entity is not known.

4-3.2 Lane and Area Dividers.

Provide racing lane dividers consisting of a set of continuous disk-type, wave quelling floats strung on a cable or cord running the full length of the lane. Provide permanent recessed anchors integral to the pool deck, wall or gutter for lane divider attachment. Provide lane dividers with a tensioning device so that they can be stretched tight and held in position. Provide one racing lane divider to separate each racing course lane and additional dividers to separate outside lanes from additional space adjacent to the pool wall. In the general-use pools, separate deep water (the diving area) from shallow water using a lane divider, bulkhead, or an area divider. Provide area dividers consisting of a rope with buoys spaced along the length. Provide recessed anchors centered between racing lanes, at the line separating diving from free swim areas, and to isolate specific program areas. Provide an area divider 1 foot (.30 meter) to the shallow side to mark the 5-foot (1.5-meter) depth point during recreational swim periods.

4-3.3 Racing Lanes and Target Markings.

Provide racing lane and target markings according to the appropriate event sanctioning entity that may be involved in competitive events (e.g., NCAA, FINA). Default to FINA requirements when sanctioning entity is not known. For a 25-meter course, provide a recall line 40 feet (12 meters) from the starting end. For a 50-meter course, provide a recall line 50 feet (15 meters) from the starting end. Hang the recall line from removable stanchions. Provide a cover for the stanchion anchors when not in use and design anchor to prevent standing water. If provided, specify touch pads to be a minimum of 6 feet, 6 inches (1.98 meters) wide by 2 feet (610 millimeters) tall. Install in a fixed position in the center of the lane and vertically positioned in accordance with the requirements of the event sanctioning body. Provide slip-resistant race lane and target markings.

4-3.4 Bulkheads.

Provide bulkheads for competition pools where the length of the pool is greater than the required course length for competition. Provide bulkhead locations such that the required course dimensions are met when the bulkhead is anchored into position.

Use moveable bulkheads with “flow thru” vertical surfaces where displaced water moves through the bulkhead for easier movability. Avoid bulkhead designs that have a “trampoline effect” or are required to maintain constant air pressure for structural integrity.

*For Army facilities, provide motorized bulkheads.

4-3.5 Diving and Deep-Water Areas.

Diving and deep-water areas are used for competitive diving, recreational diving, SCUBA training, survival training, rock wall climbing and other activities requiring deep water. Provide a diving envelope size and depth compliant with or exceeding FINA minimum requirements or in accordance with play feature manufacturer (e.g., climbing walls). Diving and deep-water areas may be accommodated in three possible ways:

- The preferred method is to locate diving areas adjacent to the deep end of a general-use pool in a typical “L”-shaped configuration.
- Incorporate the diving area into the deep end of a general-use pool. Utilize bulkheads to separate program spaces.
- Provide a separate pool exclusively for diving or deep-water training and programs.

For Army facilities, provide a recessed toe-ledge in the pool wall no less than 4 feet (1.22 meters) below the water surface on all sides of any pool where the water depth exceeds 5 feet (1.52 meters).

4-3.6 Diving Boards and Platforms.

Where desired by local Installation, provide diving boards that are manufactured from aluminum, fiberglass, or wood, coated with a slip-resistant surface. For springboards of 10 feet (3 meters) or more above the water surface or for competitive diving, provide springboards that comply with FINA or the sanctioning organization. For diving boards over 2 feet (610 millimeters) in height, provide 3 feet (910 millimeter) high double guard rails on each side of the board extending to the water's edge. Where desired by the local Installation, provide 1 meter (3.3 feet) and 3 meter (9.9 feet) platforms compliant with FINA requirements. Cover fulcrum mechanisms to prevent injury to fingers or toes.

To increase visibility of the water surface, provide a water surface agitator using water jets at deck level or air bubble inlets in the pool bottom.

4-3.6.1 Special Diving Requirements.

Where required by the local Installation, provide high-diving platforms of 7.5 meters (24.3 feet) and 10 meters (32.8 feet) high. Provide concrete construction compliant with FINA.

4-3.6.2 Water Slides.

Where desired by the local Installation, provide recreational water slides compliant with ASTM F2376 in the water areas. Provide water slides designed for feet-first sliding only. Provide the water depth and pool floor profile required by the slide manufacturer and MAHC at the termination of the slide. Water slides may terminate in an independent landing pool, on the pool deck in a fiberglass runout or in a general pool. For slides landing in a multi-use pool, provide barriers to isolate the slide landing area. Provide an egress point(s) within the landing area such that riders do not cross the path of another rider to exit the pool. Provide a landing pad and pool floor-mounted barriers for children's slides terminating in shallow water.

Provide a minimum clear height from the water slide starting tower to the lowest overhead obstruction of at least 8 feet (2.4 meters).

4-3.7 Play Structures and Aquatic Play Equipment.

Where desired by the local Installation, include play structures and other aquatic features compliant with ASTM F2461 as part of the spray ground areas or wading pool to create a water park environment. Where desired, provide play structures/sprays located inside the main pool zero-depth entry and other water areas. Consider climbing walls for deep-water pools. Provide water area, depths and feature construction for play structures and aquatic feature equipment in compliance with MAHC and the manufacturer's requirements.

4-3.8 Spray Grounds/Interactive Water Play.

Design spray grounds with all points of the spray area sloped to drain such that no

standing water is present. Provide spray ground equipment for the dependent population at each facility. Install ground sprays flush with the spray ground finish. For overhead spray equipment, provide protective coverings over flanges and anchor hardware, or anchor feature below grade to prevent toe-stub hazards. Spray grounds may be designed with either recirculated or potable water for features.

Physically separate spray ground areas from other pool areas with a low fence or barriers with a self-closing, self-latching, lockable gate. Provide low barriers in accordance with the MAHC for barriers not serving as part of the aquatic facility enclosure.

4-3.8.1 Recirculated Systems.

For recirculated systems, design the spray ground recirculation independent from any other pool or spray ground system. Provide a turnover rate compliant with MAHC and ISPSC. Provide supplemental disinfection system in accordance with MAHC.

4-3.8.2 Potable Water Systems.

Potable water supplies connected directly to play features are acceptable as an alternative to recirculated spray grounds. For potable water systems, discharge waste water (water that has been sprayed through a feature and has then contacted the spray ground finish) into the sewer as permitted by the Installation and according to local codes or collect water for reuse in grey water applications.

4-3.9 Wading Pools.

The depth of wading pools* may range from 0 to 18 inches (150 to 450 millimeters). Provide a pool floor slope between 1:15 and 1:20. Provide an independent water recirculation system for wading pools.

Locate wading pools at the shallow end of the main pool. Provide adult seating opportunities for at least one parent for each child at maximum capacity. Physically separate wading pools from the main pool with a low fence or barriers with a self-closing, self-latching, lockable gate. Provide low barriers in accordance with the MAHC for barriers not serving as part of the aquatic facility enclosure.

*For Navy facilities: Do not provide wading pools in new construction projects. Existing shallow wading pools may be maintained, as needed, for small children to play and swim.

4-3.10 Recreational Spa Pools.

These requirements apply to spas used for non-medical purposes. Provide a spa depth between three feet (0.9 meters) and four feet (1.2 meters). Provide underwater bench seating a maximum of 18 inches (0.45 meters) below the normal operating water level. Provide underwater pool steps to the spa pool floor. Utilize skimmers and wall inlets for recirculation. Provide flat main drains installed flush with the pool floor at the deepest

point of the spa pool floor. Spa pools may include water or air induced hydrotherapy jets.

4-3.11 Pool Access.

Pool access may be accomplished in several ways.

4-3.11.1 Accessible Ramps and Equipment.

Provide accessible entry and equipment in accordance with paragraph ACCESSIBILITY.

4-3.11.2 Zero-Depth Entry Area.

Design slip-resistant zero-depth entry areas with a slope between 1:15 and 1:20 for main pools and wading pools. Provide a perimeter overflow gutter with pre-fabricated grating at the normal operating water level to assist in debris removal and reduce maintenance.

If provided, group spray play features to maintain a path free of spraying water adjacent to the play area.

4-3.11.3 Ladders and Grab Rails.

Provide steps and ladders recessed into the pool wall. No ledges or projections are permitted under the water surface. Grab rails with recessed steps are preferred over projecting ladders. Locate grab rails and recessed steps at both ends of the long walls near the corners for 25-yard or 25-meter pools. For 50-meter or uniquely shaped pools, provide intermediate grab rails and recessed steps in accordance with the MAHC.. Where steps, step holes, or ladders are located within the pool, provide a grab rail on both sides extending over the edge of the deck.

Locate a ladder or recessed step with grab rails no more than 16 feet, 5 inches (5 meters) from a diving board or water slide. Position ladders or recessed steps so swimmers don't have to cross the landing areas of diving boards and water slides.

4-3.11.4 Pool Steps and Ramps.

Provide one set of shallow water steps or a sloped-entry compliant with ABA for access into the shallow end of the pool unless prohibitive. Design underwater steps recessed into the pool wall. Provide slip-resistant finish on ramps and stair treads, on the leading edge of stair treads and grab rails. Provide a contrasting color, permanent marking on the leading edge of each tread.

4-4 POOL DECK AREA REQUIREMENTS.

Provide the following deck equipment: lifeguard stands and stations, backboards, head immobilizer, rescue tubes, a drinking fountain, emergency telephone, lounge chairs, umbrellas and other sun screens, and night lighting. Other potential furniture, fixtures,

and equipment (FF&E) includes supplemental chairs, dining tables, occasional tables, basketball goals, volleyball nets and poles, pace clocks, floor stand portable signs, starting blocks, starting block safety covers, backstroke stanchions, lockers, storage carts, lane lines and area dividers, lane line reels, pool cover, and pool cover reels.

4-4.1 Lifeguard Stations.

Provide portable lifeguard stations for different activities and conditions. Provide a minimum of one elevated lifeguard station for pools with a surface area of over 2,000 square feet (186 square meters). Provide a minimum of two lifeguard stations for pools over 4,000 square feet (371 square meters), and one for every successive 2,500 square feet (232 square meters) or majority fraction thereof. Consider pool layout, shape, and elevated features in the determination of the required quantity of lifeguard chairs.

Require lifeguard stations capable of securing portable lifesaving equipment (e.g., ring buoys). Provide lifeguard stations capable of securing UV protection compliant with MAHC.

4-4.2 Life Safety Equipment.

Provide one rescue (reaching) pole fitted with a life hook or shepherd's crook and one ring buoy for each 2,000 square feet (186 square meters) of water area. Provide two wound throwing ropes of length equal to one-and-a-half times the pool width. Provide a minimum of one backboard with straps and head immobilizer for each pool. Locate required items in the immediate vicinity of the pool. Provide a rescue tube at each lifeguard station.

Provide a first aid kit, cot, blanket, pillow, and Automatic External Defibrillator (AED)*, in the first aid room.**

*For Navy projects: Provide (AED) in the pool enclosure with immediate access from the pool deck.

**For Army facilities: Refer to the MAHC for minimum life safety equipment requirements.

4-4.3 Depth Markings.

Locate deck depth markers on the pool deck beside the pool edge. For pools with a freeboard of 4 inches (10 cm) or greater, provide vertical wall depth markers at or above the water level. For pools with a freeboard less than 4 inches (10 cm), place wall depth markers as high on the wall as possible. For deck level pools, provide wall depth markers below the water level, as high as possible on the pool wall.

4-4.4 Starting Platforms.

When competitive swimming is a program requirement, provide starting platforms for each course lane in the pool. Mount starting platforms above the water level at the

dimension required by the sanctioning institution governing the competitive events. Mount the front edge flush with the vertical end wall of the course. Provide a minimum platform width of 20 inches (510 millimeters). Slope the platform's surface at not more than 10 degrees and provide a slip-resistant surface. Number starting platforms according to FINA. Provide anchors for starting platform installation. Provide winterizing covers for when platforms are stored.

4-4.5 Automatic Timing Devices.

Where required, equip timing devices to be initiated by the starting system. Provide automatic timing devices that display all recorded information and finish contact pads activated by a light hand touch. Where automatic timing devices are installed, provide in deck timing system connections, such that there are no exposed wires on the pool deck.

4-4.6 Chairs, Tables, and Umbrellas.

Provide a variety of chairs, tables, and umbrellas designed for outdoor use around the pool deck. Use reclining lounge-style chairs for sunbathing and general pool-side use. Provide some chairs and tables grouped together. For outdoor pools, provide movable umbrellas for shaded, informal seating areas. Use stackable chairs, where possible, to facilitate storage. Provide chair and umbrella fabrics that are moisture-resistant and designed for outdoor use. Do not use glass table tops.

Provide a line of demarcation in the pool deck to delineate between seating/lounging areas and walking areas. Use permanent, slip-resistant finish materials, contrasting in color to the pool deck surface.

4-4.7 Sun Screens.

For outdoor pools, provide large pool deck areas protected by overhead sun screens (shade structures), especially around the check-in and bathhouse areas. Provide shade structures that provide shading for a portion of the pool water areas, common grass areas, and at least half of the spray ground or wading pool areas. Provide shade accommodations at each lifeguard station that are adjustable and can be moved according to changing sun conditions.

4-4.8 Deck Equipment Storage.

Provide freestanding or built-in storage for instructional and recreational equipment, such as kickboards, floats, buoys, fins, masks, SCUBA equipment, noodles, pennants, swim trainers, scoreboard, chalkboard, electric clock, water polo goals, water basketball goals, volleyball equipment, pool cleaning equipment, lane markers, pool covering, thermometer, backstroke lines, personal flotation devices (PFD), aquatic exercise equipment, and other miscellaneous items. Consult with Installation-level personnel and the aquatic facility director regarding storage areas needed to meet program and operating policy requirements.

4-4.9 Locker Areas.

Locker storage for clothing may be located on the pool deck or within the dressing rooms.

4-4.10 Water Fountains.

Provide public water drinking fountains accessible from the pool deck in accordance with MAHC.

4-4.11 Deck Signage.

Provide signs regarding pool rules at the entrance to the pool deck and within the water areas. Include signs that provide emergency numbers near the office telephone, warnings outside the pool area, room names, entry prohibitions, and instructions necessary for diving or special equipment. Provide signs in accordance with UFC 3-201-02.

4-5 BATHHOUSES AND NATATORIUM AREA REQUIREMENTS.

Bathhouses normally contain the following core spaces: check-in area, male and female dressing rooms, showers, toilets, storage, offices, and administrative areas. These core spaces may be contained within the same building or separated into different structures, as desired. Food service, filter rooms, chemical storage, and mechanical equipment may also be contained within the bathhouse building; however, some of these components may not be required to be located within a building structure and may need to be located in separate areas of the site for safety and functionality. Typical bathhouse spatial relationships are shown in Figure A-3: Bathhouse Functional Area Relationships.

4-5.1 Entry Control Checkpoints.

This area serves to monitor the flow of people in and out of the facility. If valuables storage is handled in this area, provide 12 inch by 12 inch (127 millimeter x 127 millimeter) lockers. Additionally, this space also serves as a surveillance station for the pool and deck area. Locate check-in areas immediately adjacent to the entrances to both dressing areas. Visibility of and direct access to pool and deck areas is required.

4-5.1.1 Entry Control Checkpoint Area FF&E.

FF&E required for entry control areas include locker systems for valuables, desk or check-in counter, staff chairs, telephone with PA systems, cash register, and an exterior clock visible from the pool area. Provide storage for small equipment and lost/found items. Optional items include a bulletin board.

4-5.1.2 Natatorium Lobbies.

Incorporate a lobby area in designs for natatoria that serves as the primary entrance to the facility for all participants, visitors, and spectators. Direct access from the lobby is

required to spectator viewing areas and dressing rooms. Locate public toilets, staff office, and concession areas (if provided) adjacent to this space. Visual monitoring of the lobby is required from the staff office or the check-in area. Accommodate at least 50 percent of the visitors in the largest spectator seating areas. Include chairs, trash receptacles, and bulletin boards.

4-5.2 Dressing Rooms.

Provide separate facilities for men and women. Locate dressing areas to be easily accessible to the pool deck and check-in area. Design the locker room/changing room to prevent visibility from public areas. Locate showers, lavatories, toilets, and drying areas within or adjacent to each dressing room. Lockers may be located inside the dressing room or on the pool deck for increased visibility and security. Include floor slopes to drain for hosing and cleaning.

4-5.2.1 Family Dressing Rooms.

Provide separate family dressing room(s)* with showers, toilets, sinks and baby changing stations to serve the needs of single-parent families or special needs of the disabled or elderly. If accessible off the pool deck, these family dressing rooms may also serve as public toilets. Provide lockers outside of family dressing rooms in separate, non-lockable area.

*For Navy and Air Force facilities: Evaluate requirement for family dressing rooms on a project-specific basis. Family dressing rooms are required for Army facilities.

4-5.2.2 Dressing Room FF&E.

Provide a locker for each user based upon the overall pool capacity. Provide additional lockers dedicated for use by the staff. Other furnishings and equipment include benches, vanity mirrors, one full-length mirror, and ceiling fans. Optional equipment includes a clock, hair driers, and a bulletin board. Provide wooden or recycled plastic bench seating, mirrors, soap dispensers, and paper towel dispensers or blowers conveniently located near the lavatories. Provide sanitary napkin dispensers and disposal units inside the female dressing rooms. Provide at least one GFCI electrical outlet near the vanity sinks and vanity mirrors spaced every 30 inches (762 millimeters) on center. Provide baby changing accommodations in both male and female dressing rooms*. Provide a minimum of one swimsuit dryer (spinner)** in each dressing room wired on a dedicated GFCI branch circuit and plumbed to drain. Provide two to five dressing cubicles with seats or benches in each dressing room.

*For Army facilities: Provide baby changing stations in the family dressing rooms only.

**For Army facilities: Provide swimsuit dryer located in a tiled alcove out of the traffic path. Provide floor drain below dryer.

4-5.3 Showers.

Provide showers located inside or adjacent to each dressing room for customer personal hygiene use before and after swimming. Provide direct access from the showers to the dressing area. Provide separate facilities for men and women. The exact size requirements for showers depend upon the peak number of potential customers and the type of shower facilities desired. Provide fixtures in accordance with UFC 3-420-01.

Provide all private showers with attached drying area enclosures for new construction and major renovations. Provide a bench in each adjacent drying area. Do not allow direct views into the shower room areas. Provide commercial-grade built-in soap dispensers inside shower stalls and at lavatory sinks. Provide built-in towel racks and clothing hooks in drying areas. Use natural lighting whenever possible and waterproof lighting fixtures in all showers. Furnish shower stalls with showerheads mounted on a side wall to permit users to initiate shower without getting wet. Locate tempering controls beneath shower head. Provide all fittings and fixtures to feature cut-off valves and be of commercial quality. Provide for proper drainage of each stall by using floor drains or perimeter trench drains, or a combination of the two. Do not allow discarded water from bathers to pass into adjacent shower spaces.

4-5.4 Toilets and Urinals.

Provide both male and female toilet stalls in or near each respective dressing room area. Provide at least one low mounted urinal near the men's toilets for children. Provide direct access from the toilets to the dressing room areas. Locate toilets next to the showers and lavatory sinks for each sex. Refer to UFC 3-420-01 for the quantity of toilets and urinals required according to the overall size of each facility.

Provide flushometer-style commercial toilets that are durable and require less maintenance than tank-top residential models. Provide graffiti-resistant and corrosion-resistant toilet stall partitions that are attractive and complement the interior design of the dressing room area. Provide a separate exhaust system for the toilet areas in both the male and female dressing rooms.

4-5.4.1 Public Toilets.

Locate public toilets near the lobby in natatoria. Locate public toilets readily accessible to spectator viewing areas. Provide separate accessible restrooms according to ABA guidelines for both men and women. Include a lavatory, mirror, soap dispenser, paper towel dispenser or blower, baby changing station, and a separate exhaust fan for each restroom. The peak number of spectators and visitors anticipated will establish the quantity of public toilets. Provide fixtures in accordance with UFC 3-420-01.

4-5.5 Office and Administration Areas.

Locate office and administrative areas adjacent to the entry control checkpoint. Provide visual monitoring of and easy access to the water and deck areas from these spaces.

Provide furnishings that are durable, moisture- and mildew-resistant. Use non-woven, impermeable materials in lieu of fabrics for seating. Include floor drains and floor slopes to prevent standing water.

4-5.5.1 Administration Office.

Provide an office with a lockable door for use by the aquatic facility director and staff. Provide a separate small lounge area for pool staff and lifeguards. Provide a desk with compatible chair in the office area and at least two visitor's chairs along with a telephone, data and phone connections, file cabinets, shelving units, and a bulletin board.

4-5.5.2 Staff Lounge.

Locate central controls for the public address, security, lighting systems, and all environmental controls in the staff lounge or administrative office. Provide a work table with chairs, as needed to accommodate the staff, bulletin board, staff lockers, time clock, refrigerator, microwave, storage shelves, first aid kit, and cabinets in the staff lounge.

4-5.5.3 Training Rooms.

For small facilities, this room may be combined with the staff lounge. Design the room so it can be darkened for video presentations. Provide locally controlled dimmer switches for lights. Consider the need for telephone and video conferencing and provide the required infrastructure for these capabilities. Provide a lockable credenza or storage cabinets, a table, stacking chairs, television with media player, and a trash can. Provide modular furniture appropriate for wet conditions, a conference table, computer data connections with high-speed Internet access, a speaker phone, and electrical power accommodations. Provide furnishings that are durable, moisture- and mildew-resistant. Use non-woven, impermeable materials in lieu of fabrics for seating. Provide a whiteboard and a cork bulletin board for posting changeable information. For natatorium, provide access to the training room from both the wet and dry circulation path.

4-5.6 Safety & First Aid.

Provide a first aid room immediately off the pool deck with hand sink, cot, first aid kit, and telephone compliant with MAHC requirements. For small facilities, this room may be combined with staff lounge. Provide privacy screens or treatments on vision pathways. Furnish first aid equipment per MAHC.

4-5.7 Concession, Resale, and Vending Areas.

Provide public water fountains located near the administrative areas of the bathhouse or in a covered, shaded area of the pool deck. Consider the need for food and beverage service within the aquatic facility compound. Coordinate with the aquatic facility director regarding their policies for a resale and concession area that may offer a variety of food

and beverage options. Determine functional need for indoor concession service, locate concessions and concessions seating to serve this need. Outdoor pools may include a concession area that includes tables and seating as desired at each facility. Locate seating areas to have good visibility of the pool and deck and some shading. Refer to the current FDA Food Code and supplements when considering a concessions area to ensure inclusion of all required sanitary areas. If food like hamburgers and hotdogs will be cooked on-site, ensure that the concession kitchen meets the requirements outlined in NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

Provide concession and vending areas in the shade, adjacent to, or easily accessible from the pool deck and major sunbathing areas. For facilities with picnic areas, locate concessions near picnic area with easy access by vendors with pushcarts. Separate concession and vending areas from the pool area. Provide service access through an entrance separate from the customer entrance to the facility. Provide power outlets, water service with hose bibs, and drainage for cleaning the concession and vending areas. Consider the need to provide electrical, water, and parking space to accommodate a mobile concessions trailer that may be located near the pool deck and moved when not in use. Use materials and finishes that are water- and mildew-resistant and can be easily cleaned.

4-5.8 Mechanical Rooms.

Mechanical rooms are required for natatoria and the bathhouses for outdoor pools to accommodate HVAC equipment, plumbing, electrical, hot water, telephone, fire suppression, and other building systems equipment. To minimize noise and service disruptions, locate mechanical rooms so the entry and service doors are located on the outside of the building. Avoid locating the entrance to the mechanical rooms at the front of the facility; locate mechanical entrances to the side or rear (allowing for access by maintenance staff).

For indoor pools, provide sound attenuation at pool mechanical room walls common to natatoria and other public spaces. Slope floors to drains for rooms with equipment involving water or exposed piping. Separate all pedestrian and vehicular circulation associated with mechanical services and maintenance operations from circulation provided for participants and the public. Locate mechanical rooms to minimize the lengths of distribution services or “runs.” Treat service doors architecturally in a manner that will minimize their visibility or impact on the building design.

4-5.9 Electrical Room.

Provide a dedicated electrical equipment room for the installation of service-entrance equipment and other major electrical equipment that serves the facility.

4-5.10 Telecommunications Room.

Provide a dedicated telecommunications room (TR) to house the point-of-entrance of the telecommunications service, telecommunications equipment, cable terminations,

cross-connect cabling, data and telecommunications systems, and other low-voltage systems such as fire-alarm, CATV, CCTV, and electronic security and surveillance systems. Coordinate with Installation communications POC for size and other requirements for this space.

4-5.11 Equipment Storage.

Provide storage for life-saving, instructional, and competition swimming supplies and equipment. Also consider requirements to accommodate pool-cleaning equipment, supplies, and other items related to pool operations. Equipment storage space must open directly onto the pool deck and be readily accessible by staff members. Provide the storage room with a minimum width of 8 feet (2.44 meters) to allow storage of materials on either side of a small aisle. The minimum length is defined by program of stored equipment, and accommodating overnight storage of reach poles and other first aid equipment. Access the storage room through double doors with a minimum width of 6 feet (1.83 meters).

Verify storage requirements with aquatic facility personnel at each Installation, since special storage requirements may be required for instructional items (e.g., kickboards), lane lines, ropes, flags, starting platforms, and other competition equipment, as well as equipment for games or water shows. Pool maintenance equipment includes a pool vacuum, water-testing supplies, hose reels, sprinklers, scoop nets, and miscellaneous tools. Typical safety equipment includes shepherd's crook, ring buoys, reach poles, life lines, resuscitator, first aid equipment, backboard, and a stretcher. Provide lighting in accordance with UFC 3-530-01. Ventilate the equipment room per paragraph HEATING, VENTILATION AND AIR CONDITIONING (HVAC), slope floor to floor drains to help reduce moisture and mildew.

4-5.11.1 Natatorium Storage.

For natatoria, provide storage capacity that complements pool programming. For pools with competition equipment, provide storage capacity for lane lines, timing equipment and instructional aids.

4-5.11.2 Seasonal Storage.

For seasonal outdoor facilities, consider out-of-season storage requirements. Properly size access to dressing rooms and other open spaces to accommodate movable equipment and furnishings during the off-season.

4-5.12 Maintenance Storage.

Provide space to store equipment and supplies required for the maintenance of the facility. Maintenance storage spaces require floor drains if storing pool equipment. Provide lighting in accordance with UFC 3-530-01. Ventilate the maintenance storage room in accordance with paragraph HEATING, VENTILATION AND AIR CONDITIONING (HVAC).

For natatoria, provide storage capacity that compliments facility size and programming. Accommodations for pool vacuums, hoses, test kits, cleaning supplies and equipment are required. The final size requirements must be determined after coordination with Installation personnel on a project-specific basis. For outdoor facilities, additional equipment such as lawn mowers, trimmers and ladders, will dictate the size requirements. Include space for other maintenance items, like rakes, brooms, clippers and cleaning equipment.

4-5.13 Custodial Closets.

Provide a custodial closet for storing janitorial equipment and supplies, including other maintenance items with access to the dressing rooms, showers, and toilets. Include a floor-mounted mop sink, dry storage for supplies, shelves for maintenance supplies, and a sloped floor with a floor drain. Provide water-resistant finishes for all surfaces. Provide shelves and hooks for cleaning and maintenance equipment and supplies. Provide lighting in accordance with UFC 3-530-01. Ventilate the custodial closet in accordance with paragraph HEATING, VENTILATION AND AIR CONDITIONING (HVAC).

APPENDIX A BEST PRACTICES

A-1 PLANNING AND PROGRAMMING.

Each project requires a unique design tailored to the local character of the Installation, the site, and the needs of the user population. Consider the following items when planning aquatic facility projects.

- The type of competitive swimming events to be hosted at an aquatic facility has a major impact on the planning of the facility. Facility requirements and rules vary depending upon the different institutions that sanction competitive events. For example, lane bottom and target wall marking requirements are different for many of the governing institutions that sanction events.
- Consider small lockers for valuables only, such as phones, wallets and keys.
- Consider first aid procedures in the planning of aquatic facilities, including timely access to the pool deck for emergency responders and their equipment. Consider inclusion of a sink.
- Consider location of chemical storage and chemical storage venting. Prevailing winds, locations of patron walkways, patron access, and ease of chemical delivery should be considered in siting chemical storage areas.
- Consider the possibility of recycling excavated rock for alternative uses.
- Consider geothermal heat sources for heating pools where easily accessible, co-generation (the simultaneous generation of electric power and useful heat), and time-controlled activity pumps. Consider retractable roof structures over pool areas where climate is favorable to reduce HVAC energy consumption and to provide natural lighting.

A-2 DESIGN.

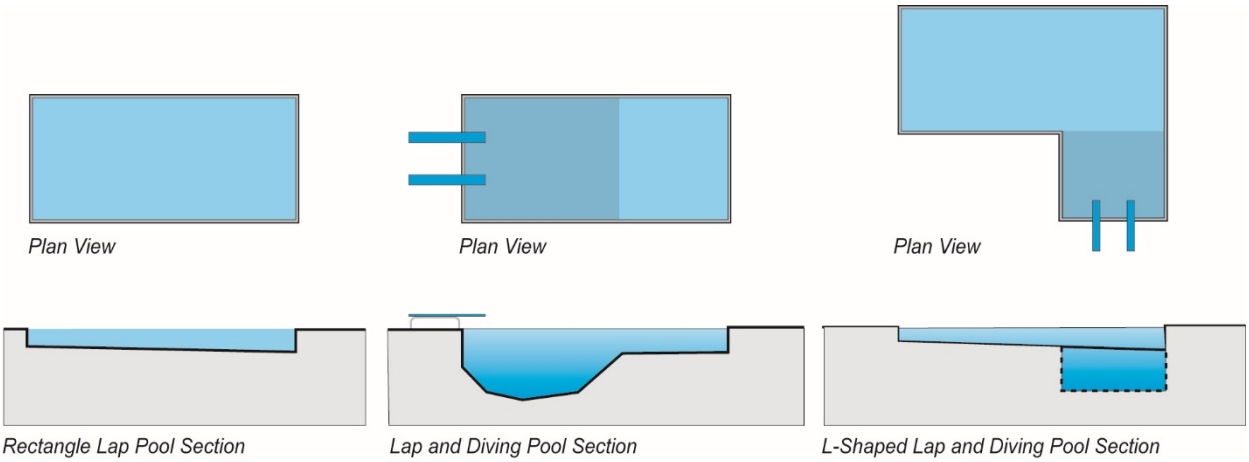
A-2.1 Landscaping.

Deciduous trees are acceptable in picnic or play areas, but do not allow their drip line to extend over the pool deck. Evergreens and shrubs can be beneficial as wind screens or visual barriers, and grass sunbathing areas inside the pool complex are always appreciated but must be designed to minimize “tracking” grass clippings onto the pool deck.

A-2.2 Lap Pool Layouts.

Traditionally rectangular, lap swimming centric pools have been utilized for the main pool, however the requirements are not intended to prevent new recreation centric pool designs of unique shapes and program capabilities. Traditional layouts for lap pools are shown in Figure A-1: Lap Pool Layouts:

Figure A-1 Lap Pool Layouts



The shape of the pool is affected by the placement of the diving area, if provided. Provide a simple rectangle pool shape for free swimming area, with a diving well placed on either side of the deep end to create an overall "L" shaped pool. If the depth of water in the swimming course is held to a maximum of 5 feet (1.5 meters), the "L"-shaped plan will offer the largest-capacity pool.

A-2.3 Zero-Depth Entry.

Use zero-depth entry pools to create a beach-like, gradual entrance to the water. These pool entrances are commonly used for play areas and access to the shallow end of a pool to help accommodate the needs of children, the elderly, and weak swimmers. If properly designed, zero-depth entry pools meet the requirements for accessible entry.

A-2.4 Pool Construction.

The three methods of construction addressed in Chapter 3 increase in durability (as well in cost) in the order provided. The normal lifespan of a concrete pool is eleven to twenty-five years. Considering budget and durability, a concrete pool with a metal gutter system is recommended for normal use. This type of pool is less expensive than a metal pool and outlasts a concrete or shotcrete pool because the metal gutter system is placed at the point of maximum wear. This type of construction provides not only an integral continuous overflow perimeter gutter system but can also provide a majority of the pool's supply return and surge plumbing requirements.

A-2.5 Pool Finishes.

Painted finishes require repainting every three to five years, depending on water quality and use. Many metal pools have been in place for over twenty-five years and show no sign of need for replacement. Consider a metal pool under the following circumstances:

- Where questionable soil conditions exist.

- In an area where extreme vandalism is prevalent.
- Where unusual structural and/or site conditions require a lightweight, prefabricated structure.

Maintaining proper water balance is essential for pool finish longevity. Metal gutter systems (usually stainless steel with plastic accessories) require no finish.

A-2.6 Gutter Systems.

Prefabricated, stainless steel surge gutter systems are preferred because they provide constant skimming of the surface water to help remove debris and can provide surge storage capacity for water displaced by swimmers. Scuppers that utilize a thin layer of water falling over a weir may be used to skim water from wading and training pools; however, they are not appropriate for the large surge requirements of main pools.

A-2.6.1 Drains and Inlets.

Fresh water fill can deliver water to the pool or surge tank via an air gap. To prevent injuries and to slightly disturb the water for better diver visibility in the diving area, provide spout with no sharp edges and locate under one of the diving boards. Where diving boards are not provided, or where inclusion on the deck would present a safety hazard, the fill spout may be located remote from the pool and flow via gravity to the surge tank or pool wall.

A-2.7 Heating and Water Temperature.

The use of a condensing boiler design is preferred for pool heater design. Consider solar heating for the hot water side of a heat exchanger if provided.

Consider automatically-deployed insulated pool covers to address the extensive labor and storage space required by traditional pool covers.

A-2.8 Secondary Sanitizers.

Secondary sanitizers may be used to reduce chlorine demand; however, coordinate with the Installation to comply with their minimum free available chlorine residual requirements.

A-2.9 Deck.

Consider using a resilient deck surface for spray grounds and around wading pools (if provided). Consider the existing slope and drainage of the pool deck during the design of an enclosure for an existing outdoor pool.

A-2.10 Seating.

For a small number of spectators at a family-type recreational pool, a raised platform or pavilion is sufficient. For competitive events, consider the need for portable seating for up to 600 people that can be rolled for convenient storage or moved for use at other

sport facilities on the Installation. For larger numbers, the following guidelines are suggested:

- Bench seating with 2 feet (610 millimeters) of length provided for each spectator.
- Provide 6 to 8 square feet (0.55 to 0.74 square meter) of space for each spectator.
- Provide access from a pedestrian path outside of the pool area for visitors attending events. Fence off spectator seating areas from the pool. Provide a see-through fence and lockable gate between the bleachers and the pool deck to separate spectators from competitors.
- Locate spectator seating parallel to the racing lanes in the pool.
- Construct permanent bench seating from concrete, wood, non-corrosive metal (aluminum), or recycled plastic. For temporary or movable bench seating provide metal bench seating specifically designed for sporting events.
- Provide spectator seating that is stepped in elevation to allow maximum visibility.
- Provide full or partial shading options in the spectator seating area.

A-2.11 Storage.

Locker storage located on the pool deck reduces problems associated with theft and vandalism because the lockers are more visible to customers and staff. Consider locating the administrative and entry control checkpoint in the center of the building with changing facilities on each side to provide separation between male and female facilities.

A-2.12 Electronic Surveillance.

For Air Force and Navy facilities, consider the need for an electronic surveillance system to facilitate surveillance of the entire facility.

A-2.13 Underwater Lighting.

For recreational-only swimming pools, consider providing a programmable, color-changing LED lighting system for underwater lighting. The illumination requirements described in Chapter 3 must be maintained for color-changing systems.

A-2.14 Drowning Detection System.

To support the lifeguard, consider providing a computer-aided drowning-detection system for recreational swimming pools. Systems may include overhead cameras, underwater-binocular cameras in water deeper than 7 feet (2.13 meters), redundant servers with uninterruptible power supplies, supervision workstation, audio/visual alert

stations for indoor pools, and lifeguard pagers for outdoor pools.

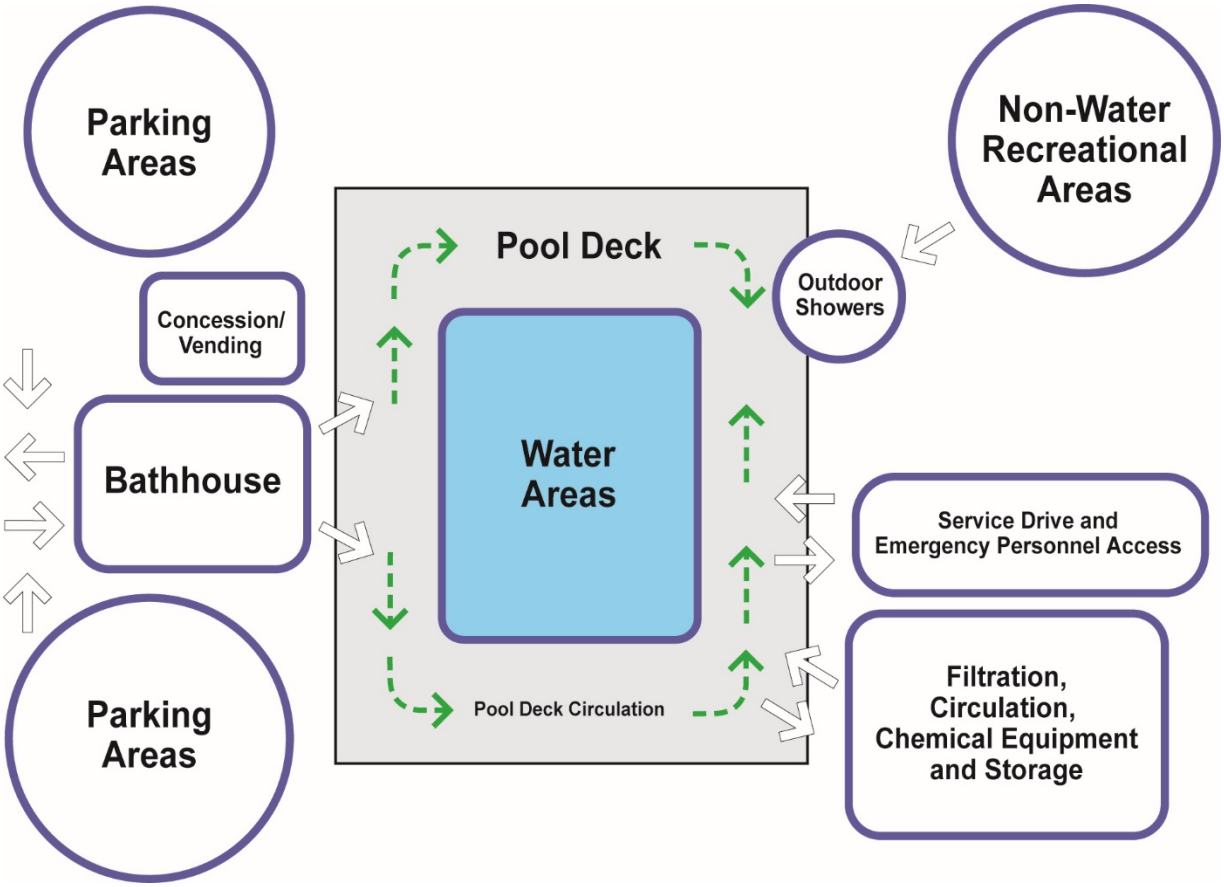
A-2.15 Natatorium/Indoor Pool Room HVAC

Consider the use of high-volume, low-speed fans to prevent stratification and provide mixing at upper elevations for facilities with high ceilings (35 feet plus).

A-3 FUNCTIONAL AREA REQUIREMENTS.

Typical spatial relationships for aquatic facilities are shown in Figure A-2: Functional Area Relationships.

Figure A-2 Functional Area Relationships



A-3.2 Recreational Areas.

Depending on the design of the site and local conditions, outdoor recreation areas may be desired in grass areas surrounding the pool deck. Consider the need for non-water-related recreational areas located inside the pool compound, such as sand volleyball courts and grass areas for sunbathing, throwing Frisbees, horseshoes, picnics, and similar activities. Consider the need for picnic tables, outdoor grills, and similar site furnishings for birthday parties and other group functions that are compatible with the

Installation's facility standards.

Rinse showers allow swimmers to rinse off dirt, sand, and sweat before entering the pool, which reduces maintenance and chemical use.

A-3.3 Low Barriers.

The purpose of a low barrier is to prevent children from wandering into the pool area; it is not designed to prevent unauthorized access when the pool is closed. In some areas, consider the need for combination fencing that has brick or masonry bases with fencing material mounted on top; this type of fencing may help prevent grass clippings and other debris from entering the pool compound.

A-3.4 Miscellaneous Considerations.

- Consider locating filtration, recirculation and heating system equipment outside near the service drive, if possible—it is usually more cost-effective and easier to provide working space around each component.
- Consider the use of portable platforms that may be placed into the main pool to create shallow water environments that can be used for training or instructional courses, and can be removed, as needed, for other pool functions.
- Consider additional recessed rope anchors for equipment and recreational features (e.g., inflatables, recreational water polo goals, etc.) based on coordination with Installation personnel.
- Consider the need for a recall line suspended above the racing course at least 4 feet (1.22 meters) above the water surface or alternative recall methods as dictated by the sanctioning organization. Consider the need for automatic timing touch pads.
- Consider the need for movable fiberglass or stainless-steel bulkheads to divide the water surface area for multifunctional use. Movable bulkheads are very useful for competitive swimming events to provide variable short course lengths, as desired, and other recreational activities.
- Orient outdoor diving boards facing north or east (northern hemisphere) or south (southern hemisphere) where possible, to help eliminate visibility problems associated with sunlight and glare reflecting off the water. An elevator or man-lift is recommended for easy access to high dive platforms. Detailed requirements for competitive diving will depend upon the sanctioning agency sponsoring certain events. For springboards over 10 feet (3 meters) in height, consider a stair access in lieu of a ladder access for diver safety.
- Consider different types of slides for recreation pools, e.g., body slides, drop slides, children's slides. A wide variety of commercially

manufactured play structures and play features designed for use in aquatic environments is available from different specialty companies.

- Consider using rigid board or closed cell sprayed insulation in natatorium areas to prevent moisture build-up in the insulation that might occur using fiberglass insulation. Do not use fiberglass insulation.

A-3.5 Spray Grounds.

Spray grounds are referred to by the MAHC as Interactive Water Play Venues. Spray grounds are recommended instead of wading pools as they are generally safer because there is little to no standing water to create a drowning hazard for children. Spray grounds may include a wide variety of water play equipment designed specifically for children, offering a greater variety of recreational opportunities than traditional wading pools. Spray grounds may include ground sprays, overhead sprays, climbable play structures, slides and other apparatus specifically manufactured for interactive water play.

For potable water spray pads, consider collecting spray ground waste water for alternative purposes, such as irrigation or washing cars and aircraft, especially in areas where water conservation is critical.

A-3.6 Wading Pools.

Typical wading pool construction uses scuppers instead of a continuous perimeter overflow system. Parental supervision of children in wading pools is mandatory for safety.

A-3.6.1 Pool Access.

Aquatic lifts may also serve a dual purpose by providing an effective method to get an injured swimmer on a backboard out of the pool.

Providing an egress within the specified minimum distance allows lifeguards to keep their focus at all times on the area around the board or slide by eliminating the need to track an exiting swimmer who has to leave the immediate area of the board or slide, making supervising the next diver or slider problematic.

A-3.7 Depth Markers.

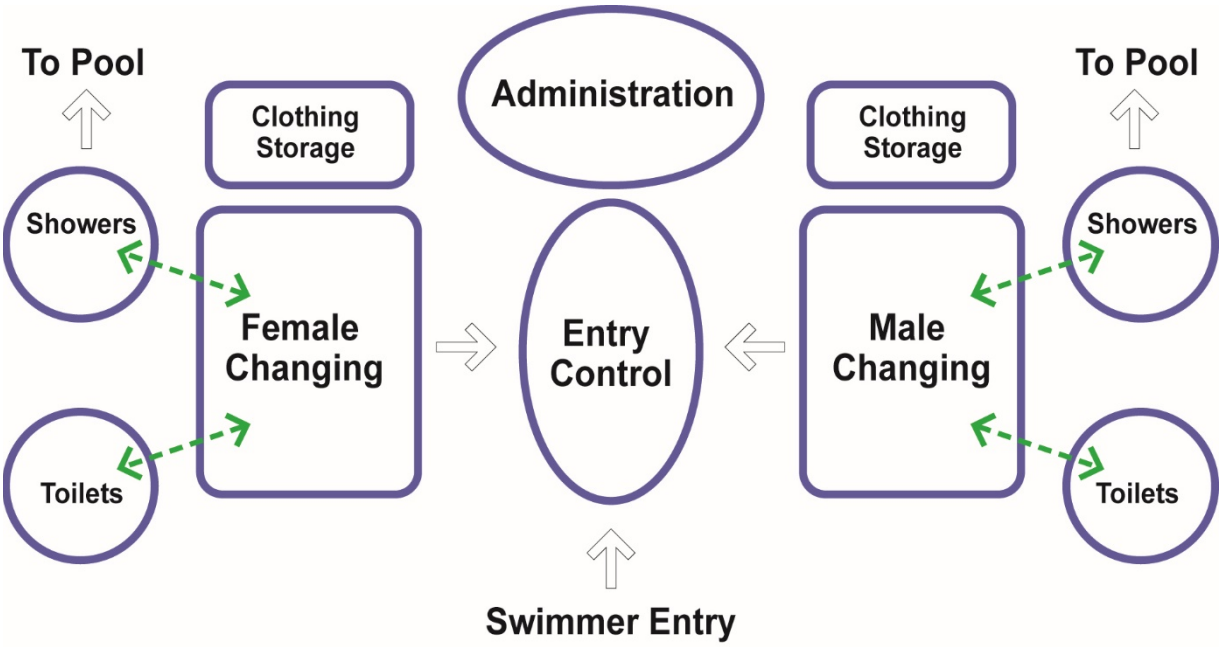
In addition to the required pool wall depth markers, for deck level gutter designs, consider site and pool specific design conditions and place depth markers around the pool, above the water line, on buildings, fences, or walls to clarify the pool depths. Refer also to MAHC annex for rationale.

A-3.8 Bathhouse.

Consider the following items when designing the bathhouse. Refer to Figure A-3: Bathhouse Functional Area Relationships

- Consider placement, type and number of toilet and shower fixtures when designing toilet/shower/clothing storage spaces.
- Consider using recycled plastic toilet and urinal stall partitions because they are non-corrosive, cost-effective, durable, and environmentally friendly.
- For large facilities, consider the need for additional public toilets for visitors and spectators because of the limited access requirements to the dressing room areas.
- The staff lounge, training rooms, and food service areas may be located away from the entry control checkpoint. Locate with views of the water and deck areas, where possible. Consider the need for a washer and dryer in the staff lounge.
- Consider the need for a drop-down projection screen and wall-mounted white boards.
- A storage room length of 16 feet (4.88 meters) is recommended if safety equipment has not been selected prior to design.

Figure A-3 Bathhouse Functional Area Relationships



A-3.9 Showers

Consider the following items when designing showers:

- Consider the need for vandal-proof showerheads.

- Consider adding shower caddies or built-in shelves in each stall for storing soap and accessories.
- Glass and glazing must not allow visual access from adjacent buildings or outside areas into shower areas.

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http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

UFC 3-575-01, *Lightning and Static Electricity Protection Systems*,
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Whole Building Design Guide, http://www.wbdg.org

B-2 NON-GOVERNMENT PUBLICATIONS.

ANSI/APSP-16 *Standard Suction Fittings for Use in Swimming Pools, Wading Pools, Spas and Hot Tubs*. https://webstore.ansi.org

ASHRAE Standard 55 *Thermal Environmental Conditions for Human Occupancy*.
https://www.ashrae.org/

ASHRAE Standard 62.1 *Ventilation for Acceptable Indoor Air Quality.*
https://www.ashrae.org/

ASHRAE Standard 90.1 *Energy Standard for Buildings Except Low-Rise Residential Buildings* https://www.ashrae.org/

ASHRAE Standard 189.1 *Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings.* https://www.ashrae.org/

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Model Aquatic Health Code, https://www.cdc.gov/mahc/editions/current.html

NFPA 70, *National Electric Code,* http://www.nfpa.org

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations,* http://www.nfpa.org

B-3 INDUSTRY ORGANIZATIONS.

Association of Pool and Spa Professionals (APSP), http://www.apsp.org/splash

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Amateur Athletic Union (AAU), http://aauswimming.org/

Federation Internationale de National (FINA), http://www.fina.org/

National Collegiate Athletic Association (NCAA), http://www.ncaapublications.com/

National Federation of State High School Associations (NFSH), https://www.nfhs.org/

USA Swimming, https://www.usaswimming.org/

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APPENDIX C GLOSSARY

C-1 ACRONYMS AND ABBREVIATIONS.

AAU	Amateur Athletic Union
ABA	Architectural Barriers Act
A/E	Architect/Engineer
AFCEC	Air Force Civil Engineer Center
AFI	Air Force Instruction
AFMAN	Air Force Manual
AFPAM	Air Force Pamphlet
AFSVC	Air Force Services Center
ANSI	American National Standards Institute
APSP	Association of Pool and Spa Professionals
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
AT/FP	Antiterrorism / Force Protection
CCTV	Closed Circuit Television
CPSC	U.S. Consumer Product Safety Commission
DCOF	Dynamic Coefficient of Friction
DDC	Direct Digital Control
DoD	Department of Defense
DoDI	Department of Defense Instruction
DoE	Department of Energy
FDA	US Food and Drug Administration
FF&E	Furniture, Fixtures, and Equipment
FINA	Federation Internationale de Natation

FPCON	Force Protection Condition
GFCI	Ground-Fault Circuit Interrupter
HVAC	Heating, Ventilating, and Air Conditioning
IAC	Indoor Air Quality
ICC	International Code Council
ISPSC	International Swimming Pool and Spa Code
LAN	Local Area Network
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
MAHC	Model Aquatic Health Code
MILCON	Military Construction
MWR	Morale, Welfare, and Recreation
NAVFAC	Naval Facilities Engineering Command
NAVMED	Naval Medical Command
NCAA	National Collegiate Athletic Association
NFPA	National Fire Protection Association
NFHS	National Federation of State High School Associations
OCONUS	Outside Continental United States
OPNAV	Chief of Naval Operations
OSHA	Occupational Safety and Health Administration
PA	Public Address
PFD	Personal Floatation Device
PVC	Polyvinyl Chloride
SCUBA	Self Contained Underwater Breathing Apparatus
SDI	Steel Door Institute

TBMED	Technical Bulletin Medical
TM	Technical Manual
UFC	Unified Facilities Criteria
UMCS	Utility Management and Control System
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USGBC	United States Green Building Council
UV	Ultra-violet (light)

C-2 TERMS.

Aquatic facilities may have a variety of different components, depending upon the unique requirements for each facility. Below are some common definitions associated with major aquatic facility components:

- Swimming Pool: Any artificial basin of water constructed, installed, modified, or improved for the purpose of swimming, wading, diving, recreation, or instruction. It does not include pools designed to be used exclusively for military training or operations.
- Natatorium: An indoor or enclosed swimming pool.
- Spa: An artificial basin of water designed for recreational use and/or therapeutic use and is not drained, cleaned, and refilled for each individual user. Spas may include hydro jets, hot or cold water, air induction systems, or any combination thereof. It does not include pools used under the direct supervision of medical personnel.
- Wading Pool: A pool that is no more than 18 inches (0.45 meter) deep and intended to be used by young children.
- Slip-Resistant: A surface meeting the minimum coefficient of friction for slip-resistance in accordance with the MAHC.
- Spray Ground: An area, with no standing water, that includes water-spraying devices and other water related recreational equipment intended to be used by young children. May also be referred to in the industry as a splash pad, spray pad, or spray deck or wet deck.
- Pool Deck: The concrete or hard surface area surrounding the pool water areas.
- Bathhouse: A building that typically contains changing areas, restrooms,

and locker areas. Bathhouses may also contain administrative, entry control, food service, storage, mechanical, and other related functions or areas.

- Zero Depth Entry: A sloped means of access into the pool starting from the deck elevation and continuing into the body of water until the first point of slope change.
- Freeboard: Vertical distance between the normal operating water elevation and the deck elevation.
- Fiberglass Runout: The fiberglass portion of manufactured slide that is used to decelerate and stop the slider.
- Surge Tank: A tank used to hold water displaced by bathers in the pool.
- Skimmer: A manufactured device installed in a pool wall that is used to remove floating debris from the surface of the water.
- Weir: A barrier over which water flows.
- Flooded Suction: A term used to describe the installation of a pump where the suction pipe is below the normal operating water elevation of the tank or body of water connected to the pump suction.

FC 4-760-10N
1 December 2013

FACILITIES CRITERIA (FC)

NAVY MUSEUMS AND HISTORIC RESOURCE FACILITIES

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**

FOREWORD

Facilities Criteria (FC) provide functional requirements (i.e., defined by users and operational needs of a particular facility type) for specific DoD Component(s), and are intended for use with unified technical requirements published in DoD Unified Facilities Criteria (UFC). FC are applicable only to the DoD Component(s) indicated in the title, and do not represent unified DoD requirements. Differences in functional requirements between DoD Components may exist due to differences in policies and operational needs.

All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC (replace w/ FC), the SOFA, the HNFA, and the BIA, as applicable.

Because FC are coordinated with unified DoD technical requirements, they form an element of the DoD UFC system applicable to specific facility types. The UFC system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applicable to the Military Departments, Defense Agencies, and the DoD Field Activities. The UFC System also includes technical requirements and functional requirements for specific facility types, both published as UFC documents and FC documents.

FC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request. The form is also accessible from the Internet site listed below.

FC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Refer to UFC 1-200-01, *General Building Requirements*, for implementation of new issuances on projects.

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FACILITIES CRITERIA (FC)
NEW SUMMARY SHEET

Document: FC 4-760-10N, *Navy Museums and Historic Resource Facilities*

Superseding: None

Description: FC 4-760-10N, *Navy Museums and Historic Resource Facilities* represents an effort to establish uniform design and construction standards for Naval History and Heritage Command (NHHC) facilities including public museums, artifact storage and curatorial spaces, archives, secure archives, and administration. These standards will cover new construction, leased facilities and repair projects.

Reasons for Document:

- Many existing facilities are inadequate in size and condition, with insufficient heating, ventilating, and air conditioning systems. Many existing facilities are not conducive to the proper conservation, preservation, and storage of rare and historic archives, books, art and artifacts. Current storage conditions do not meet standards for collection management and risk permanent damage to artifacts.

Impact:

- Single, comprehensive, up-to-date criteria and standards will help to produce facilities that provide a safe, economical, and energy efficient environment for visitors, artifacts, historical documents, and art. These facilities will preserve and provide access to naval history and heritage for present and future generations.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This FC provides requirements for evaluating, planning, programming, and designing two facility types:

- Navy Museum – Protects and displays precious naval artifacts, documents and art portraying the Navy's rich military history and offers visitors, including Navy personnel, their families, retirees, recruits and the general public, an important glimpse into their cultural heritage.
    - Plans, designs, and fabricates exhibits and displays.
- Historic Resource Facility (HRF) – There are several functional areas which are included in HRFs. Although HRF is listed as a facility type, its functional areas may be co-located within a single facility or built as separate structures. See Chapter 2 for additional planning information. HRFs serve the following functions:
    - As an archive depository that consists of operational and administrative records of SECNAV, fleet, major commands, and other organizations and individuals stored in paper, microform and electronic form.
    - As a library to hold collections of books, journals, maps, charts, records, and other valuable items deemed important to the Navy for the purpose of research, analysis, and writing about naval history and related topics as well as for the purpose of preserving important icons of the Navy's heritage.
    - Executes the responsibilities of the Director of NHHC/Curator of the Navy and ensures proper documentation, cataloging, accountability, and preservation of historical art, property, artifacts, and collections.
    - Develops and administers exhibit programs, including collecting, selecting, and researching exhibit materials.
    - Manages and oversees historical underwater archaeology, conservation projects, and activities that relate to the Curator of the Navy.

The information in this FC applies to the design of all new construction projects, to include additions, alterations, and renovation projects.

This FC is organized to provide the data and criteria needed at each stage of the project development process. It also applies to the procurement of design/build services for the above noted projects. Alteration and renovation projects should update existing

facilities to meet the guidance and criteria within budgetary constraints. Some Core UFCs provide guidance and requirements on renovation and alteration projects relative to thresholds and triggers. A list of the Core UFCs is included in UFC 1-200-01, *General Building Requirements*. This FC is not intended as a substitution during design for thorough review by individual program managers and operations staff.

1-2 APPLICABILITY.

This FC is intended as a source of basic architectural and engineering information for all individuals involved in the planning, design, construction or evaluation of museums and historic resource facilities. Architects and Engineers (A/Es) that provide design services will use this FC under the direction of NAVFAC. Installation and facility planning personnel will use this FC, in conjunction with other required planning documents, for programming new or replacement facilities, pre-design planning, or assessing the extent of improvements required in an existing museum or historic resource facility in order to achieve the standard established herein.

1-3 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *General Building Requirements*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this FC in addition to UFC 1-200-01, as well as the UFCs and other government criteria referenced therein.

1-4 STANDARDS.

Museum and Historical Resource Facility standards are critical to ensure the longevity of historical artifacts and to share U.S. naval history with the public. Museums and HRFs are not the Navy's typical operational facilities. These facilities require a unique set of standards to allow the Navy to meet its mission. The intent of this FC is to reference existing standards to the greatest extent possible, supplemented by new standards for these facilities which have unique requirements. Where conflicts occur between additional referenced documents, this FC will have precedence.

1-4.1 National Archives and Records Administration (NARA).

NARA standards are the guiding documents for the following functional areas which are included in this FC:

- Navy Museums – Archival Processing
- Navy Historic Resource Facilities – Archives, Library, and Histories, as well as for common functional space shared by these groups

NARA 1571 directive establishes structural, environmental control, fire safety, preservation, and security standards for archival storage conditions in NARA archival facilities. 36 CFR, Chapter XII, Subpart B, 1234.10-14, Facility Standards for Records Storage Facilities establishes civil, architectural, structural, environmental control, and fire safety standards for records storage in NARA storage facilities. 36 CFR 1234.20

explains what rules apply if there is a conflict between NARA standards and other regulatory standards that a facility must follow.

1-4.2 National Park Service Title 36 – Parks, Forests, and Public Property, Part 79 (36 CFR 79).

For purposes of this FC, 36 CFR 79, Curation of Federally-Owned and Administered Archaeological Collections, is federal law and therefore also applies to the artifacts and underwater archaeological collections under the jurisdiction of the NHHC.

The regulations in this part establish definitions, standards, procedures and guidelines to be followed by Federal agencies to preserve collections of prehistoric and historic material remains, and associated records, recovered under the authority of the Antiquities Act, the Reservoir Salvage Act, Section 110 of the National Historic Preservation Act or the Archaeological Resources Protection Act.

1-5 HISTORIC PRESERVATION COMPLIANCE.

1-5.1 Stewardship.

The Department of Defense remains a leader in the federal government in balancing new construction projects with the protection of historic properties. According to SECNAVINST 4000.35A, “The DON is a large scale owner of historic buildings, districts, archaeological sites, ships, aircraft and other cultural resources. Protection of the components of the nation’s heritage is an essential part of the defense mission, and the DON is committed to responsible cultural resources stewardship.” The Department of Defense abides by federal legislation on protecting cultural resources, and issues its own complementary policies for stewardship.

1-5.2 Compliance with Laws.

Museum and Historic Resource Facility projects related to existing facilities on or eligible for the National Register of Historic Places must comply with federal laws regarding cultural resources including the National Historic Preservation Act and the Archaeological Resources Protection Act. Navy personnel need to determine possible adverse effects upon an historic structure and/or archaeological resource during project development and consult accordingly. The Navy is required to identify, protect and nominate historic properties to the National Register of Historic Places. NAVFAC HQ develops policy statements and other forms of guidance, maintains and interprets data, and produces reference and promotional materials.

1-5.3 Compliance with DoD Standards.

Conversely, historic preservation compliance does not negate the requirement to implement DoD policy. Federal agencies are always the decision maker in the Section 106 process of the National Historic Preservation Act. Navy Cultural Resource managers work directly with naval installations, state historic preservation offices and other interested parties to implement the Section 106 process.

1-6 MUSEUM ACCREDITATION.

One of the goals set forth in OPNAVINST 5450.342 for the NHHC's outreach mission is to sustain a fully accredited "Smithsonian class" Navy museum network. Use of this FC will provide facilities that meet requirements of the American Alliance of Museums' *National Standards and Best Practices.* Note that museum accreditation by the American Alliance of Museums involves a wide range of issues beyond planning and facility-related requirements such as a Code of Ethics, fundraising, and other operational needs.

1-7 REFERENCES.

Appendix A contains a list of references used in this document. The publication date of the code or standard is not included in this document. In general, the latest available issuance of the reference should be used.

1-8 RESOURCES.

Appendix B contains additional resource materials for planners and designers of Museums and Historic Resource Facilities.

1-9 GLOSSARY.

Appendix C contains acronyms, abbreviations, and definitions.

CHAPTER 2 PLANNING AND LAYOUT

2-1 PLANNING CONSIDERATIONS.

The content of Chapter 2 provides guidelines and information needed for planning and programming Navy Museums and Historic Resource Facilities. Development planning and the programming of facility space and other requirements may be different for each project depending upon the unique factors regarding each facility. Review applicable programmatic requirements based on facility location, master plan development, landmark status, or site security requirements that may be part of larger site context requirements.

2-2 SPACE CRITERIA.

Museum and Historic Resource Facility space needs are site and mission specific and must be individually programmed based on a facility study. Actual size must be determined during the planning phase using UFC 2-000-05N (P-80), *Facility Planning Criteria for Navy and Marine Corps Shore Installations* and UFC 3-101-01, *Architecture*.

2-3 FACILITY REQUIREMENTS.

In developing the space program for an individual facility, consider the issues of overall building design and relationships discussed in Chapters 3, 4 and 5. The adjacency diagrams at the end of Chapter 2 do not indicate sizes of spaces. The diagrams should be used as guidance for space functional relationships including adjacencies and flow.

2-4 FACILITY TYPES.

- Museums.
- Historic Resource Facilities.

2-5 MUSEUMS.

Each museum should be planned and sized based on the mission of the facility, the type and size of the planned collections, and the projected audience. Most museums have non-government organizations (NGO) which should be included in the planning, design and operations of revenue-generating spaces. These spaces may include, but are not limited to: parking, museum store, theater, food service, and special events area(s). See Figure 2-5, Museum Adjacency Diagram, for additional guidance.

The goals of museum planning are:

- to provide space and facilities that are both aesthetically pleasing and effective in preserving and interpreting museum collections for museum visitors;

- to establish and/or maintain an institution which can perform these functions efficiently and sustainably.[1]

2-5.2 Site.

2-5.2.1 Location.

Visibility, access, and convenience are all contributing factors to the success of a museum. If possible, locate public museum facilities outside the secured perimeter of the base to enable unrestricted public access. If located on base, the museum should be readily accessible from the main entrance to the base. Locate museum facilities near existing transportation alternatives to provide various options for visitors. A museum's location along a prominent thoroughfare or in a key district of a community, such as a housing, shopping, or recreational area, increases its visibility to its audience. If the museum has multiple buildings, locate the museum and resource facilities near each other to reduce travel time between buildings and to minimize potential exposure of collections. Consider desirable natural site features such as terrain. Existing natural site features may be incorporated into required site elements like antiterrorism standoff distances or vehicle barriers that may help to blend the facility into the natural setting of the site. Though it may not be possible in certain areas, it is desirable to have the museum located above the 500 year flood pain or have critical artifacts protected to this level. See Chapter 3 for minimum design requirements.

2-5.2.2 Size.

It is desirable to have a minimum level terrain site area of approximately two or three times the gross area of the building. This size will allow for proper truck access to loading dock areas, parking and other site features such as attractive landscaping and monuments. More area may be needed if the site has any special features, such as natural ravines, existing specimen trees, or rock outcroppings to be preserved. The loading dock will serve as a space for material shipping and receiving, as well as a place for building waste removal. When sizing, consider shipments and large collection items that will enter the facility through the loading dock. A preliminary site design should be prepared to ensure the basic building and site criteria can be accommodated. Site size should provide for future expansion, if practical.

2-5.2.3 Access.

New construction, additions, and renovations of existing facilities must be designed and constructed to meet accessibility requirements of the Architectural Barriers Act Accessibility Standard (ABAAS) for DoD Facilities. All functional areas must be barrier-free and accessible to persons with disabilities. Site and building designs should enable persons with disabilities to act independently and enjoy the full range of programs provided. Level changes may be included but must be accommodated by ramps suitable for wheelchair users, both indoors and outdoors. Include access to all areas

[1] B. Lord, G. Dexter Lord, L. Martin, "Museum Planning" in *MANUAL OF MUSEUM PLANNING*, 3rd Edition, 2012

and facilities, including staff and work areas, restrooms, water fountains, and communication devices.

Consider service road access for loading dock/service entrance and emergency vehicles. Along with parking area(s) and service road, consider group tour bus drop off area(s) with the access planning. When possible, provide two (2), two-way access drives to separate service vehicles/truck access from privately owned vehicle parking area access. Provide bicycle racks in a secure location near the facility entrance.

2-5.3 Building Service Areas.

Provide an interior off-loading area separated from the remainder of the building by a second overhead coiling door to accommodate the staging and delivery of materials and collections. After the items have been processed, they will proceed either to the collections or the exhibit areas. Minimum size of the overhead coiling door is 8 ft. (2.4m) wide by 8 ft. (2.4m) high, but larger sized doors may be required based on the size and type of collection materials. To accommodate the movement of items, the loading dock must be connected to each of these other spaces by corridors which have the same minimum width as the overhead coiling door. All interior doors and openings along these access routes must accommodate a minimum height dimension equal to the height of the overhead coiling door. The general collections storage space is required to be adjacent to the loading dock. To minimize the possibility of contamination of exhibits and collections due to a common path with the trash, locate a trash room separated from, but accessible to the loading dock. If the loading dock is used to receive food, provide a separate path of travel for food items to the food service area, thereby isolating museum exhibits and collection storage areas.

2-5.4 Public/Private Areas.

Separation between public and non-public, more secure spaces should be a planning consideration for museum facilities. Public functions, including exhibition halls, theaters, food service, public toilets and museum store should be located near the main building lobby. Elevators should be visible from the main entrance.

2-5.4.1 Public Areas.

2-5.4.1.1 Lobby.

Plan for all visitors to enter the museum through one common entrance unless the size of the facility and expected visitor count require a separate bus/group entrance. Visitor areas should be continuously monitored by the facility's video surveillance system. Provide space for possible security desk and screening equipment. If possible, provide queuing space in front of security/inspection stations inside lobby.

2-5.4.1.2 Museum Store.

The museum store must be in close proximity to the main entrance and lobby. Provide adjacent office for museum store manager, storage area and packing area.

2-5.4.1.3 Toilets.

In addition to public toilets, provide family toilets in the same area. For facilities where high visitation by children is anticipated, consider child-size toilet fixtures and mounting heights in family toilet. Provide drinking fountains in this area.

Provide separate staff-only restrooms in non-public areas of the building.

2-5.4.1.4 Visitor Services.

Plan visitor services area to include coatroom, storage for loaner wheelchairs, strollers, or walkers, and possible first aid room. Consider providing locker storage for visitor accommodation. Include display and storage space for printed materials for visitors, easily accessible to front visitor reception counter. Locate visitor services adjacent to lobby and public toilets.

2-5.4.1.5 Food Service.

Any requirement for food service must be approved under a coordinated business financial management plan. Food service operations for each facility should be determined based on mission and projected visitor needs. Food service may range from vending machines/self-service café to full-service restaurant. Food service should be located adjacent to the lobby or special events area. Consider location of food service to allow for outdoor dining space as well as convenience to the education space. Food service must be separated from collections storage areas.

Locate separate catering kitchen and beverage vault adjacent to main food service facilities in order to isolate food preparation, storage, and service areas from the museum exhibits and collections. The catering kitchen should be zoned for possible after-hours use.

2-5.4.1.6 Theater.

Theater should be sized and designed based on the museum exhibits, mission and expected visitor count. The theater should accommodate large presentations and varied media viewing. It should incorporate fixed seating, a focal point stage or platform, projection room, and AV systems. Theater location should be adjacent to lobby, special events area and exhibits, with the option for after-hours use. Consideration must be given to NFPA 101, Life Safety Code®, compliance regarding lobby design relative to required egress width from the theater.

2-5.4.1.7 Special Events Area.

Consider providing a space adjacent to the lobby which can function as a gathering space for larger group events such as change-of-command and retirement ceremonies, youth and educational functions, receptions and parties. This space can also serve as an exhibition hall for museum displays which provide a “wow-factor” and an enticing introduction to the overall museum collections. This area should be zoned to allow for after-hours use.

2-5.4.1.8 Exhibit Space.

The exhibit areas should consist of minimal fixed items. Recommend involvement of an exhibit designer early in the design process. Planning considerations which must be decided early in the process include the following:

- Determine if there will be fixed walls and/or panels.
- Determine if there will be an exposed or finished ceiling design (e.g. black or white box, high or low bay).
- Determine if the exhibits will follow a linear progression or an open plan.

Exhibit space should have a minimum clear ceiling height of 12 ft (3.7m).

2-5.4.1.9 Education Space.

Provide classroom space to educate young adults and children in naval history through special programs and outreach activities. Provide large, flexible space with folding partitions to accommodate smaller groups. Larger museum facilities may include Science, Technology, Engineering and Mathematics (STEM) laboratories, possibly located throughout the museum near specific exhibit areas. Provide outdoor education space if possible. The education space should be zoned to allow for after-hours use.

2-5.4.2 Private Areas.

2-5.4.2.1 A/V Room(s).

Locate near exhibit space and theater. Multiple A/V Rooms may be required based on exhibit layout.

2-5.4.2.2 Exhibit Production/Maintenance Spaces.

The size and functions within exhibit production and maintenance spaces will vary depending on whether exhibits are produced off-site or in-house. In-house exhibit production may require planning for separate spaces for the following functions:

- Tool Room
- Sign and Framing Shop
- Lighting Shop
- Metal Shop
- Project Assembly Room
- Dust Collection Room

2-5.4.2.3 Collections Storage.

Collections storage should be located near exhibit space as well as the shipping/receiving area. If a freight elevator is required, it should be located in close

proximity to the collections storage area. The collections storage area must be located remotely from any break rooms, vending areas or food service operations.

2-5.4.2.4 General Storage.

Provide storage space for building maintenance supplies. Provide storage space for furnishings and equipment required for functions in the special events area and the catering kitchen.

2-5.4.2.5 Mechanical/Electrical.

Provide a buffer between mechanical and finished public space to prevent potential problems of noise, vibration and odors.

2-5.4.2.6 Office Space.

Design administrative space for long-term flexibility and possible future re-configurations. Open plans, with a high use of workstations rather than closed offices, have a greater degree of efficiency and flexibility, and provide easier distribution of heating, cooling and natural light to the work areas. Where private office space is required, consider the use of demountable partitions for flexibility. Provide administrative support space adjacent to offices including conference rooms, training rooms, copy/mail rooms, file rooms, and supply rooms. Provide staff break room with refrigerator, microwave and sink. Follow planning guidance and criteria per UFC 4-610-01, *Administrative Facilities*.

2-6 HISTORIC RESOURCE FACILITIES (HRF).

Historic Resource Facilities should be planned and sized based on the site and mission-specific functions of the facility. Functional areas that may be a part of this facility include Administrative Space, Archives, Library, Histories, Artifacts, Art, and Underwater Archaeology. See Figure 2-6, Historic Resource Facilities Adjacency Diagram, for additional guidance.

2-6.1 Administrative.

Provide administrative and support space (break rooms, copy rooms, conference space, supply storage rooms) for the Historic Resource Facility. Note that a planning goal is to share as many administrative and support spaces as possible depending upon which functional groups are combined in one building. For example, Archives office space may be combined with Histories and Library office space if these functions are within one facility. Likewise, if NHHC Command Administration shares space in the HRF, common administration and support spaces may be shared with one or more of the other functional areas. Follow planning guidance and criteria per UFC 4-610-01, *Administrative Facilities*.

2-6.2 Archives.

Navy Archives mission is to collect, preserve, arrange, describe, catalog and make available for use the official documents, personal papers, and oral histories relating to the US Navy and Navy personnel. See Figure 2-7, Archives, Library, and Histories Adjacency Diagram, for additional guidance.

2-6.2.1 Archives – Office Space.

Provide general administrative office space including reception area for Archives visitors. Locate adjacent to research area for unclassified documents. Locate adjacent to exterior walls to allow for windows and daylighting. Consider a separate staff entrance to reduce disruption to researchers in the reference and research areas.

2-6.2.2 Archives – Classified Receiving.

Provide secure, open and flexible space adjacent to Loading Dock, Archives – Decontamination Area, and Archives – Classified Processing.

2-6.2.3 Archives – Decontamination.

Provide a secure classified space for the inspection and decontamination of archives prior to entering the HRF. Note that unclassified materials may be handled in this classified space. Two separate decontamination spaces are not required for unclassified and classified decontamination. Locate adjacent to Archives - Classified Receiving and Archives - Classified Processing.

2-6.2.4 Archives – Declassification.

Provide a secure classified space to be used for mandatory declassification reviews of archival materials. Locate adjacent to Archives – Classified Research.

2-6.2.5 Archives – Classified Research.

Secure Archives includes space for classified document research. This secure space should be located near Archives – Office Space, Archives - Classified Archives Storage, Archives – Declassification.

2-6.2.6 Archives and Library – Unclassified Research.

Provide a shared public research space for unclassified Archives and Library documents. This space should be located adjacent to the Entry, Archives – Office Space, and Library – Reference and Circulation for more convenient public access.

2-6.2.7 Archives – Unclassified Archives Storage.

Archives include space for unclassified archives storage. This space should be located adjacent to the Archives - Classified Processing, Archives – Unclassified Cold Storage, and Archives – Classified Storage.

2-6.2.8 Archives – Classified Archive Storage.

Secure Archives includes space for top secret archival storage. This secure space should be located adjacent to Archives –Classified Processing, Archives – Classified Cold Storage, and Archives – Unclassified Storage. Classified Archive Storage should be located near Archives – Office Space, Archives – Classified Research, and Archives - Declassification.

2-6.2.9 Archives – Secure Space.

Secure Space is a compartmented area located within Classified Archives Storage. Include JWICS access. Refer to the section in Chapter 3 entitled, “Physical Security Requirements” for additional security requirements for this space.

2-6.2.10 Archives – Cold Storage.

Provide Archives – Cold Storage in a central, easy-to-access location due to heavy use of this functional area. Research and Reference areas should be adjacent, but separate. Provide both classified and unclassified Cold Storage for negatives, photos, microform, motion recordings and sound recordings.

2-6.3 Library.

Navy Department Library is the only functional group that allows visitors direct access to research materials. The library should be located at the front of the facility because it requires the most public interaction. The library must have controlled access via a single location which includes inventory control sensors. Follow library planning guidance and criteria per UFC 4-740-20, *Libraries*. See Figure 2-7, Archives, Library, and Histories Adjacency Diagram, for additional guidance.

2-6.3.1 Library – Reference/Circulation Area.

Provide reference/circulation area located adjacent to the main entry, book stacks, and Archives and Library - Unclassified Research Room. Rare books/special collections room and restricted research room should be located within clear visible sight from the reference/circulation area.

2-6.3.2 Library – Books Stacks.

Provide space for the book stacks located centrally in the space adjacent to the Reference/Circulation area and within easy access to the Archive and Library Unclassified Research Room.

2-6.3.3 Library – Rare Books/Special Collections Room.

Provide separate room for rare books and special collections with restricted access and alarm system. The rare books/special collections room should be located adjacent to the Restricted Research Room.

2-6.3.4 Library – Restricted Research Room.

Provide restricted access research room located adjacent to the rare books/special collections room. This room should have interior windows visible from the circulation desk for monitoring.

2-6.3.5 Library – Cataloging Area.

Provide cataloging area adjacent to or within the office space.

2-6.3.6 Library – Office Space.

Provide general administrative office space for library staff with exterior windows for daylighting and views if possible.

2-6.4 Histories.

Histories functional group researches and analyzes printed, artifact and oral sources as evidence for articles, reports, monographs and published books. Provide additional space in Historian Office area for numerous bookcases and storage cabinets. Provide separate room for Histories microform viewing and storage. Include separate spaces for conducting classified and unclassified oral histories. Include space for historian office within overall secure boundary. The Histories space is administrative and should be located adjacent to the Archives and Library functional areas. See Figure 2-7, Archives, Library, and Histories Adjacency Diagram, for additional guidance.

2-6.5 Artifacts.

The Artifacts functional grouping is guided by the need for appropriate storage facilities for a wide variety of historic artifacts and modern conservation capabilities including Macro and Micro Artifact Storage, as well as the Navy Art Collection.

2-6.6 Artifact Storage.

Artifact Storage includes general storage space for Macro and Micro Artifact collections as well as support spaces for Loan Artifact Processing, Shipping and Receiving, Technical Library, Record Storage, and Photo Room. Locate general and support spaces adjacent to both Macro Artifact Storage and Micro Artifact Storage. Provide for classified, sensitive, weapons and high-value storage.

2-6.6.1 Macro Artifact Storage.

Provide room for Macro Artifact bulk storage. In addition, provide an area for Macro Artifact Processing. See Figure 2-1 for example of Macro Artifact Storage.

Figure 2-1 Sample Macro Artifact Storage



Maryland Archaeological Conservation Laboratory, Jefferson Patterson Park & Museum

2-6.6.2 Micro Artifact Storage.

Provide room for Micro Artifact Storage to include area for Micro Artifact Processing. In addition, provide specialized areas for Conservation, Uniform/Textile Storage, Cold Storage, and Secure Weapons Storage. Specialized storage areas should be located adjacent to Micro Artifact Storage. See Figure 2-2 for example of Micro Artifact Storage. See Figure 2-3 for example of Artifact Processing Area. See Figure 2-8, Historic Resource Facilities – Artifact Storage Adjacency Diagram, for additional guidance.

Figure 2-2 Sample Micro Artifact Storage



Museum Support Center, Fort Belvoir, VA

Figure 2-3 Sample Artifact Processing Area



Museum Support Center, Fort Belvoir, VA

2-6.6.3 Navy Art Collection.

NHHC is the principal custodian of the Navy's art/painting heritage. The mission of the Navy Art Collection is to collect, document, preserve, and exhibit art that is significant to the history of the Navy for service personnel and for the public, as well as to promote the creation of art through the Navy Art Program.

The Art Collection space includes the following areas: Administrative space including studio for resident office, Processing, Art Gallery Art Storage, Framing Room, Accessioning, and Secure Storage. The collocation of the Navy Art Collection non-exhibit functions and the Artifacts conservation, distribution, and storage functions allows for a consolidated facility, appropriate storage methods, and improved distribution of Navy assets. Separate art galleries may be located at Navy museums.

2-6.6.4 Underwater Archaeology.

Underwater Archaeology (UA) is the center of expertise and recognized authority for the Department of the Navy in all matters related to science of underwater archaeology, identification, research, analysis, interpretation, preservation, conservation, inventory, and management of Navy's historic ship and aircraft wrecks and their associated contents.

The functions of UA are not easily grouped with other functions found in the HRF. UA is most closely associated with the Artifact Storage function and has been shown in Figure 2-6 to be adjacent to Artifact Storage. There are also functional relationships between UA, NHHC Command Administration, and the museum functional group. See Figure 2-9, Underwater Archaeology Adjacency Diagram for additional guidance.

2-6.6.4.1 UA - Administration.

Provide UA offices and support space to include a conference room, secure library, break room, map room, and copier room. Provide a demonstration lab space which is adjacent to the conservation laboratory space.

2-6.6.4.2 UA – Conservation Laboratory.

Locate adjacent to UA offices and demonstration lab space in a visible way to facilitate tours. Conservation laboratory should be large enough to accommodate increasing collection. Locate lab adjacent to loading dock. Provide overhead crane. Provide adjacent space for equipment storage, forklift storage, boat storage, chemical storage, cold storage, x-ray machine, and dive operation facility with storage for dive gear and remote-sensing equipment. Plan for adjacent outdoor tanks. See Figure 2-4 for example of UA Conservation Laboratory.

Figure 2-4 Sample UA Conservation Laboratory



Maryland Archaeological Conservation Laboratory, Jefferson Patterson Park & Museum

2-6.6.4.3 UA – Collections Storage.

Provide a large, open bay storage area with an adjacent space or space within the large storage area for smaller object storage.

Figure 2-5 Museum Adjacency Diagram

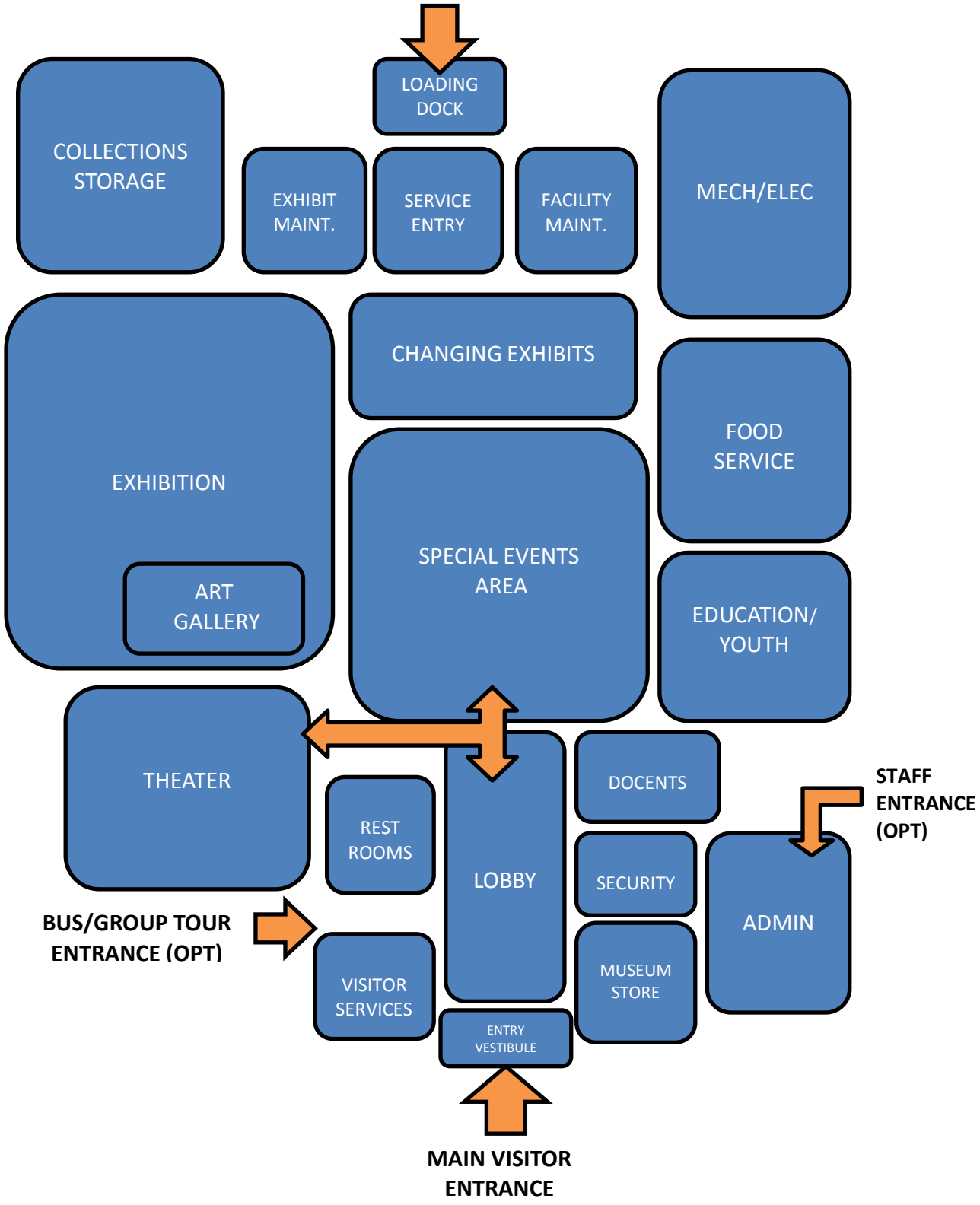
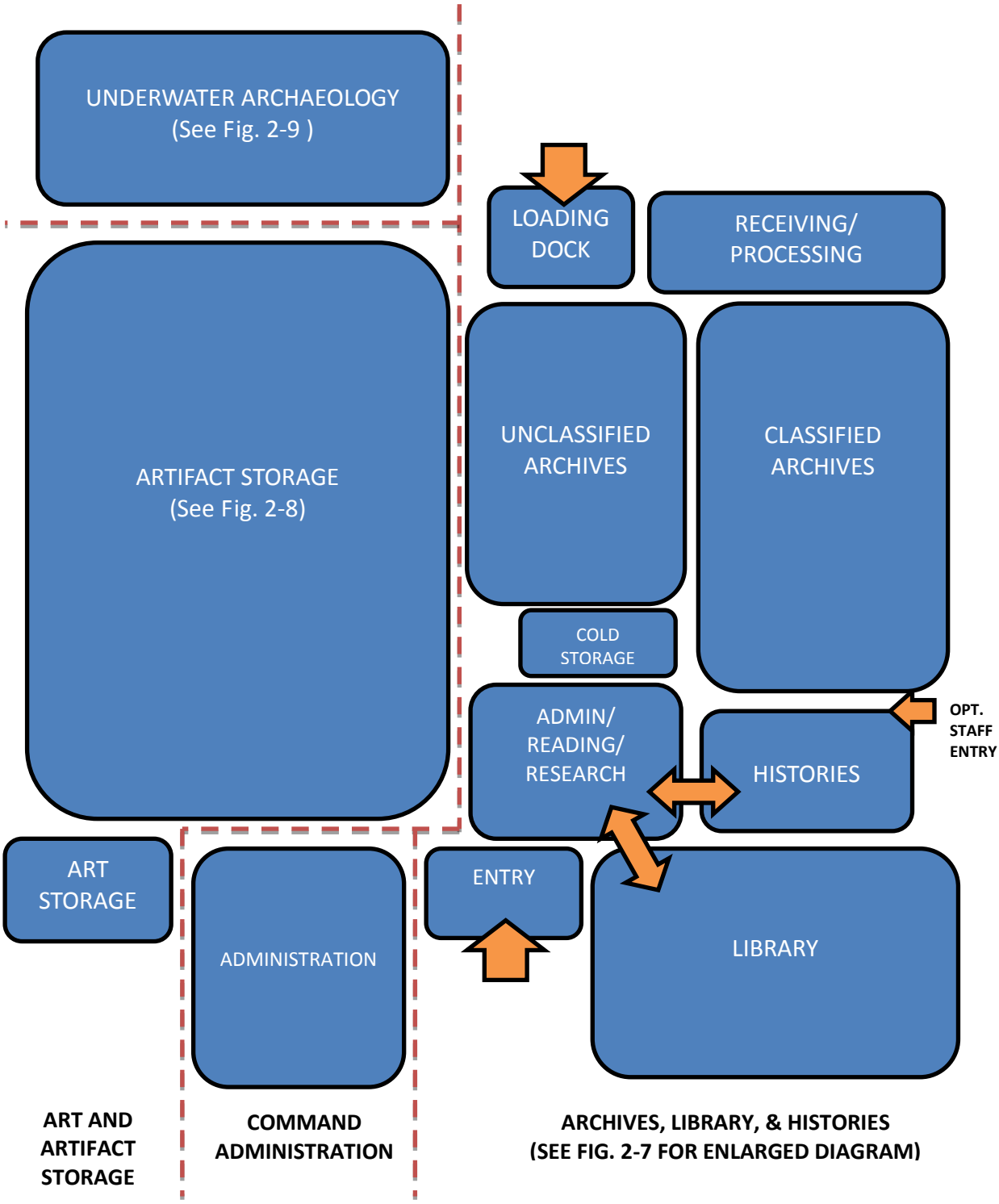
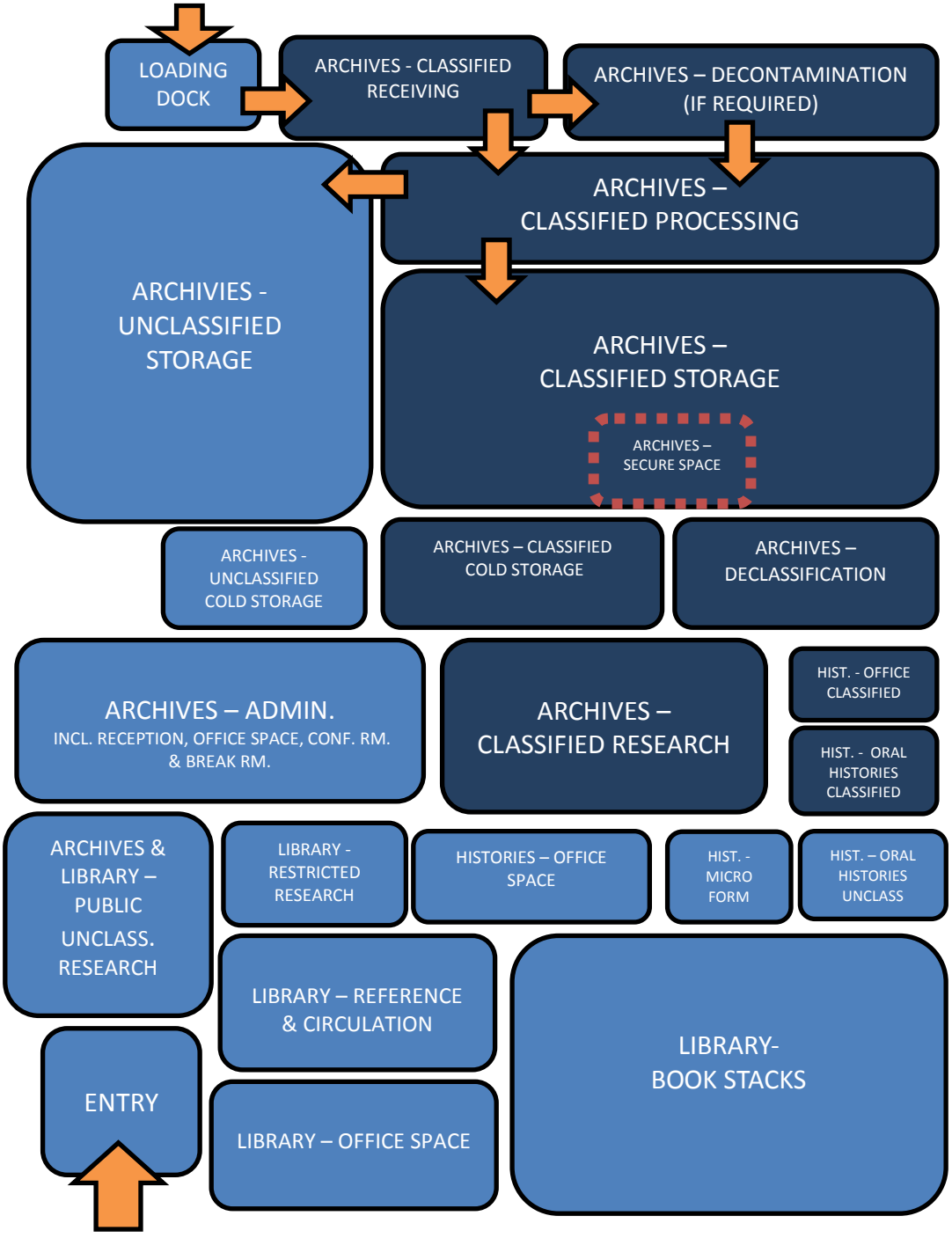


Figure 2-6 Historic Resource Facilities Adjacency Diagram



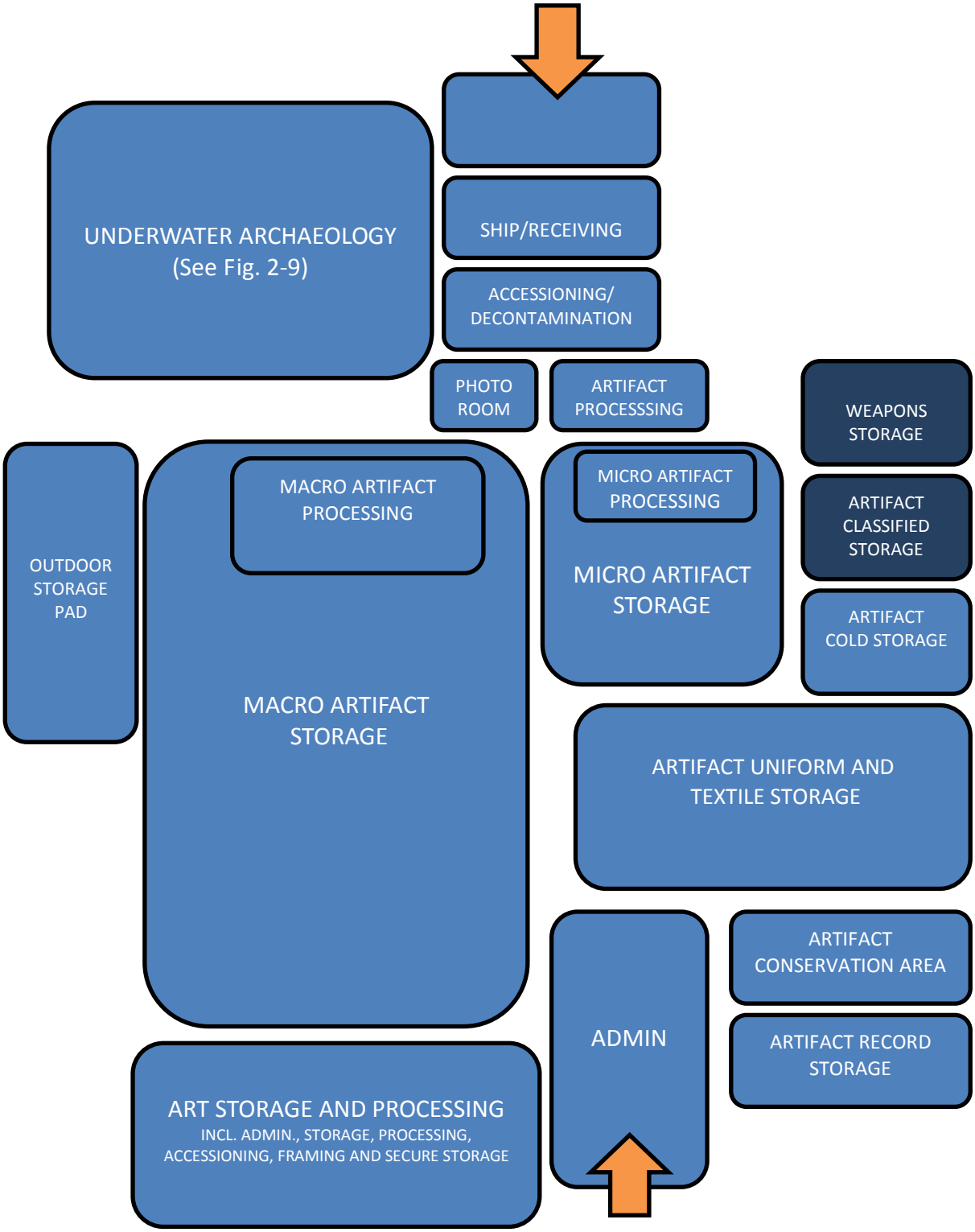
Note: Dashed lines indicate that these functional areas may be located in separate facilities.

Figure 2-7 Archives, Library, and Histories Adjacency Diagram



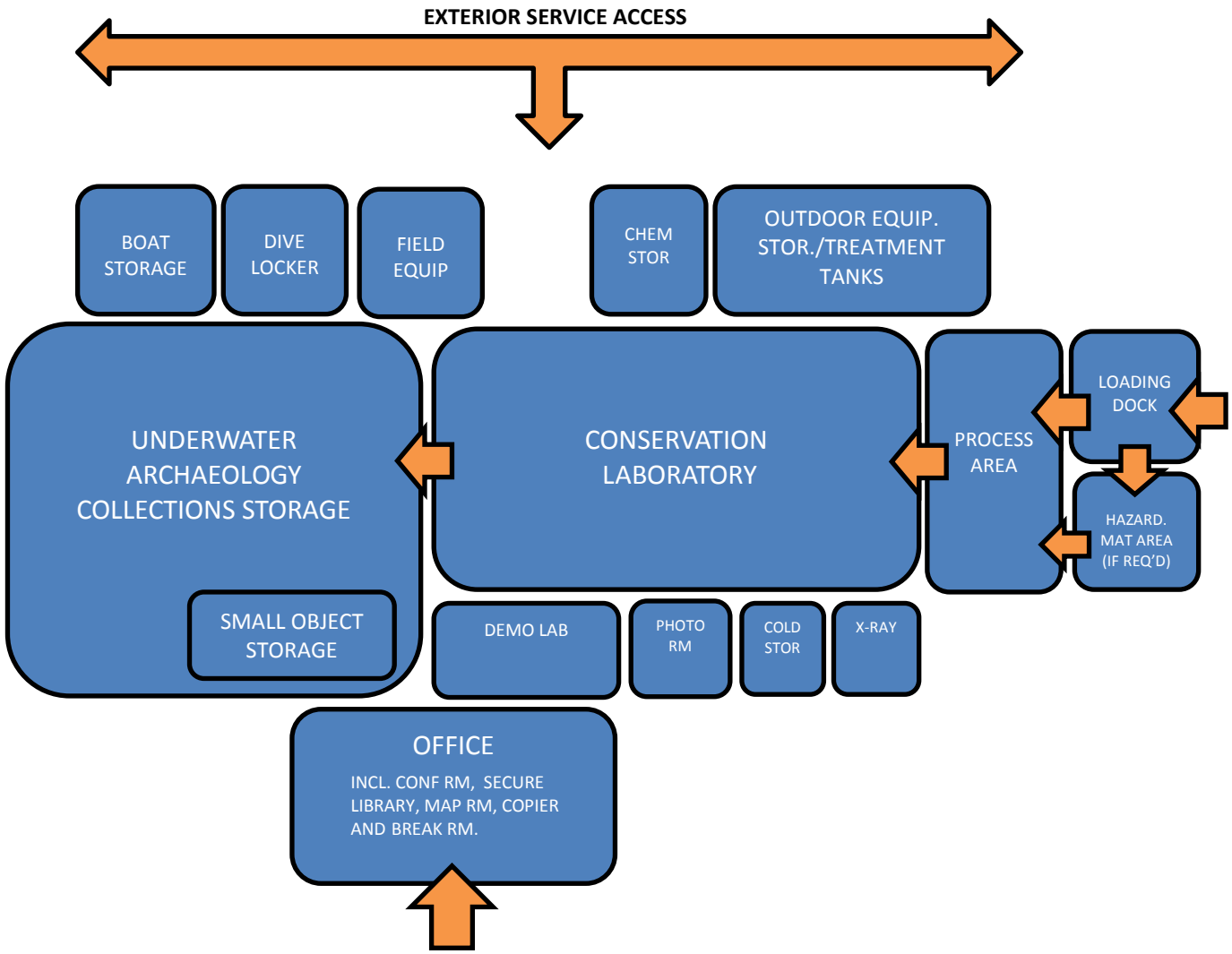
Note: Dark blue shading represents Top Secret/Open Storage functional areas and protected area perimeters. The dashed line represents a secure area boundary within a secure area. See Functional Data Sheets for more information.

Figure 2-8 Historic Resource Facilities – Artifact Storage Adjacency Diagram



Note: Dark blue shading represents special secure areas. See Functional Data Sheets for more information.

Figure 2-9 Underwater Archaeology Adjacency Diagram



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CHAPTER 3 GENERAL DESIGN REQUIREMENTS

3-1 GENERAL.

This chapter describes the general design criteria shared by Museums and Historic Resource Facilities.

3-2 CIVIL.

3-2.1 Site Design.

Site design must be in accordance with UFC 3-201-01, *Civil Engineering*. Also, in addition to the requirements of UFC 1-200-01, *General Building Requirements*, the building must be sited a minimum of five feet (1.52m) above and 100 feet (30.48m) from any 100 year flood plain areas, or be protected by an appropriate flood wall that conforms to local or regional building codes. As noted in Chapter 2, it is desirable to have both museums and HRFs located above the 500 year flood plain or have critical artifacts and records protected to this level. Provide adequate parking for both staff and visitors based on historic and projected parking requirements with the appropriate access drives. Consult local planning documents for facilities located outside the secured perimeter of the base to ensure compliance with applicable regulations.

3-2.2 Water Distribution Systems.

A dependable water supply free of interruption must be provided including a continuous site distribution loop connected to the water main and sized to support the facility with only one portion of the loop operational. Water supply and distribution systems must have the capacity to meet both fire hose and fire sprinkler requirements for 2 hours.

3-2.3 Building Access.

New construction, additions, and renovation of existing facilities must be designed and constructed to meet accessibility requirements of the Architectural Barriers Act Accessibility Standard (ABAAS) for DoD facilities. All functional areas must be barrier-free and accessible to persons with disabilities. Site and building designs should enable persons with disabilities to act independently and enjoy the full range of programs provided. Level changes may be included but must be accommodated by ramps suitable for wheelchair users, both indoors and outdoors. Include access to all areas and facilities, including staff and work areas, restrooms, water fountains, and communication devices.

3-2.4 Service Areas/Loading Docks.

Provide appropriate access drives and loading docks/service entrances in compliance with UFC 4-440-01, *Design: Warehouses and Storage Facilities.*

3-3 ARCHITECTURAL.

3-3.1 Exterior Design.

3-3.1.1 Landscaping.

All landscaping must adhere to guidelines found in UFC 3-201-02, *Landscape Architecture*, and local Installation Appearance Plans (IAP's). All design disciplines should coordinate planning and design efforts. Create design solutions that minimize adverse impacts on the natural environment. Landscaping should be compatible with existing surrounding landscapes. Use plant materials to screen undesirable views, land uses, utilities, and reduce visual impacts of parking lots. All landscaping must adhere to current AT standards.

Maximize low-maintenance landscapes. Use hardy, regionally native and drought-tolerant plant material to the greatest extent possible. Where irrigation systems are required, install water-efficient systems.

3-3.1.2 Site Amenities.

Site amenities include items such as benches, trash receptacles, planters, and flag poles. Use site amenities that are durable, well-constructed, and resistant to vandalism.

Provide bicycle racks in a secure location near the facility entrance.

3-3.1.3 Exterior Signage.

An exterior signage system must be developed in accordance with UFC 3-120-01, *Design: Sign Standards*. Coordinate exterior sign programs with the exterior design of the building and local base standards. Signs must also identify the building, parking areas, service areas, and facilities for the disabled.

3-3.1.4 Exterior Screening.

Loading docks, trash dumpsters, and both ground and rooftop mechanical equipment must be screened from views at areas such as main entrance, courtyards, gathering areas, streets and parking lots. Screens should be compatible with main building materials.

3-3.2 Future Expansion Capability.

Plan for building design that permits additions as collections and storage needs grow. Design the structural system for easy expansion and additions, without over-designing the initial construction.

3-3.3 Roofs.

Pitched roofs with exterior gutters and downspouts should be used whenever possible. Roof penetrations should be kept to a minimum to reduce potential leaks.

For storage occupancies, roof or ceiling slope above fire sprinkler systems must not exceed a pitch of 2 in 12 (a rise of 2 units in a run of 2 units, a roof slope of 16.7 percent). Coordinate with the project fire protection engineer.

3-3.4 Windows.

Windows should only be provided in administrative offices, break areas, vestibules, lobbies, classrooms and other public areas that do not house artifacts or archival materials. See Functional Data Sheets for specific locations where windows are permitted.

According to the IES HDBK, the potential damage that daylight can cause to sensitive materials is a concern in both museums and HRFs for the following reasons. Fading and bleaching is caused by the ultraviolet, visible, and infrared portions of the spectrum. Because daylit spaces generally have higher illuminance levels, it is logical that sensitive materials in daylit spaces are more likely to suffer fading and bleaching. In museums, light exposure is quantified in terms of lux-hours (with UV filters applied) and must be limited to protect preservation-worthy materials. This is why daylighting systems in museums often have sophisticated automated controls to maintain interior daylight values at or below specified target values. UV is a well-known cause of fading and is found at higher levels in daylight than in electric lighting (10 times higher than in incandescent lighting). The ratio of UV energy compared to visible energy is almost twice as high in diffuse skylight as it is in sunlight, however, sunlight is generally stronger and therefore provides more UV exposure when present. Coatings on glass can reduce the transmission of UV radiation by up to 75%. Additional absorptive films within laminated glass can further decrease UV transmission to a low as 1%. In instances such as renovations to existing facilities where windows are unavoidable use absorptive films on inside surface of laminated glass.

3-3.5 Acoustics.

Follow outside to inside noise control guidance and interior acoustic requirements per UFC 3-101-01, *Architecture.* Include the service of an acoustics consultant on the design team to properly address acoustics within the facilities.

Specific interior acoustic requirements are included in the Functional Data Sheets. These acoustic ratings (Noise Isolation Class or NIC) reference wall partition assemblies only.

3-3.6 Integrated Pest Management (IPM).

Apply a decision-making process that helps determine if, when, and where pest suppression is needed. Develop a strategy to keep pests from attacking collections. Use a variety of techniques to prevent and solve pest problems using pesticides only as a last resort. Consider knowledge of a pest's habits, ecology and the environment in which it thrives and survives. Using IPM provides a structure in which to make responsible decisions about treating pests. Use IPM to develop a site specific facility design to meet these goals:

- Protect the museum/resource facility and its collections from pests
- Reduce the amount of pesticides used in collections

3-3.7 Interior Design.

3-3.7.1 Interior Construction/Finishes.

Interior construction and finishes (floors, walls, and ceilings) must be durable, low maintenance and appropriate to the purpose of the facility. Select finish materials, adhesives and sealant systems that contain low to no VOCs to promote healthy indoor air quality. Per NARA 1571 and SI Facilities Design Guide, following is a list of materials that are not permitted in areas where records and artifacts are used, processed, exhibited and stored, including vaults, but may be used in other areas of the facility. These materials are prohibited due to properties that can rapidly degrade and negatively affect artifacts and archival materials:

- Asbestos
- Cellulose nitrate lacquers and adhesives
- Polyurethane products, including paints, varnishes and foams
- Acid-curing silicone sealants and adhesives
- Sulfur containing materials that could release sulfur dioxide (SO2) – include, but are not limited to, vulcanized rubber and cadmium sulfide pigments
- Pressure sensitive (tacky) adhesives that release VOCs
- Unstable chlorine-containing polymers (polyvinyl chloride or PVCs)
- Formaldehyde (urea, phenol) emitting compounds, such as might be found in plywood, particle board and plastic laminates
- Vinyls
- Oil-based paints and varnishes and modified alkyd paints

Flooring materials throughout both facility types must be level to facilitate smooth transport of exhibit materials, archival records and artifacts.

3-3.7.2 Interior Signage.

Develop a comprehensive interior signage package for each facility type that addresses permanent spaces. Refer to UFC 3-120-01, *Design: Sign Standards*, when developing interior signage packages.

3-3.7.3 Wall and Door Protection.

Provide wall protection and corner guards in service corridors where high cart and equipment traffic may be present. Provide door and door frame protection at heavily traveled doors within service corridors, loading dock/service elevator areas, and artifact, exhibit, and record storage areas.

3-3.7.4 Window Treatments.

Treatments should be provided at all exterior windows, to include storefronts or locations where control of daylight or privacy at night is required. Uniformity of window covering color and material should be maintained to the maximum extent possible throughout the facility.

3-3.7.5 Storage Systems.

Provide static or mobile specialty storage systems, as required, to properly house collections. Storage methods include, but are not limited to, flat files, warehouse pallet racks, file cabinets, electric lateral filing machines, specialty art storage racks, and various storage cabinets, some with filter vents for passive air purification. Consider using storage equipment that can be easily adapted for use as movable, high density storage systems.

Design and locations of high density mobile storage systems will require close coordination with structural, mechanical and fire protection engineers. Floor load limits within all storage areas must be established by a licensed structural engineer and will need to be calculated based on storage densities and the type of stored collection (paper-based and larger artifacts will be heavier). Fire suppression and mechanical distribution systems will impact cabinet/shelving heights and the overall design of the storage system. Lighting layouts will also need to be coordinated with these systems, typically running perpendicular to the storage system for optimal illumination of the aisles. When determining high density mobile shelving system requirements also consider:

- Shelving system must include mechanisms (such as bumpers or guards) to maintain a minimum 4 inch (102mm) to 6 inch (152mm) flue space between carriages to reduce the amount of potential fire damage.
- Manual operation of mobile shelving system is recommended due to lower maintenance requirements. However, the use of motorized system operation should be considered during design based on specific user requirements (for example, motorized operation may offer smoother and controlled carriage movement, thereby minimizing vibrations and jarring of fragile artifacts).
- Consider off-gassing of materials utilized in system components such as bumpers, gaskets, recessed tracks, and ball bearings.
- Cold storage areas (temperatures less than 50 degrees F (10 degrees C) should utilize open chrome-plated stainless steel wire racks which promote air circulation and prevent condensation on stored materials.
- Coordinate mobile shelving system design with the structural engineer with regard to floor slab loads, slab flatness, and insertion of recessed tracks. Consult NFPA 232, Standard for the Protection of Records, for additional guidance on construction of mobile shelving to withstand fire damage.

- Perforated shelving uprights and end panels will facilitate air flow circulation or flow of water in the event of fire.

3-4 MECHANICAL.

3-4.1 Heating, Ventilation, and Air Conditioning (HVAC) Design.

In addition to the criteria established in the section in Chapter 1 entitled, “General Building Requirements” and the stated and cross-referenced requirements for HVAC systems, comply with the following in the design of the mechanical system:

- UFC 3-410-04, Industrial Ventilation
- ASHRAE HVAC Applications Handbook Chapter, “Museums, Galleries, Archives, and Libraries”
- ASHRAE HVAC Applications Handbook Chapter, “Laboratories”
- ASHRAE Standard 62.1, “Ventilation for Acceptable Indoor Air Quality”
- NARA 1571, Archival Storage Standards

3-4.1.1 Humidification.

Do not use base steam.

3-4.1.2 Ductwork.

Coordinate duct layout with the end user and architect concerning heights of partitions, displays, shelves, and storage racks, to avoid the disruption of air distribution for spaces with ductwork intended for general air distribution. Provide maintenance access for personnel.

Where theft is a concern due to large duct access, coordinate with the user’s security specialists on duct sizes and maintenance access points.

3-4.1.3 Sound and Vibration Isolation.

Mechanical systems must not transmit or radiate noise or vibrations. Provide an acoustical analysis to demonstrate how noise levels will be addressed.

3-4.1.4 Critical Spaces.

Roof penetrations, roof-mounted equipment, and water piping are prohibited above critical spaces.

Design spaces deemed critical by the end user and in the Functional Data Sheets of this FC at their respective indoor temperature and relative humidity requirements and categorize them as process requirements. Conditions in these spaces must be maintained 24 hours/day 365 days/year. Include these spaces in zones conditioned for specialized technical requirements. Air-side economizers are prohibited in these spaces. Perimeter fin-tube radiation and other sensible- only heating or cooling elements that can create local humidity extremes near collections are prohibited.

Coordinate with the electrical engineer to provide emergency power to maintain indoor requirements in these spaces. The HVAC systems for these spaces must be capable of achieving a gradual shift between the cooling and heating conditions, and must maintain these conditions as stated by the end user and in the Functional Data Sheets included in this FC.

3-4.1.4.1 Renovations.

Coordinate with the architect on protecting the building envelope and structure against moisture migration and condensation. In critical spaces, provide drain pans under all existing roof penetrations and piping containing water or other fluids, except for fire protection piping. Provide piping from drain pans to outdoors and discharge at grade.

Coordinate with the end user on the possible levels of climate control that can be achieved with the existing building(s) and their requirements.

3-4.1.4.2 Redundancy.

If required by the Commanding Officer due to the value of items in these spaces, provide 100% redundancy.

If chilled water systems are selected, size the chillers for 75% (60% allowable with approval) of peak load for the entire facility. Alternate the use of the chillers via a user programmable schedule and equalize run time to lengthen the life span and improve efficiency. Include in controls that in the event of a failure, non-critical loads can be dropped. Variant Refrigerant Volume (VRV) systems and glycol systems are prohibited.

3-4.1.4.3 Filtration.

Filter the combined supply air, including return and outside air, with a combination of prefilter(s) with a Minimum Efficiency Reporting Value (MERV) of 7 and final filter(s) with a MERV of 15 when tested in accordance with ASHRAE 52.2, “Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size”. Verify and coordinate with the user if a micro-environment is needed when critical spaces with collections require higher than MERV of 15 filtration. Provide minimal airflow and separate filtration at a HEPA level (99.97%).

Provide chemical filtration of outdoor air if there is a risk of ambient air pollution.

3-4.1.4.4 Contaminated Materials.

Contaminated materials must be stored in a separate space on a separate HVAC system.

3-4.1.4.5 Positive Air Pressure.

Provide positive air pressure as required in critical spaces where it is necessary to prevent particle pollution during entry and exit from these spaces.

Coordinate requirement for smoke control with the project fire protection engineer. Refer to the Section in Chapter 3 entitled, “Fire Protection”.

3-4.1.4.6 Warehouse-type Storage Spaces.

- Infiltration rate - Design for an infiltration rate of two air changes per hour. The rate is dependent upon the installation of dock door seals.
- Under floor heating system - Investigate the use of an under floor heating system when outside design temperature is below -10 degrees F (-23 degrees C). Under floor heating systems must be between the bottom 2 inches (51mm) to 3 inches (76mm) of the floor slab.
- Ceiling fans - Provide multi-speed ceiling fans with wall-mounted controls where required by the end user and in the Functional Data Sheets included in this FC.
- Space thermostat and humidistat - In existing buildings where it is determined that object receiving areas cannot be separated from sensitive storage areas by dual bays/door locks, a switch activated by opening the dock doors should override the space thermostat and humidistat to stop the HVAC equipment. Provide a minimum temperature thermostat field set at 34 degrees F (1 degree C) to override the heating deactivation switch during door-open periods of subfreezing ambient temperatures. After the doors are closed, the space thermostat and humidistat should resume control. Maximum HVAC system recovery time should be 60 minutes after the doors are closed.
- HVAC zones - Each module/bay must be on a separate HVAC zone. Coordinate with fire protection engineer for smoke management requirements.

3-4.1.4.7 Laboratories.

Coordinate with the end user on air filtration requirements at the diffusers for laboratories where dust control is critical.

3-4.1.4.8 Lobbies and Entrance Areas.

Provide and maintain positive air pressure in lobbies and entrance areas relative to the outside. Maintain lobbies at a negative pressure relative to the rest of the building. Air servicing the lobby must not circulate to other parts of the building. If feasible, the lobby should have a separate HVAC system.

3-4.1.4.9 Loading Docks.

If enclosed, provide and maintain positive air pressure in loading docks relative to the outside. Maintain loading docks at a negative pressure relative to the rest of the building. Air servicing the loading dock must not circulate to other parts of the building.

If the user requires an enclosed loading dock with HVAC, the loading dock must have a separate HVAC system.

3-4.1.5 Stairwells.

Provide heating and cooling in stairwells adjacent to critical spaces. Maintain stairwells not adjacent to critical spaces at mechanical room conditions. Special attention may be required for high humidity areas to prevent condensation in the stairwells.

3-4.1.6 Controls.

Specify direct digital control (DDC) system per UFGS 23 09 23.13 20, BACnet Direct Digital Control Systems for HVAC. Coordinate DDC specification to ensure proper interface to existing or planned base-wide DDC/EMCS system or UMCS/BAS, and remote network monitoring of temperature and relative humidity.

Due to the critical nature of these facilities, the end user, not the base EMCS office, must have direct control of the thermostats and humidistats. The end user must also have direct control of the cooling and heating utilities, not the base central plant. Coordinate locations of temperature and humidity data loggers, thermostats and humidistats, and DDC system temperature and humidity sensors with the end user in spaces that require them.

3-4.1.7 Exhaust Equipment.

Provide snorkel type localized exhaust systems with articulating arms that can be adjusted and manually set to desired positions of users where required in laboratories, conservation work spaces, restoration work spaces, and office spaces. Provide damper shutoff of snorkel type exhaust at the main trunk, not at the capturing hood. Verify during design if fume hoods and ventilated safety cabinets are also required by the end user.

3-5 PLUMBING.

In addition to the criteria established in the section in Chapter 1, entitled, “General Building Requirements”, and cross-referenced requirements therein, include the following requirements:

3-5.1 Emergency Shower / Eyewash Stations and Floor Drains.

Provide emergency shower/eyewash stations and floor drains where required by the end user and in the Functional Data Sheets included in this FC. Coordinate locations of emergency shower/ eyewash stations with electrical equipment.

3-5.2 Compressed Air.

Provide compressed air where required by the end user and in the Functional Data Sheets included in this FC.

3-5.3 Specialty Gases.

Provide specialty gases where required by the end user and in the Functional Data Sheets included in this FC.

3-5.4 Critical Spaces.

Roof penetrations and all plumbing piping are prohibited above critical spaces.

3-5.4.1 Renovations.

In critical spaces, provide drain pans under all existing roof penetrations and plumbing piping containing water or other fluids. Provide piping from drain pans to outdoors and discharge at grade.

3-6 FIRE PROTECTION.

3-6.1 Fire Protection Design Objective.

The fire protection design objective is to minimize damage to, and loss of, historic artifacts and archive material by incorporating active and passive fire protection features. Active features include automatic fire sprinkler systems, smoke detection systems, and smoke control systems. Passive features include fire and smoke resistive construction to create protected fire compartments for the artifacts and archives. Additionally, these compartments are limited in size to minimize the maximum foreseeable loss if a fire event were to occur. The requirements specified herein blend requirements from the various references listed below to minimize the loss of items having cultural, historic, or strategic significance. Special occupancy requirements are included in Chapter 4.

3-6.1.1 Applicable Design References and Criteria.

- UFC 3-600-01, Fire Protection Engineering for Facilities
- 36 CFR 1234, Facility Standards for Records Storage Facilities
- National Park Service *Museum Handbook, Part 1: Museum Collections,* Chapter 9: Museum Collections Security and Fire Protection
- NFPA 232, Standard for the Protection of Records
- NFPA 909, Code for the Protection of Cultural Resource Properties — Museums, Libraries, and Places of Worship

3-6.2 Fire Suppression Systems.

Facilities must be protected with wet pipe sprinkler systems to provide 100 percent coverage throughout the entire building. Areas subject to freezing or designated cold storage areas must be protected with dry pipe or preaction sprinkler systems as required by NFPA 13 and as appropriate for the protected area. Storage collection areas must be individually zoned with dedicated isolation valve and alarm flow switch. Refer to Chapter 4 for additional requirements.

3-6.2.1 Piping.

Sprinkler systems must be designed to minimize the risk of corrosion. Design must consider selection of piping material, pitching of piping, auxiliary drains, and other

methods as recognized by the applicable codes standards, and industry practices. Use of galvanized piping is prohibited. Use of non-ferrous piping materials must be approved by the cognizant NAVFAC fire protection engineer. Use of non-ferrous piping requires an analysis of dissimilar metal corrosion potential, along with mitigation measures if necessary. Where dry pipe or preaction systems are necessary, systems must be charged with nitrogen. For wet pipe system, nitrogen inerting may be considered as an acceptable method of minimizing internal corrosion of pipe. Consideration may be given to new technologies, such as nitrogen inerting of wet pipe sprinkler systems. When provided, nitrogen generation systems must comply with UFC 3-600-01.

3-6.3 Fire Alarm and Detection Systems.

All facilities must be protected with a voice evacuation fire alarm system. The system may serve as the MNS and public address functions as required or as necessary. Smoke detection is required throughout and may be provided with spot, optical beam, video, or early warning smoke detection as appropriate for the protected area. Additional specific design requirements are defined in Chapter 4 and the applicable Functional Data Sheets.

3-7 ELECTRICAL.

Provide site electrical utilities, interior distribution systems, and communications in accordance with UFC 3-501-01, *Electrical Engineering*, and the latest installation design requirements.

- Site Electrical Utilities include equipment, overhead power distribution, underground electrical systems, grounding, metering, and exterior site lighting.

- Interior distribution systems include distribution and service entrance equipment, surge protective devices (SPDs), wiring devices, raceways, conductors, interior lighting systems, lightning protection systems, and hazardous locations.

- Communications includes telecommunications systems, Cable Television System (CATV), and Closed Circuit Television (CCTV).

3-7.1 Lighting.

Provide lighting system designs in accordance with the above which includes UFC 3-530-01, *Design: Interior and Exterior Lighting and Controls*. Exceptions and additions are identified in this FC, and in the Functional Data Sheets.

For areas or rooms not specifically covered, comply with the requirements of the Illuminating Engineering Society of North America's (IESNA) *Lighting Handbook Reference and Application* (hereafter called the *Lighting Handbook*).

3-7.1.1 Exterior Lighting.

Provide vehicular traffic areas, parking facilities, pedestrian areas, and building lighting meeting the requirements for Lighting Zone 2 (LZ2).

3-7.1.1.1 Security Lighting.

Provide a Medium Level of Protection (MLOP) including the security lighting required by 36 CFR 1234.

3-7.1.2 Interior Lighting.

Conservation considerations are a primary concern when illuminating sensitive artifacts such as paintings, photographs, textiles, tapestries, furniture, rare books, scrolls, and other organic objects. Optical radiation may cause damage through photochemical action and radiant heating. Therefore, all light sources in areas displaying or storing sensitive objects must eliminate harmful ultraviolet (UV) and infrared (IR) wavelengths through ultraviolet filtering or choice of light source.

For the purposes of this FC, lighting for these areas, displaying, handling, or storing sensitive artifacts will be considered “Sensitive Lighting” (SL) and will be designated as requiring SL on the Functional Data Sheets.

3-7.1.2.1 Requirements for Sensitive Lighting (SL).

Provide SL systems with the following characteristics:

- Limiting UV light to less than 400 nm
- Limiting IR light greater than 700 nm
- Light sources with CRI’s greater than 85
- When Life Cycle is cost effective, provide Light Emitting Diode (LEDs). They are an excellent choice for this application since most LED light sources do not emit UV and IR[2].

3-7.1.2.2 Levels of Sensitive Lighting.

The levels are divided into three major categories based on the particular object being examined, stored, or on display. These categories are described in a variety of ways in the standards from organizations such as IESNA, Smithsonian, and Society of American Archivists (SSA). Table 3.1 identifies the sensitivity and recommended light levels for materials that will be displayed, handled, or stored in these facilities.

The levels and additional details identified in the FDSs are based on the interpretation of generalized room characteristics, and for archival and display spaces, the general visitors age and visibility limits. Coordinate the requirements herein with the user of the specific facility under design. Modifications may be made to the values, based on the

[2] GATEWAY report for the J. Paul Getty Museum, http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/getty_museum_gateway_final.pdf.

additional age and visibility requirements identified in the IESNA *Lighting Handbook* for the specific rooms applicable to the project.

Note: There are numerous specialized reference documents available for additional information, such as the “Archival and Special Collections Facilities: Guidelines for Archivists, Librarians, Architects and Engineers”. It provides extensive detailed information on lighting systems focusing on striking a balance between three essential goals of being “Economical, Safe, and Functional”. It also includes detailed descriptions, lighting system considerations, and recommended light levels for many of the areas / rooms covered by this FC. However, the latest Lighting Handbook, included in our order of precedence requirements, continues to expand and currently addresses many of these issues with updated information as well.

Table 3-1 Light Sensitivity Categories

Category	Example Materials	Maximum Recommended Light Level fc / (Lux)
Extremely Sensitive (Per IESNA - High Sensitivity)	Fragile textiles (e.g., silk) Wool Paper Dyed leather Feathers Natural-dyed materials Lacquer Composite objects utilizing any of the above materials	5 / (50)
Moderately Sensitive (unless qualified above) (Per IESNA - Low Sensitivity)	Bone, Ivory, Horn Textiles (Cotton, Linen) Cellulosic Materials (Wood, Tapa, Basketry, Reed, Grass) Leather, Parchment, Rawhide, Skin Fur Furniture Paintings	15 / (150)
Fairly Sensitive (unless qualified above) (Per IESNA – No Sensitivity)	Metal - unpainted Stone - unpainted Ceramic - unpainted Glass - unpainted	25 / (250) see Note 1

Note 1: Object Exposure may be unrestricted (up to 100 fc (1000 lux) max). Adjust fc / Lux accordingly. However, when in Museum setting, recommend limits be adhered to.

3-7.1.3 Areas Covered by CCTV.

When area covered by CCTV is unoccupied, provide ambient lighting with a minimum illumination level of 0.5 ft-candle (5 lux) average in the camera's field of view.

3-7.1.4 Additional Lighting Requirements.

In addition to the requirements covered by the core documents, provide the following:

- Emergency (battery backup) lighting in restrooms.
- Lighting systems in stack areas perpendicular to the stack arrangement.
- Special effects lighting in the theater, demonstration, ceremony and event areas, coordinated with the end user based on the planned museum and HRF functions and their missions.

3-7.2 Power.

In addition to the power requirements covered by the core documents, provide the following:

- Dedicated electrical panels in areas such as Underwater Archeology Conservation Laboratory where there are significant electrical loads that need to be controlled from within that area. These areas are indicated on the FDSs.
- Ceiling mounted power cord reels in areas with individual workstations such as the Artifact – Micro Artifact Processing Area and Art - Framing Room when indicated on the Functional Data Sheets. See Figure 2-3 Sample Artifact Processing Area.
- Arc-Fault Circuit Interrupters (AFCIs) on circuits serving stack areas.
- Recessed in floor power in special areas, such as for stages and podiums. Coordinate with the end user and provide the flexibility for the variety of potential functions / events.
- Appropriate power and controls for specialty systems as designated by the end user (such as for the HVAC necessary for the micro-environment storage systems often used in areas like the Underwater Small Object Storage Area.)

3-7.3 Emergency Power.

If required by Installation mission requirements due to the extreme fragility or historical significance of materials being stored, provide the service entrance with either an external temporary / portable emergency generator hook-up for the facility, or in rare instances, provide a permanent emergency power generator for the facility. Comply with paragraph entitled "Emergency Generators" in UFC 3-520-01, *Interior Electrical Systems*, and ensure the availability of a hard surface area adjacent to the building service entrance to accommodate the emergency power hookup when designating a temporary / portable generator.

Comply with UFC 3-540-01, *Engine Driven Generator Systems for Backup Power Applications*, when a permanent generator system is used. (Note: The final draft of this UFC is available on the Navy Design Build Master (NDBM) website.)

3-7.3.1 Emergency Power Coordination with End User.

Coordinate specific requirements with the end user on a case-by-case basis utilizing the information on the Functional Data Sheets. As a minimum, place the following loads on emergency power:

- Life safety loads, including elevators
- Emergency and Perimeter Lighting
- Sump pumps
- Head end communication systems
- Physical Electronic Security Systems (ESS), including IDS, ACS and CCTV
- Cold Storage

Validate the planned emergency operation process with the end user, including the following:

- Extent of Load: Is complete power needed for the designated area including air-conditioning/humidity control, or is power only needed for the critical component such as the walk in or portable freezer units for specimen isolation or film storage?
- When will it be needed – immediately, or only if the outage is extended beyond a certain number of hours?
- How long will it be needed – duration of outage or only until the critical articles are relocated?

3-7.3.2 Connection Point Signage.

When a portable generator connection point is provided, coordinate with end user to develop a written, manual load-shedding procedure for the facility. Document size of the generator required to support design conditions. Place signage at the connection point designating proper generator size.

3-7.4 Cable Television System (CATV).

Provide the infrastructure for a CATV system for utilization by specific groups to access cable television programs. This normally consists of the conduit, wire and outlets from the outside point of connection to the local provider, via the telecommunications room, to the individual locations identified in the FDSs. Coordinate with the local provider's requirements.

3-7.5 Telecommunications.

Provide the telecommunications (data and telephone) system infrastructure. Provide the infrastructure for the Secret Internet Protocol Router Network (SIPRNET) system and JWICS system in areas identified. Coordinate requirements with the end user's Certifying Tempest Technical Authority (CTTA). Provide Protected Distribution Systems (PDS) when required, in accordance with UFC 3-580-10, *Navy and Marine Corps Intranet (NMCI) Standard Construction Practices*. See FDSs for the identified rooms and spaces.

- Coordinate the quantities and locations of outlets with the end user to support the specific equipment requirements in the individual areas.
- Coordinate with the end user and provide recessed in floor telecommunication outlets in areas where special events and functions may be held.

3-8 PHYSICAL SECURITY.

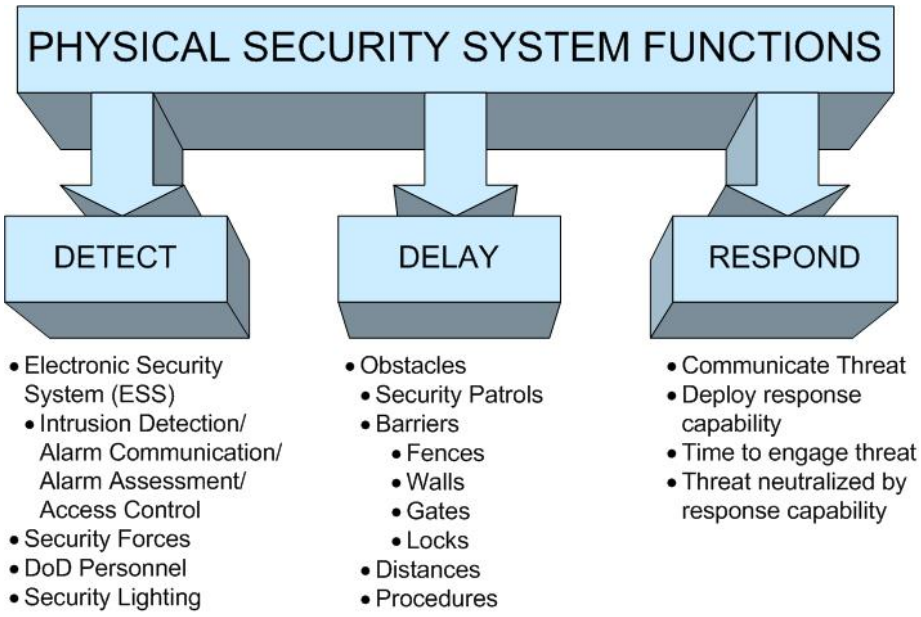
That part of security concerned with physical measures designed to safeguard personnel; to prevent or delay unauthorized access to equipment, installations, material, and documents; and to safeguard them against espionage, sabotage, damage, and theft.

3-8.1 Physical Security System.

A physical security system is comprised of people, equipment, and operational procedures that control access to critical facilities or assets. Electronic Security Systems (ESS) and security lighting are two of the elements that comprise the equipment component of a physical security system.

Design physical security systems to ensure protective measures work as an integrated system rather than separate elements. The system must detect threats, delay threats, and then respond to threats. This concept is referred to as detect, delay, and respond or detect, delay, and defend. To create an effective system, the time between detection and response by response capability must be less than the time it takes the threat to compromise the asset. Physical security systems accomplish this by detecting threats at the farthest possible distance from the asset and providing delays between the detection points and the asset giving the response capability time to neutralize the threat. Figure 3-1 diagrams some of the components of a physical security system.

Figure 3-1 Diagram Physical Security Functions



3-8.2 Physical Security Requirements.

Museums and Historic Resource Facilities contain assets that must be protected against damage or theft.

3-8.2.1 Defining Physical Security Requirements.

The requirement to protect assets such as classified materials or arms are defined in Director of National Intelligence (DNI), Secretary of the Navy (SECNAV), and Office of the Chief of Naval Operations (OPNAV) policies and Instructions. For assets not defined in policy, the requirements are determined by evaluating the value of the assets and the threats to those assets. Defining the requirements of a physical security system and its components involves an interdisciplinary team. The team should consider all interests relating to a project to determine how security fits into the total project design. The specific membership of the team will be based on local considerations, but in general, the following functions should be represented; facility user, antiterrorism officer, operations, security, logistics, architecture, engineering, life safety, and others as required. This team identifies the design criteria, which includes the assets to be protected, policy based requirements, threats to the identified assets (the Design Basis Threat), and the level of protection to be provided to protect the assets. For information on Security Engineering Planning and Design process, refer to UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual,* and UFC 4-020-02, *DoD Security Engineering Facilities Design Manual.* In addition, the team must identify user constraints such as appearance, operational considerations, manpower requirements or limitations, energy conservation and sustainment costs when establishing the physical security system requirements.

When required, integrate physical measures into the site, building, room(s), or area(s) as applicable. Refer to the Specific Design Requirements and Functional Data Sheets (FDS) for specific area requirements.

3-8.2.1.1 Arms Storage.

Provide in accordance with OPNAV INSTRUCTION 5530.13C, *Department of the Navy Physical Security Instruction for Conventional Arms, Ammunition, and Explosives*.

3-8.2.1.2 Classified Materials Storage.

Provide in accordance with SECNAV M-5510.36, *Department of the Navy Information Security Program.*

3-8.2.1.3 Archives Secure Space.

Provide in accordance with Intelligence Community Standard (ICS) 705-1 *Physical and Technical Security Standards for Sensitive Compartmented Information Facilities* and design in accordance with UFC 4-010-05, *Sensitive Compartmented Information Facilities Planning, Design, and Construction*.

3-8.3 Vaults.

Vaults are required for arms storage. In addition, vaults may be required to store high value assets of historical significance. Vaults must be constructed to provide a minimum of 10 minutes' resistance to forced entry against an unlimited supply of hand and battery-operated tools.

3-8.3.1 Walls, Ceilings, and Floors.

Walls, ceilings, and floors must be constructed of 8-inch (20cm) reinforced concrete. Concrete must have a minimum strength of 2,500 psi (175 Kgf/sq cm). Reinforcing must be a minimum of 5/8-inch (16mm) diameter steel, 6 inches (15cm) on center each direction. Wall reinforcement must be tied into floors and ceilings. A modular vault meeting Federal Specification AA-V-2737 (with a GSA-approved Class 5 Armory Vault Door) may be used to meet this requirement.

3-8.3.2 Vault Doors.

Doors must be a GSA-approved Class 5 vault door that meets requirements of Federal Specification AA-D-600.

3-8.3.3 Locks.

Vault doors must be equipped with a combination lock meeting Federal Specification FF-L-2937.

3-8.4 Staff and Visitor Separation.

Staff only areas must be grouped to reduce access control requirements. The grouping of staff spaces must provide both vertical and horizontal access controls to enable adequate Public/Staff separation and Intrusion Detection System zoning. Egress paths from Public space must not pass through Staff only areas.

3-8.5 Protected Area Perimeter.

The protected area may be defined as the entire facility, an area, or areas within the facility. The protected area perimeters and the penetrations in those perimeters are the primary focus of physical security design. The perimeter of protected areas must be designed for forced entry, covert entry, and visual evidence penetration.

3-8.5.1 Perimeter Walls.

Walls must go from floor slab (true floor) to underside of floor or roof deck (true ceiling). Perimeter walls, floor and ceiling must be permanently and solidly constructed and attached to each other. Openings which penetrate a perimeter wall (including HVAC ducts) and are larger than 96 sq inches (240sq cm) with any dimension being greater than 10 inches (25.4cm), must be protected with permanently affixed bars or grills.

- Bars must be a minimum of ½ inch (13mm) diameter steel, welded vertically and horizontally 6 inches (150mm) on center. A deviation of ½ inch (13mm) in vertical and/or horizontal spacing is permissible.
- Grills must be of ¾ inch (20mm) #9 (10 gauge) case hardened expanded metal. When used, metal sound baffles or wave forms must be permanently installed and set no farther apart than 6 inches (150mm) in one dimension.

3-8.5.2 Perimeter Ceiling and Floors.

Ceilings and floors must meet the same requirements as walls with regard to forced entry, covert entry, and visual evidence penetration.

3-8.5.3 Primary Entrance.

Unless otherwise noted or approved, each protected area must have one primary entrance where visitor control is conducted. The primary entrance should incorporate a vestibule/lobby for reception desk, queuing, and future requirements such as magnetometer and bag screening equipment. Primary entrance must be:

- Equipped with an automated access control device.
- Equipped with a GSA-approved pedestrian door deadbolt meeting Federal Specification FF-L- 2890.

3-8.5.4 Perimeter Door.

Doors must be constructed of metal, metal clad or solid wood. At a minimum, wood doors must be 1-¾ inches (45mm) thick solid wood core (wood stave). At a minimum,

metal doors must have a 1-¾ inches (45mm) thick face steel equal to 18 gauge with a predrilled lock area or reinforced to 10 gauge. At least one perimeter door must be provided with an exterior key lock for emergency entrance purposes.

3-8.5.5 Emergency Exit Doors.

Emergency exit doors must meet perimeter door requirements and:

- Be alarmed 24/7 and equipped with a local annunciation.
- Have no exterior hardware.
- Have delayed-egress with NFPA 101 compliance.
- Be secured with deadlocking panic hardware.

Delayed egress hardware must be specified with the activation switch incorporated into the door panic hardware. Delayed egress hardware that integrates the activation switch within the magnetic locking mechanism is not permitted.

3-8.5.6 Internal Security Doors.

Internal security doors are used to secure internal spaces such as closed exhibit or between public events areas and other areas within the facility. When required, internal security doors must meet the requirements of the perimeter door or may be a roll up security gate. Security gate must be one of the following:

- Interlocking perforated or non-perforated Slats: Galvanized ASTM A653/A653M Grade C or ASTM A240/A240M Stainless steel 300 series 16 gauge slats.
- Grille: Solid 5/16 inch (8mm) ASTM A641/A641M galvanized carbon steel wire. Maximum horizontal spacing of 6 inches (15cm) and a maximum vertical spacing of 2 inches (5cm).
- Roll-up security doors which are electrically operated must be provided with key-operated switch. The key-operated switch may be internal or external of protected area.

3-8.5.6.1 Locks.

All locking arrangements must meet the International Building Code and NFPA 101, Life Safety Code requirements and the following:

- Locks must be capable of receiving full size cylinders.
- Card access controlled doors must be provided with key cylinders on the unprotected side to permit bypass of inoperative card readers for emergency purposes. Use of key bypass will cause a forced entry alarm.
- Doors with automatic door openers (during public hours) must have a lock-down mechanism (e.g.: door deadbolt locks) for use after area/building is closed.

- Roll-up doors at perimeters which are electrically operated must be provided with key-operated electrical switches internal to the protected area.
- Electric locks should be coordinated with the architect, door hardware, and electronic security designer to ensure appropriate lock specification.

3-8.5.6.2 Hinges.

Hinges must be reinforced to 7 gauge and may be full mortise, half mortise, full surface, or half surface.

Hinge pins on perimeter doors must be tamper resistant unless mounted on the protected side of the door. Tamper resistant hinges must have non-removable pins, security pins, set screws, welded, or equipped with a safety stud.

3-8.5.6.3 Door Closures.

All perimeter doors must be equipped with a heavy duty door closure, reinforced to 12 gauge, automatic non-hold door-closer installed internal to the protected area.

3-8.5.7 Windows.

Windows in protected areas less than 18 feet (5.5m) (measured from the bottom of the window) above the ground or from the nearest platform; such as lower roof, canopy or mechanical equipment, which affords access to the window must be non-operable, have positive latch, or deadbolt to secure the window in the closed position. Positive latch must preclude opening with ordinarily obtainable tools. Where window hinges are on the exterior of the building and the hinge pins are capable of being removed, the hinge pins must be either fixed in place with a set screw which is inaccessible when the window is closed or welded in place.

3-8.6 Electronic Security System (ESS).

ESS is the integrated electronic system that encompasses one or more of the following subsystems; access control system (ACS), intrusion detection system (IDS), and closed circuit television (CCTV) systems for assessment of alarm conditions. Refer to the Specific Design Requirements and Functional Data Sheets (FDS) for specific area requirements.

ESS must meet the policy based requirements for assets being protected and designed in accordance with UFC 4-021-02, *Security Engineering Electronic Security Systems*. For policy based requirement, refer to Physical Security Requirements in this chapter.

3-8.6.1 ESS Closet.

Provide ESS closets dedicated to ESS distribution equipment and workstations. ESS closets must be adjacent to telecommunications room and be stacked vertically in multi-floor facilities. The minimum size of an ESS closet must be 40 sq feet (3.7sq m) with a minimum ceiling height of 8 feet (2.4m).

3-8.6.2 Intrusion Detection System (IDS).

All Interior areas of a Museum and Historic Resource Facilities through which reasonable access could be gained to works of art, archives, and artifacts must be protected by IDS.

3-8.6.2.1 IDS Zones.

An IDS zone is a room or space within a building that can be armed and disarmed independently from all other zones. See Specific Design Requirements for IDS zoning. Regardless of IDS zoning, each sensor must annunciate as a discrete, identifiable alarm point.

3-8.6.2.2 Motion Detection Sensors.

Must be UL 639 Listed.

3-8.6.2.3 Point Sensors.

Must be UL 634 high security switches (HSS) level 1 or 2. HSS Level 2 is preferred. Balanced Magnetic Switches meet HSS Level 2. Level 2 rated switches include only Balanced Magnetic Switches that pass additional performance testing.

3-8.6.2.4 Local Annunciation.

The local alarm annunciation (sounder) must produce a minimum 92db local chime measured at 10 feet (3.0m) from the device. Provide local sounder at all card reader doors. Sounder should be mounted flush on a stainless steel single-gang box cover, on the protected side, above the door and below any ceiling or tiles and meet the following:

- Sounder must initiate with a Door prop-open alarms.
- Door held-open alarms may be incorporated with request-to-exit devices only if the device will provide the intermittent, chime alert that can be achieved by a stand-alone device.
- Local sounders must be programmed to automatically reset upon reset of door position (secured position).

3-8.6.2.5 IDS Local Processor or Intrusion Panel.

Provide an IDS local processor or intrusion panel within the protected area. System must be configured to only allow cleared personnel located within the protected area to initiate changes in access modes or alarm conditions.

3-8.6.2.6 Sensor Cabling.

Cabling between all sensors and the IDS local processor or intrusion panel must be dedicated to the system and contained within the protected area. If the wiring cannot be contained within the protected area, provide tamper protection in accordance with UFC 4-021-02, *Electronic Security Systems*.

3-8.6.2.7 External Transmission Line Security.

IDS transmission lines leaving the protected area to the central monitoring station, must have line supervision. If line supervision is unavailable, two independent means of alarm signal transmission is required.

3-8.6.2.8 Backup Power.

Provide 24 hours of uninterruptible backup power. This may be provided by internal batteries, uninterruptible power supply (UPS), generators, or any combination. Emergency backup power for IDS should not generate the requirement for a UPS or generator. If a generator or UPS is not available for backup, provide backup with internal batteries.

In the event of primary power failure, the IDS must:

- Automatically transfer to the emergency electrical power source without causing alarm activation.
- Initiate an audible or visual indicator at the IDS local processor or intrusion panel to provide an indication of the primary or backup electrical power source in use.
- Initiate an audible or visual indicator at the monitoring station indicating a failure in a power source or a change in power source.

3-8.6.3 Access Control System (ACS).

Provide ACS to ensure only authorized personnel are permitted ingress and egress into areas containing protected assets. The ACS should log and archive all transactions and alert authorities of unauthorized entry attempts. Equipment containing access-control software programs must be located in the protected area. Unless otherwise directed, the default ACS identifier credential should be the Common Access Card (CAC) [3].

3-8.6.4 Closed Circuit Television (CCTV).

Provide CCTV system for alarm assessment, routine, and event video archiving. CCTV system must be integrated to the IDS and ACS to access and archive events such as alarm conditions and unauthorized entry attempts.

3-8.6.4.1 CCTV Workstation.

Provide a minimum of one workstation for each CCTV system. Multiple workstations may be required for a large distributed system. Video management software must be compatible with all cameras, encoders, and recording devices.

[3] Per DoD 5200.08-R

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CHAPTER 4 SPECIFIC DESIGN REQUIREMENTS

4-1 GENERAL.

This chapter describes specific design requirements that only apply to each type of facility including:

- Museums.
- Historic Resource Facilities (HRF).

4-2 MUSEUMS.

4-2.1 Civil.

4-2.1.1 Service Areas/Loading Docks.

Provide a covered loading dock and adequate access for trucks to enable easy transfer of artifacts and supplies. When space allows, provide a separate service access from privately owned vehicle parking access. The size of required service vehicles should be verified by the designer prior to planning the service access areas. A back-up spur should be provided for dead-end and service drives that exceed 100 feet (30 meters) in length. Access should be near the loading dock and receiving area. Provide a service vehicle apron and consolidate service access, when possible. Screen or separate the service area from public use or traffic areas with attractive fences, depressions, berms and landscaping. Ensure proper drainage if depressions are used. Do not cross outdoor activity areas with service access. Ensure compliance with AT/FP standards, particularly for dumpster separation and access control. Consult installation fire officials concerning emergency access.

If the museum has food service which involves food deliveries and waste removal, a separate loading dock should be provided from the collections shipping and receiving dock.

4-2.2 Architectural.

4-2.2.1 Exterior Design.

Museums are often thought of as important buildings due to their status as cultural landmarks. The exterior design may be either well integrated into the surrounding environment or more prominent if the decision is made to have the museum stand in contrast to its surroundings. If the museum is located on a base, the exterior design should comply with the Installation Appearance Plan (IAP).

4-2.2.1.1 Entrances.

Museum entrances should be clearly identifiable from parking areas with easy to follow directions to the main door. The building should have one primary means of public access unless a bus or group tour entrance is required to due facility size and expected visitor count. Provide drop-off areas to the primary entrance that are easily accessible

for people who are unable to walk from the parking lot. Consider covered waiting areas if people are expected to queue outside. Control all other service and emergency egress points with access limited to authorized individuals. Design the main entrance to be visible by inside staff. Incorporate a point of reference or landmark that serves as a welcome and transition location for visitors. Visually separate the primary entrance from other entrances and service areas.

Provide security doors or secure gates to exhibit areas and other non-public areas from public spaces that may be used after-hours. Locks must meet the requirements of the section in Chapter 3, entitled ”Locks”.

4-2.2.1.2 Exterior Materials/Architectural Character.

The museum should have a distinctive architectural character, whereby the architecture identifies the building as an impressive and inviting destination. Materials and detailing should be of high quality. The architectural character and the interior design of the museum should be integral and related. They both involve functional analysis and consideration of the appropriate environmental character, building organization, circulation, supervision, and flexibility requirements, as well as finishes and furnishings.

4-2.2.1.3 Exterior Signage.

Provide information regarding the museum’s hours of operation on exterior signage that is visible to customers from their cars and at the entrance to the building.

4-2.2.1.4 Outdoor Public Areas.

Where site allows, provide outdoor gathering space for viewing exterior sculpture, works of art, or historical artifacts. These areas should include, as a minimum, specialty paving, benches, plantings, lighting and signage. Provide as much seclusion from adverse impacts (e.g. utility appurtenances, poor views, noise) as possible in order to create outdoor areas that lend themselves to quiet reflection.

4-2.2.2 Future Expansion Capability.

Plan for building design that permits additions as collections and storage needs grow. Design the structural system for easy expansion and additions, without over-designing the initial construction.

4-2.2.3 Building Circulation.

The museum should be designed with clarity of circulation in mind. Public circulation should flow with self-evident ease and without the need for extensive signage. Public circulation should be directed, but should also allow for some self-paced flexibility and choice among museum visitors, especially among repeat visitors.

4-2.2.4 Supervision and Security.

Provide only one main public entrance/exit that is a prominent architectural component to facilitate visitor wayfinding and supervision. A separate staff only entrance may also

be provided that is not in a prominent location, but near dedicated staff parking areas. All other exits should be for emergency use only and alarmed. Staff at the information/ticket desk should have visual control over the lobby, public toilets, museum store, special events area, and entrances to exhibit spaces. Provide closed circuit television (CCTV) monitoring capability for staff working at the information/ticket desk if a separate security room is not provided.

4-2.2.5 Windows.

Consider a larger storefront system in the lobby or special events area which could be temporarily removed or partially removed in order to accommodate the installation or removal of an oversized collection object.

4-2.2.6 Integrated Pest Management.

Food and beverage service, catering kitchens, vending areas and break rooms must be separated from all museum display and storage areas. Organic garbage disposal must be kept separate from museum collections areas. Loading docks should be dedicated to museum collections only. Collections storage rooms must include doors with closers and door sweeps.

4-2.2.7 Interior Design.

4-2.2.7.1 Interior Construction/Finishes.

Interior construction and finishes (floors, walls, and ceilings) should support the cultural theme of the museum facility and convey a cohesive image throughout. Museum facilities receive a tremendous amount of visitor traffic as well as heavy equipment traffic to facilitate exhibit changes. Durability is important when specifying materials for interior construction. Finishes should also be low maintenance and promote limited use of cleaning supplies and resources.

Interior finishes should provide a neutral backdrop for artwork and exhibits. Consider the mission of the museum when selecting interior finishes. Interactive, dramatic spaces may utilize dark ceiling and wall finishes creating a “black box” effect. Museums that are more informational or exhibit-based may use lighter tones on walls and ceilings to give the space a lighter feel, thereby allowing the exhibits and displays to stand out. The finishes within entry areas, lobbies and main halls should provide visual interest through the introduction of color and texture.

For more information on finishes in specific areas, see the Functional Data Sheets.

- Floors
    - Floor finishes should be durable, easy to maintain and provide slip resistance for those visiting the facility. Floors in main traffic areas (lobby, special events area, main corridors) should receive high-quality hard surface flooring materials such as epoxy terrazzo, stone, or porcelain tile. Utilize large format tiles to minimize grout lines, thereby reducing maintenance. Consider the introduction of

non-distracting flooring patterns for visual interest. Provide modular, recessed aluminum framed entrance floor mat systems at all major entries to deter the transition of exterior debris into the facility.

- Galleries and exhibit areas could utilize a variety of floor finishes (carpet tile, vinyl flooring materials, stone) to delineate specific collections or displays. Address flooring transitions to eliminate tripping hazards and ensure smooth transport of exhibit materials and artifacts.

- Where carpet is introduced, use tile products with 100% solution-dyed nylon fiber, multi-level loop construction. All carpets, backings and adhesive systems must be certified by Carpet and Rug Institute (CRI) Green Label Plus to ensure low VOCs, promoting healthy indoor air quality. The carpet tile backing system should be non-vinyl.

- Solid wood and composite wood flooring is not recommended for use in museum spaces.

- Walls
  - Wall finishes in public areas should be durable and promote an upscale image for the backdrop of the facility. Exterior wall finishes, such as brick or stone, could transition into interior spaces for visual flow and introduction of varying material textures. Consider the use of high performance coatings (pro-industrial, precatalyzed, water-based epoxy) on walls in high traffic and service areas. Fabric-wrapped wall panels may be introduced for acoustical benefit, visual interest or display requirements.

- Miscellaneous
  - Toilet partitions should be floor-mounted overhead-braced and constructed of stainless steel, solid plastic (HDPE) or color-through phenolic for durability and graffiti resistance.

  - Built-in casework and cabinetry should consist of plastic laminate base and wall cabinets with solid polymer (solid surfacing) material countertops. Provide integral solid surface material sinks at restrooms. Stainless steel sinks should be provided at all other locations.

4-2.2.7.2 Raised Access Flooring.

Raised access flooring may be introduced in changing exhibition spaces where flexibility of power and data accessibility is required. Consider load requirements as well as

equipment used for exhibit maintenance when selecting raised access floor product. Seal concrete under raised flooring with a clear water-borne sealer.

4-2.2.7.3 Interior Signage.

Develop a comprehensive interior signage package for the facility that addresses permanent spaces and facilitates visitor wayfinding which is critical to a positive museum experience. Consider low lighting levels within exhibit spaces and the impact on viewing critical directional or informational signage content.

Consider the use of digital signage and interactive floor plans, specifically at the main entry/lobby. The interior signage package should complement interior finishes and exhibit signage with regard to materials, fonts, and style.

4-2.2.7.4 Demountable and Operable Folding Partitions.

Consider the use of demountable partition systems in exhibit gallery spaces as well as office/administration areas. These partitions will add flexibility to areas that are prone to frequent reconfiguration. System should be non-progressive, moveable and easily reconfigurable unitized panels from a single manufacturer (SI Facilities Design Standards).

Consider the use of operable folding partitions to create temporary separate areas, such as within education/training spaces.

4-2.2.7.5 Fixed Theater Seating.

Provide fixed seating in theater spaces. Frame and upholstery finishes should be durable and easily cleaned. Design must comply with NFPA 101. Refer to SI Facilities Design Guide, Section 126100, Fixed Auditorium Seating, for recommended performance specifications. Ensure adequate positions are provided for wheelchairs.

4-2.2.7.6 Furniture, Fixtures and Equipment (FF&E).

Throughout the museum facility, it is crucial to provide enough seating, offering rest areas for visitors. This can be accomplished through the introduction of built-in or freestanding benches scattered within the facility. Consider FF&E construction and finish materials during the selection process to ensure off-gassing is kept to a minimum in all spaces.

For more information on FF&E in specific areas, see the Functional Data Sheets.

4-2.3 Structural.

4-2.3.1 Special Loading Conditions.

Floor live loads must be in accordance with UFC 3-301-01, *Structural Engineering*. Since locations of corridors are subject to change over time, use a minimum uniform live load of 100 pounds per square foot (4.79 kilopascals) over the entire floor area. Identify

specific live loads based on the use of the space. Consider display size and weights along with potential equipment required to move or service the exhibits.

4-2.4 Mechanical.

4-2.4.1 Interior Design Conditions.

See Functional Data Sheets for additional requirements.

4-2.4.2 Temperature Control.

See Functional Data Sheets for additional requirements.

4-2.4.3 Humidity Control.

See Functional Data Sheets for additional requirements.

4-2.4.4 Heating, Ventilation, and Air Conditioning (HVAC) Design.

4-2.4.4.1 “Immersive” Experience Displays.

Coordinate with the end user on HVAC requirements needed in museum displays to create an “immersive” experience for the museum visitor (i.e., heating to simulate Vietnam, cooling to simulate Korea).

4-2.4.5 Acoustics and Noise.

See Functional Data Sheets for additional requirements.

4-2.5 Plumbing.

4-2.5.1 “Immersive” Experience Displays.

Coordinate with the end user on plumbing requirements needed in museum displays to create an “immersive” experience for the museum visitor (i.e., compressed air and hydraulics to simulate helicopter vibration).

4-2.6 Fire Protection.

4-2.6.1 Fire Protection Design.

Fire protection designs must incorporate the prescriptive-based options of NFPA 909. Performance-based options must not be considered without explicit approval of the NAVFAC Chief Fire Protection Engineer.

Designs must incorporate redundant fire protection concepts, employing active fire protection through automatic fire suppression and detection systems, passive fire barrier features, and limiting combustible fuel load in order to control and minimize potential injury to staff and losses to collections, mission, and infrastructure.

4-2.6.2 Applicable Guidance and Criteria.

- National Park Service *Museum Handbook, Part 1: Museum Collections,* Chapter 9: Museum Collections Security and Fire Protection
- NFPA 909, Code for the Protection of Cultural Resource Properties — Museums, Libraries, and Places of Worship
- Smithsonian Institution Office of Safety, Health, and Environmental Management's Fire Protection and Life Safety Design Manual

4-2.6.3 Fire Alarm and Detection Systems.

Fire alarm and smoke detection systems must be provided throughout. Smoke detection in public exhibit and gathering spaces may be provided with spot, optical beam or early warning smoke detection as appropriate for the protected area. Serviceability and accessibility of detectors must be considered when selecting detector type. Incorporate necessary interfaces such that activation of the building fire alarm system automatically overrides theater A/V systems and other immersive type experiences.

4-2.6.4 Sprinkler Systems.

Fire Sprinkler System design criteria must comply with NFPA 13 –Installation of Sprinkler Systems, but must be designed for no less than Ordinary Hazard Group 2 criteria.

4-2.6.5 Passive Fire Protection.

Fire barriers must have a minimum one-hour fire resistive construction and be constructed as smoke barriers. Higher fire ratings may be required depending on the materials, process or hazards present, or as dictated by an applicable code or standard. In addition to fire separation requirements covered by the core documents, provide fire resistive barriers to separate and protect the following areas:

- Process areas or other rooms where collections will be inventoried, processed, restored, and cleaned.
- NGO spaces, such as the museum store or restaurant.

4-2.6.6 Interior Finishes and Decorative Materials.

- Wall and ceiling materials, paneling, and acoustical tile must be Class A or B, unless otherwise noted, with a maximum flame spread rating of 75 or less, and maximum smoke developed of 450 as tested in accordance with ASTM E84.
- Wood used for platforms, enclosures, cases over 100 cubic feet (or with heat producing equipment) or for other purposes must be fire retardant pressure impregnated lumber and markings clearly visible attesting to its fire retardant characteristics.

- Fire retardant coatings of intumescent paint or other fire retardant chemicals must not be used in lieu of fire retardant pressure impregnated treatment.
- Textiles or other materials treated with a fire retardant must be re-treated as per the recommended frequency by the treatment manufacturer. The building manager must maintain a record of the date and type of treatment for as long as the material is in use.
- Artificial rocks, faux environments, and similar construction must be fabricated of noncombustible materials to the greatest extent possible. Gypsum, glass fiber, metal lath and other noncombustible materials must be used in lieu of foamed plastics and other combustibles.
- Cellular or foamed plastics and expanded plastics must not be used unless they comply with the fire test criteria and limits on quantities in the IBC and in NFPA 101.

4-2.7 Electrical.

4-2.7.1 Lighting.

Provide automatic controls to maintain minimum light levels throughout the facility and prevent the lights from completely turning off during occupied hours. Provide master control stations at main staff entrance and at information /ticket desk if a separate security room is not provided. See Functional Data Sheets for additional information.

4-2.7.2 Additional Lighting Requirements in Exhibit and Display Areas.

Provide SL for all of the various lighting systems used in the exhibit and display areas, addressing the following:

- Coordinate with the end user and exhibit designer to determine how much illuminance and how much exposure time is acceptable for the artifacts planned to be displayed in each area. Limit the maximum display illuminance based on sensitivity of the artifacts (See Table 3-1). The maximum is usually between 5 and 25 fc; (50 to 250 lux).
- Provide luminaire and light sources that provide a defused light pattern, appropriate warmth/coolness of light for the art, color rendering, and visual clarity.
- Provide sources that are suitable for illuminating color paintings and black-and-white prints.
- Limit the use of incandescent specialty lighting to prevent infrared (IR) damage. Use of incandescent lamps requires specific authorization from the end user.
- Provide adjustable lighting systems in rotating exhibit areas. Implement systems, such as Track lighting on a 10 ft. (3.0m) x 10 ft. (3.0m)

permanent grid, to accomplish the initial arrangement while building in flexibility to accommodate future display requirements.

- Comply with Accessibility Laws including provision of circulation pathway lighting into and out of exhibit areas with a minimum of 1 FC (10 lux).
- Incorporate specific pre-programmed controls to permit the light level to remain low or off until a visitor approaches.
- Fiber optics for displays are ideal and are usually integrated into the display cases. Coordinate with the end user, and incorporate the appropriate power and controls for these systems.
- Note: The exhibit systems are often provided via a separate contract, however, exhibit areas must still have a separate maintenance / ambient lighting system. Establish locations of controls and the planned control procedures so that both systems can be operated independently by the staff, at appropriate times.

4-2.7.3 Power.

All receptacles located in areas occupied by children, such as the Education Center, must be listed Tamper-Resistant (removable caps or plugs are not acceptable).

Coordinate with exhibit planners and provide dedicated sources of power to support the exhibit requirements. Ensure connection points, when concealed, are accessible to staff without disruption of planned exhibits. Provide modular underfloor or within floor power and communication systems in rotating exhibit areas, such as a 10 ft. (3.0m) x 10 ft. (3.0m) permanent underfloor grid, to accomplish the initial arrangement while building in flexibility to accommodate future display requirements.

4-2.7.4 CATV.

Coordinate with exhibit planners and provide infrastructure to support the educational interactive features planned for the exhibits.

See Functional Data Sheets for additional requirements.

4-2.7.5 Telecommunications.

Provide modular underfloor or within floor system in the rotating exhibit areas, such as a 10 ft. (3.0m) x 10 ft. (3.0m permanent underfloor grid, to accomplish the initial arrangement while building in flexibility to accommodate future display requirements. Provide recessed in floor telecommunication outlets in the Theatre, including at the stage and podium areas. Coordinate with the end user and provide the flexibility for the variety of potential functions / events.

See FDS for additional requirements.

4-2.7.6 Coordination.

The following items require interdiscipline coordination with the electrical design:

- Location of the cashier stations in museum stores that accommodate both data and telephone outlets.
- All power requirements for:
  - Lab equipment
  - Shop equipment
  - Food service equipment
  - Integration of food service equipment with fire suppression equipment

4-2.8 Electronic Security System (ESS).

See FDS for additional requirements.

4-2.8.1 ESS – Food Service and Museum Store.

When provided, ESS for the Food Service and Museum Store must be a standalone system. Coordinate requirements with service provider.

4-2.8.2 Intrusion Detection System (IDS).

- All Interior areas of a Museum through which reasonable access could be gained to works of art, artifacts, and archives must be protected by IDS.
- Provide point sensors on all windows, doors, and man-passable openings. Provide motion sensors within protected areas to protect all windows, doors, and man-passable openings and detect movement within the protected space.
- All emergency exit doors must be alarmed 24/7 and equipped with a local annunciation and delayed-egress is recommended with NFPA 101 compliance. Delayed egress hardware must be specified with the activation switch incorporated into the door panic hardware. Delayed egress hardware that integrates the activation switch within the magnetic locking mechanism is not permitted.

4-2.8.2.2 Exhibit Alarms.

Depending on value of the asset, some exhibit cabinets, wall mounted, or free standing exhibits may require IDS. When required, comply with the following:

- Exhibit cases must be protected with plunger or point sensor(s) on all doors/hatches and have vibration sensor(s) within the case. Sensors and wiring must be routed within the case, and protected from tampering.
- Wall mounted or free standing exhibits must be protected with plunger or point sensor and vibration sensor. In addition, wall mounted or free standing exhibits may utilize motion sensors with a curtain pattern to

create a detection zone around the asset. Protection patterns expand with distance from the detector. Therefore, careful detector placement is required to avoid inadvertent alarms. In most applications, floor mounted sensors are recommended. Movement within the detection zone should initiate a local sounder and alarm at the security office. In lieu of a toned alarm at the local sounder, consider a pre-recorded message such as "Please step back from the exhibit".

Provide a local sounder mounted at the exhibit to warn individuals who may have touched an exhibit case, wall mounted or free standing exhibits, or trespassed into an alarm zone. Provide a timer to silence the alarm after a preset time.

4-2.8.2.3 Local Annunciation.

A minimum of four local sounders should be placed in the corners of exhibit galleries. Additional sounders may be required in large galleries.

4-2.8.2.4 IDS Zones.

Staff only areas and public areas must be on separate IDS zones. In addition, the following areas will be on separate IDS Zones:

- Lobby, Special Events Area, Education Youth, and Theater
- Exhibition and Changing Exhibits
- Exhibit Alarms
- Collection Storage
- Exhibit Maintenance
- Facility Maintenance
- Loading Dock and Service Entrance

4-2.8.3 Access Control System (ACS).

At a minimum, provide card reader with keypad at the primary entrance, group tour entrance, primary staff entrance, loading dock entrance, ESS closet, the primary entrance of each protected area and IDS zone.

4-2.8.4 Closed Circuit Television (CCTV).

The following provides the minimum requirements.

4-2.8.4.1 Cameras.

Infrared (IR) illuminators are prohibited in areas that store or display IR sensitive objects or materials. Coordinate lighting design with camera locations; reference the Lighting in Areas Covered by CCTV section.

4-2.8.4.2 Cameras - Public Areas.

Provided camera coverage at the public entrances, lobby, emergency exits, loading dock, and in areas where the public has reasonable access to valuable assets. Provide a minimum of 75% camera coverage in the exhibit galley space with a combination of fixed and pan-tilt-zoom (PTZ) cameras. Cameras must provide coverage of:

- Alarmed cases and exhibits
- Museum windows
- Persons entering and exiting museum

4-2.8.4.3 Cameras - Non-Public Areas.

Provide camera coverage for the primary entrance to each protected area/IDS Zone, emergency exits, and within the protected area based on asset value.

4-2.8.4.4 CCTV Workstation.

Provide at locations indicated in FDS.

4-2.8.4.5 Video Recording.

System should have the capability to digitally record and store all cameras images for a minimum of seven days.

- On-demand and event activated recording must be 30 frames per second (fps)
- Routine recording should not be less than 10 fps
- Resolution should be no less than 720 X 480 pixels.

4-3 HISTORIC RESOURCE FACILITIES (HRF).

4-3.1 Civil.

4-3.1.1 Site Design.

All Historic Resource Facility site designs must be in accordance with Department of Defense (DoD) criteria. These criteria are based on national standards, private sector consensus standards, and model codes. Refer to UFC 4-440-01N, *Design: Warehouses and Covered Storage,* for additional design requirements.

4-3.1.2 Parking.

Provide parking for facilities staff and persons with disabilities within walking distance of the facility entrance. Parking areas should be separated from truck docks and other activity areas by some appropriate physical means. Provide access for the largest size truck expected to serve the facility along with materials handling apparatus and fire apparatus. Truck parking and turning space for the largest size truck expected must be provided.

4-3.1.3 Service Areas/Loading Docks.

Provide maneuvering space to facilitate loading and unloading operations at dock. Inside loading docks are preferable over outside docks. Outside docks should be protected by full width canopies to shield docks from precipitation. Protect building corners and dock areas from vehicle impact by using concrete filled bollards. Dock height will vary between 44 and 52 inches (1120 mm and 1320 mm) depending on the class of trucks served. Configure truck docks to conform to building, site, and traffic flow requirements. Provide dock levelers at all truck positions. Provide space to load and unload flatbed and low-boy trucks and to move material in and out of the facility using a hoist or similar material handling equipment. Specify dock leveler capacity to provide a minimum 20 year life.

4-3.2 Architectural.

4-3.2.1 Exterior Design.

If the historic resource facility is located on a base, the exterior design should comply with the Installation Appearance Plan (IAP).

4-3.2.2 Entrances.

Control all other service and emergency egress points, with access limited to authorized individuals. Design the main entrance to be visible by inside staff. Incorporate a point of reference or landmark that serves as a welcome and transition location for visitors. Visually separate the primary entrance from other entrances and service areas.

4-3.2.3 Roof and Rainwater Collection System.

Consider using the roof for the collection of rainwater for the Underwater Archaeology outdoor treatment tanks.

4-3.2.4 Future Expansion Capability.

Plan for building design that permits additions as collections and storage needs grow. Design the structural system for easy expansion and additions, without over-designing the initial construction.

4-3.2.5 Building Circulation.

The flow of an item or material into, through and out of the building must be considered during the design of a HRF. There should be direct, uninterrupted flow, without ramps, turns or steps, from the loading dock through shipping/receiving to packing/unpacking, holding, and final location.

4-3.2.6 Supervision and Security.

Provide only one main public entrance/exit that is a prominent architectural component to facilitate visitor wayfinding and supervision. A separate staff only entrance may also be provided that is not in a prominent location, but near dedicated staff parking areas.

All other exits should be for emergency use only and alarmed. Staff at the reception or security desk should have visual control over the entrance and access points to secured areas. Provide closed circuit television (CCTV) monitoring capability for staff working at the reception/security desk if a separate security room is not provided.

4-3.2.7 Integrated Pest Management.

Provide separate holding room for pest inspection and treatment of materials prior to entering the HRF.

Vending areas and break rooms must be separated from all collections and storage areas.

4-3.2.8 Interior Design.

4-3.2.8.1 Interior Construction/Finishes.

HRFs should incorporate the use of functional and practical interior construction and finishes. Interior construction materials and finishes should contain low to no Volatile Organic Compounds (VOCs). Off-gassing of VOCs could adversely affect historic artifacts and archival materials. Per NARA 1571, all interior finish materials used in areas where records are stored must be approved by NARA Preservation Programs (NWT). Ensure testing times are incorporated into project planning and construction schedules.

For more information on finishes in specific areas, see the Functional Data Sheets.

- Floors
    - Flat and smooth concrete floors must be utilized throughout storage and lab spaces. Ensure there are no changes in floor levels or materials in corridors or path of travel for collections. Coordinate with structural engineer. Use of carpet is not permitted in records storage areas, but may be used in other parts of the archival facility (such as administrative spaces and library areas).
    - Archival Storage - Per NARA 1571, within archive/record areas, use a low VOC acrylic membrane curing compound for concrete floors, after which an epoxy should be applied. Limit off-gassing of any epoxy and floor coating used to less than 0.1 part per million by restricting the use of toluene and xylene in the floor coating mix.
    - Artifact Storage - Per NPS Museum Handbook, within artifact storage and work areas, treat concrete floors with a sodium silicate sealing/curing agent which will harden and increase the density of the surface of the concrete. The floor should be easy to clean without the use of chemicals. Seal concrete floors with a water-borne sealer (deck gray or similar color so that dirt and wear will be evident) which does not off-gas during or after curing. Product

should be able to be reapplied once worn without the need to remove collections from the spaces.

- Ceilings
  - Do not install dropped ceilings in record storage areas since they obscure leaks, provide habitats for pests and acoustic tile material can generate dust and debris (National Park Service Museum Handbook, Part 1). Exposed ceiling structure (as well as all exposed ceiling pipes) must be painted with an acrylic water-reducible primer covered by two coats of latex paint (NARA 1571.12). Acoustical tile ceilings can be used in administrative spaces, corridors and other spaces where stacks are not present. Ceilings should be a light color.
- Walls
  - Per NARA 1571.12, use water-based latex paint for walls. Do not use oil-based or alkyd paints. All concrete block walls in storage areas must be primed and painted to prevent dust. Walls should receive a light color.
- Casework
  - Built-in casework and cabinetry should consist of plastic laminate base/wall cabinets with solid polymer (solid surfacing) material countertops. Countertops in lab spaces should be constructed of a material that is nonporous, heat- and scratch-resistant, such as stainless steel or epoxy resin. Provide integral solid surface material sinks at restrooms. Stainless steel sinks should be provided at all other locations.

4-3.2.8.2 Storage Systems.

- Archival Storage Systems
  - All archives/record storage shelving, racking and high density mobile shelving systems must meet National Archives and Records Administration (NARA) standards per 36 CFR 1234, Facility Standards for Records Storage Facilities. Per NARA 1571, all metal shelving surfaces within records storage areas must be factory-finished with a “powder-coating polymer that must be a polyester epoxy hybrid or best equivalent that passes NWT-conducted or independent lab tests for hardness, coating stability, bending, coating adhesion, and coating durability.” Paints must not exceed off-gassing limits specified in Appendix B of NARA 1571. Wood shelving is not permitted.
  - Shelving must be stabilized to prevent tipping. Seismic conditions must be considered during design. Air circulation around static

shelving in archival storage areas is critical. At perimeter shelving units, the use of perforated backs, coupled with placing units 6 inch (152mm) off walls, will facilitate air flow.

- Electronic media such as CDs, DVDs, and magnetic tapes may require specialized storage units with 4 inch (102mm) to 7 inch (178mm) high drawers, promoting vertical orientation of the media.

- Artifact Storage Systems
  - Micro artifact storage systems include cabinets, shelving units and racks depending on the type and size of the object or collection stored. Specialized storage cabinets can reduce artifact exposure to light, increase security with locking mechanisms, or create a micro-environment inside the cabinet to protect against dust, pollutants, and pests. Macro artifact storage requires the use of heavy-duty widespan shelving or warehouse pallet rack systems. Refer to UFC 4-440-01*, Design: Warehouses and Storage Facilities*, for additional information. Macro and micro storage units could also be designed as a high density mobile system. Incorporate aisles that allow for safe handling of artifacts as well as full operation of any drawers or doors. Macro artifact mobile systems would need to accommodate forklift-accessible crates.
  - The use of restraining bars or cords secured to edges of shelves is recommended to prevent objects from falling, especially for collections housed in mobile storage systems or in earthquake zones. Per the NPS Museum Handbook, consider raising static storage shelving and cabinets off the floor at least 4 inches (102mm), preferably 6 inches (152mm) on metal risers to protect against flooding, pests and to facilitate cleaning. Artifact storage units should be factory-finished to match the requirements for Archival Storage Systems as described above.

4-3.2.8.3 Furniture, Fixtures and Equipment (FF&E).

For information on FF&E in specific areas, see the Functional Data Sheets.

4-3.3 Mechanical.

4-3.3.1 Interior Design Conditions.

See Functional Data Sheets for additional requirements.

4-3.3.2 Temperature Control.

See Functional Data Sheets for additional requirements.

4-3.3.3 Humidity Control.

See Functional Data Sheets for additional requirements.

4-3.3.4 HVAC.

See Functional Data Sheets for additional requirements.

4-3.3.5 Acoustics and Noise.

See Functional Data Sheets for additional requirements.

4-3.4 Plumbing.

See Functional Data Sheets for additional requirements.

4-3.4.1 Underwater Archaeology Floor Drains.

For conservation areas, coordinate with the user on the extensive network of floor drains that include chemical traps and neutralizers, as well as the capacity to handle catastrophic failures of vats capable of holding hundreds of gallons of diluted solutions.

Provide piping from floor drains to separate chemical containment system that includes holding tank(s) sized to accommodate the site where the facility is located and the maintenance program for evacuating them on a periodic basis (i.e., monthly, biannually, as needed).

4-3.4.2 Access to Underwater Archaeology Holding Tank(s).

Provide personnel access to holding tank(s) for the disposal of chemicals.

4-3.4.3 Compressed Air System for Underwater Archaeology.

Centralize compressed air system for Underwater Archaeology. If feasible, provide air compressor and air dryer in the space for the remote sensing equipment and dive locker. If air compressor and air dryer are provided in the covered area used for the outdoor treatment tanks and equipment storage, provide outdoor rated system, mounted on a slab.

4-3.5 Fire Protection.

4-3.5.1 Fire Area Limitation.

The storage of collections and high-value items (including art, artifacts, rare books, archival materials, and objects of historic value) must be stored in fire compartments sized to minimize the maximum foreseeable loss of items stored in any one compartment from a single fire event.

- Artifacts Storage Areas: The maximum size of any single collection storage space must be 30,000 sf (2790 m2). Smaller spaces may be required, depending on the value of collection items stored.

- Archival Material and Record Storage Areas (excluding Hazardous materials, including records on cellulose nitrate film): For storage of items deemed “vital” as defined in NFPA 232, the maximum storage volume of vital archival materials or records must not exceed 25,000 cubic ft (708 m3) in a single compartment. Items not deemed “vital” are considered “important” as defined in NFPA 232. The maximum storage volume of important archival materials or records must not exceed 125,000 cubic ft (3540 m3) in a single compartment.

4-3.5.2 Fire Area Separation.

The storage of collections and high-value items (including art, artifacts, rare books, archival materials, and objects of historic value) must be protected by passive and active fire protection measures. These measures include the following unless determined otherwise by the NAVFAC fire protection engineer:

- Separate storage areas from other areas with minimum 3-hour fire-rated construction. Barriers must also be constructed as smoke barriers. Higher fire ratings may be required depending on the materials stored and hazard presented.
- Items of extreme value must be stored in fire-resistive vaults, containers, or safes.
- Archival material and records deemed “vital” as defined in NFPA 232 must be separated from other areas with minimum four-hour rated construction.
- Collection storage rooms must be dedicated for such purpose. Artifact processing, packing, unpacking, crate and packaging storage, research performed on artifacts, and conservation of artifacts must not be conducted in collection storage rooms. Separate spaces must be incorporated into the design for these purposes.
- Each collection’s storage area must have a separately zoned HVAC configured to go to full exhaust mode upon smoke detection operation in a corresponding HVAC zone. Coordinate design requirements and features with the project mechanical engineer.
- Artifacts process areas or other rooms where artifacts will be inventoried, processed, cleaned and restored must be separated from other areas by a minimum one-hour fire-rated construction. Barriers must also be constructed as smoke barriers. Higher fire ratings may be required depending on the materials in process and hazard present.

4-3.5.3 Fire Suppression.

- Wet-pipe fire sprinkler systems must be provided throughout unless ambient or design temperatures warrant consideration for freeze protection. Antifreeze systems are prohibited.

- The protection of artifact storage areas must be based on Class IV commodities, unless a more severe class of storage is anticipated. Use Early Suppression Fast Response (ESFR) protection methods.
- Storage areas utilizing high density mobile shelving systems must be protected with ESFR sprinklers. High density mobile storage of archival materials and records must comply with the provisions of NFPA 13 for "Mobile High Bay Records Storage". These requirements also apply to mobile storage units less than 12 ft (3.7m) high.
- Standpipe systems must be provided for storage areas utilizing compact mobile storage units. Fire department hose outlets must be spaced so that any point in the record storage area can be reached with a 50-foot (15.2m) hose stream from a 100-foot (30.4m) hose lay.
- Where books or records are stored in fixed open book shelves, the provisions of NFPA 909 and of NFPA 13 for "Library Stack Areas and Record Storage" apply. Performance-based options of NFPA 909 must not be considered without explicit approval of the NAVFAC Chief Fire Protection Engineer.
- Supplemental systems, such as clean agent fire extinguishing systems, may be considered based on hazard, risk, and value of the items stored. Clean agent fire extinguishing systems are not a substitute for required automatic sprinkler systems.

4-3.5.4 Fire Alarm and Detection.

Artifact and archive storage and processing areas must be protected with early warning smoke detection systems. Each storage area defined by fire rated partitions will be zoned separately. Alarm threshold activation will initiate HVAC smoke exhaust mode.

4-3.5.5 Special Occupancy Requirements.

Archival material and record storage areas must be designed and constructed in accordance with NFPA 232 for "vital" and "important" records defined except that fire area separation requirements for "important" records must be as required above.

The storage of records on cellulose nitrate film must be in accordance with NFPA 40, Standard for the Storage and Handling of Cellulose Nitrate Film.

The protection of laboratories using chemicals must be in accordance with NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals.

4-3.6 Electrical.

4-3.6.1 Lighting.

See Functional Data Sheets for specific lighting requirements. Coordinate with the user, and provide lighting controls based on the specific area zoning requirements.

Include sequentially timed lighting activated as individuals progress through the zoned areas, where appropriate.

4-3.6.2 Power.

See Functional Data Sheets for specific additional power requirements.

4-3.6.3 CATV.

See Functional Data Sheets for additional requirements.

4-3.6.4 Telecommunications.

See Functional Data Sheets for additional requirements.

4-3.6.5 Coordination.

The following items require coordination with the electrical design:

All power requirements for:

- Lab equipment
- X-ray equipment
- Shop equipment

4-3.7 Electronic Security System (ESS).

See Functional Data Sheets for additional requirements.

4-3.7.1 Intrusion Detection System (IDS).

All Interior areas of a Historic Resource Facility through which reasonable access could be gained to works of art, artifacts, and archives must be protected by IDS.

- Provide point sensors on all windows, doors, and man-passable openings. Provide motion sensors within protected areas to protect all windows, doors, and man-passable openings and detect movement within the protected space.
- All emergency exit doors must be alarmed 24/7 and equipped with a local annunciation and delayed-egress is recommended with NFPA 101 compliance. Delayed egress hardware must be specified with the activation switch incorporated into the door panic hardware. Delayed egress hardware that integrates the activation switch within the magnetic locking mechanism will not be permitted.

4-3.7.1.2 IDS Zones.

Staff only areas and public areas must be on separate IDS zones. In addition, the following areas must be on separate IDS Zones:

- Underwater Archaeology
- Art Storage
- Artifact Storage
- Arms Storage
- Archives
- Top secret/Open Storage functional areas
- Archive Secure Space
- Loading Dock

4-3.7.2 Access Control System (ACS).

At a minimum, provide card reader with keypad at the primary entrance, staff entrance(s), loading dock entrance, ESS closet, and the primary entrance of each protected area and IDS zone.

4-3.7.3 Closed Circuit Television (CCTV).

The following provides the minimum requirement.

4-3.7.3.1 Cameras.

Cameras are prohibited in areas containing classified materials. IR cameras or IR illuminators are prohibited in areas that store or display IR sensitive objects or materials. Coordinate lighting design with camera locations; reference the Lighting in Areas Covered by CCTV section.

4-3.7.3.2 Cameras - Public Areas.

Provided camera coverage at the public/Staff entrances, emergency exits, loading dock, and in areas where the public has reasonable access to valuable assets.

4-3.7.3.3 Cameras - Non-Public Areas.

Provide camera coverage for the primary entrance to each protected area/IDS Zone, emergency exits, and within the protected area based on asset value.

4-3.7.3.4 CCTV Workstation.

Provide at locations indicated in FDS.

4-3.7.3.5 Video Recording.

System must have the capability to digitally record and store all cameras images for a minimum of seven days.

- On-demand and event activated recording must be 30 frames per second (fps)

- Routine recording should not be less than 7 fps
- Resolution should not be less than 720 X 480 pixels

APPENDIX A REFERENCES

ADVISORY COUNCIL ON HISTORIC PRESERVATION

http://www.achp.gov

National Historic Preservation Act, http://www.achp.gov/nhpa.html

AMERICAN ALLIANCE OF MUSEUMS

http://www.aam-us.org

National Standards and Best Practices for U.S. Museums

AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIR CONDITIONING ENGINEERS (ASHRAE)

http://www.ashrae.org/

ASHRAE HVAC Applications Handbook, Chapter, "Museums, Galleries, Archives, and Libraries"

ASHRAE HVAC Applications Handbook, Chapter, *"Laboratories"*

ASHRAE Standard 52.2, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*

ASHRAE Standard 62.1, *Ventilation for Acceptable Indoor Air Quality*

ASTM INTERNATIONAL

http://www.astm.org

ASTM A240/A240M, *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*

ASTM A641/A641M, *Standard Specification for Zinc–Coated (Galvanized) Carbon Steel Wire*

ASTM A653/A653M, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*

CODE OF FEDERAL REGULATIONS

http://www.archives.gov/federal-register/cfr/

36 CFR 79, *Curation of Federally-Owned and Administered Archaeological Collections*

36 CFR 1234.10 to1234.14, *Facility Standards for Records Storage Facilities* (formerly numbered 36 CFR 1228.228 to 1228.232)

36 CFR 1234.20, *Creation and Use of Data Files*

DEPARTMENT OF DEFENSE

Intelligence Community Standard (ICS) 705-1, *Physical and Technical Security Standards for Sensitive Compartmented Information Facilities*

DEPARTMENT OF DEFENSE, FEDERAL SPECIFICATIONS AND STANDARDS

http://quicksearch.dla.mil/index.cfm

AA-D-600, *Door, Vault, Security*

AA-V-2737, *Modular Vault Systems*

FF-L-2890, *Lock Extension (Pedestrian Door, Deadbolt)*

FF-L-2937, *Combination Lock, Mechanical*

DEPARTMENT OF DEFENSE, UNIFIED FACILITIES CRITERIA

http://dod.wbdg.org/

UFC 1-200-01, *General Building Requirements*

UFC 2-000-05N/P-80, *Facility Planning for Navy and Marine Corps Shore Installations*

UFC 3-101-01, *Architecture*

UFC 3-120-01, *Design: Sign Standards*

UFC 3-201-01, *Civil Engineering*

UFC 3-201-02, *Landscape Architecture*

UFC 3-301-01, Structural Engineering

UFC 3-410-04, *Industrial Ventilation*

UFC 3-501-01, *Electrical Engineering*

UFC 3-520-01, *Interior Electrical Systems*

UFC 3-530-01, *Design: Interior and Exterior Lighting Controls*

UFC 3-540-01 (Final Draft dated 11/2013), *Engine Driven Generator Systems for Backup Power Applications* – (Note: this version is applicable on projects and is available on the Navy Design Build Master (NDBM) website until the official unified version is available. http://www.wbdg.org/ndbm/design_guidance.php)

UFC 3-580-10, *Navy and Marine Corps Intranet (NMCI) Standard Construction Practices*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 4-010-05, *Sensitive Compartmented Information Facilities Planning, Design, and Construction*

UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*

UFC 4-021-02, *Electronic Security Systems*

UFC 4-440-01, *Design: Warehouses and Storage Facilities,* currently in Draft and anticipated to be published January 2014.

UFC 4-610-01, *Administrative Facilities*

UFC 4-740-20, *Libraries*

UFGS 23 09 23.13 20, *BACnet Direct Digital Control Systems for HVAC*

DEPARTMENT OF THE NAVY

OPNAVINST 5450.342, *Mission, Functions, and Tasks of the Naval History and Heritage Command*

OPNAVINST 5530.13C *Physical Security Instruction for Conventional Arms, Ammunition, and Explosives (AA&E)*

SECNAVINST 4000.35A, Cultural Resources Program

SECNAVINST M-5510.36, Information Security Program

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

http://www.ies.org

Lighting Handbook Reference and Application

INTERNATIONAL CODE COUNCIL

http://www.iccsafe.org

International Building Code

NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

http://www.archives.gov

NARA 1571, *Archival Storage Standards*

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

http://www.nfpa.org

NFPA 13, *Installation of Sprinkler Systems*

NFPA 40, *Standard for the Storage and Handling of Cellulose Nitrate Film*

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*

NFPA 101, *Life Safety Code*

NFPA 232, *Standard for the Protection of Records*

NFPA 909, *Code for the Protection of Cultural Resource Properties - Museums, Libraries, and Places of Worship*

NATIONAL PARK SERVICE

Museum Handbook, Part 1: Museum Collections,
http://www.nps.gov/museum/publications/MHI/mushbkI.html

Archaeological Resources Protection Act,
http://www.nps.gov/archeology/tools/Laws/arpa.htm

SMITHSONIAN INSTITUTION, OFFICE OF ENGINEERING DESIGN AND CONSTRUCTION (OEDC)

http://www.ofeo.si.edu/

Smithsonian Institution Facilities Design Standard

UNDERWRITER'S LABORATORIES

http://www.ul.com

UL 681, *Installation and Classification of Burglar and Holdup Alarm Systems*

UL 2050, *National Industrial Security Systems*

UNITED STATES ACCESS BOARD

Architectural Barriers Act, http://www.access-board.gov/the-board/laws/architectural-barriers-act-aba

Architectural Barriers Act Accessibility Standard, http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards

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APPENDIX B RESOURCES

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MSA's Manager's Guide: Basic Guidelines for the New Museum Store Manager and *The New Store Workbook.* Museum Store Association (MSA).

Pacifico, M. & Wilsted, T. (Eds.). (2009). *Archival and Special Collections Facilities: Guidelines for Archivists, Librarians, Architects, and Engineers.* Chicago: Society of American Archivists.

Wilsted, T. (2007). *Planning New and Remodeled Archival Facilities.* Chicago: Society of American Archivists.

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APPENDIX C GLOSSARY

C-1 ACRONYMS AND ABBREVIATIONS

AAM	American Alliance of Museums
ACS	Access Control System
ACT	Acoustic Ceiling Tile
ABA	Architectural Barriers Act
ABAAS	Architectural Barriers Act Accessibility Standard
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Architectural Guidelines
AFCI	Arc-Fault Circuit Interrupters
A/E	Architect/Engineer
AFCEC	Air Force Civil Engineer Center
ANSI	American National Standards Institute
APF	Appropriated Funds
ASTM	American Society for Testing and Materials
AT	Antiterrorism
A/V	Audio/Visual
BAS	Building Automation System
BEAP	Base Exterior Architectural Plan
BFR	Basic Facility Requirements
C	Celsius
CAC	Common Access Card
CATV	Cable Television
CCTV	Closed Circuit Television
CD	Compact Disk
CD-ROM	Compact Disk Read Only Memory

CFR	Code of Federal Regulations
CID	Comprehensive Interior Design
cm	Centimeter
CONUS	Continental United States
CPSC	U.S. Consumer Product Safety Commission
CRI	Color Rendering Index, Carpet and Rug Institute
CTTA	Certifying Tempest Technical Authority
dB	Decibels
DDC	Direct Digital Control
DDN	Defense Data Network
deg	Degrees
DNI	Director of National Intelligence or Director of Naval Intelligence
DoD	Department of Defense
DODD	Department of Defense Directive
DODI	Department of Defense Instruction
DON	Department of the Navy
DVD-ROM	Digital Versatile Disk Read Only Memory
E-Mail	Electronic Mail
EMCS	Energy Monitoring Control System
EPA	Environmental Protection Agency
ESFA	Early Suppression Fast Response
ESS	Electronic Security System
ETS	Electronic Transfer System
F	Fahrenheit
FA/MNS	Fire Alarm/Mass Notification System
FC	Facilities Criteria

FDS	Functional Data Sheet
FED-STD	Federal Standard
FEMP	Federal Energy Management Program
FF&E	Furniture, Fixtures and Equipment
FIPS	Federal Information Processing Standards
FOA	Field Operating Agencies
FOIA	Freedom of Information Act
FPCON	Force Protection Condition
FPE	Fire Protection Engineer
fps	Frames per second
FRT	Fire Retardant-Treated
ft	Foot or Feet
FY	Fiscal Year
GFCI	Ground-Fault Circuit Interrupter
GSA	General Services Administration
GWB	Gypsum Wall Board
HDPE	High Density Polyethylene
HEPA	High-Efficiency Particulate Air
HQUSACE	Headquarters, United States Army Corps of Engineers
HRF	Historic Resource Facility or Historic Resource Facilities
HSS	High Security Switches
HVAC	Heating, Ventilating, and Air Conditioning
IAP	Installation Appearance Plan
IBC	International Building Code
ICS	Intelligence Community Standard
IDS	Intrusion Detection System

IESNA	Illuminating Engineering Society of North America
IPM	Integrated Pest Management
IR	Infrared
ISP	Internet Service Provider
IT	Information Technology
JWICS	Joint Worldwide Intelligence Communications System
Kgf	Kilogram-force
LAN	Local Area Network
LC	Library of Congress
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development
LRC	Learning Resource Center
LZ2	Lighting Zone 2
m	Meter
mm	Millimeters
MERV	Minimum Efficiency Reporting Value
MILCON	Military Construction
MIL-HDBK	Military Handbook
MLOP	Medium Level of Protection
MSA	Museum Store Association
MWR	Morale, Welfare, and Recreation
NARA	National Archives and Records Administration
NATO	North Atlantic Treaty Organization
NAVFAC	Naval Facilities Engineering Command
NDBM	Navy Design Build Master

NEC	National Electric Code
NFPA	National Fire Protection Association
NGE	Non-Governmental Entity
NGO	Non-Governmental Organization
NHHC	Naval History and Heritage Command
NIC	Noise Isolation Class
NIPRNet	Non-Secure or Non-Classified Internet Protocol Router Network
NISO	National Information Standards Organization
NPS	National Park Service
NRC	Noise Reduction Coefficient
NWT	NARA Preservation Programs
OCONUS	Outside Continental United States
OMSI	Operations and Maintenance Support Information
OPNAV	Chief of Naval Operations
OSHA	Occupational Safety and Health Administration
PA	Public Address
PCAS	Post-Construction Award Services
PDS	Protected Distribution System
PME	Professional Military Education
PO	Private Organization
POS	Point of Sale
psi	Pound per square inch
PTS	Performance Technical Specifications
PTZ	Pan-Tilt-Zoom
PWS	Performance Work Statement
QA/QC	Quality Assurance/Quality Control

RFP	Request for Proposal
RH	Relative Humidity
SCIF	Sensitive Compartmented Information Facility
SECNAV	Secretary of the Navy
sf	Square Feet
SID	Structural Interior Design
SIPRNet	Secret or Secure Internet Protocol Router Network
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SI	Smithsonian Institution
SL	Sensitive Lighting
SOW	Statement of Work
SPD	Surge Protection Device
SRAN	Supply Record Account Number
SAA	Society of American Archivists
STC	Sound Transmission Coefficient
UA	Underwater Archaeology
UFAS	Uniform Federal Accessibility Standards
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specifications
UL	Underwriters Laboratories
UMCS	Utility Monitoring Control System
UPS	Uninterruptable Power Supply
US	United States
USAF	United States Air Force
USGBC	United States Green Building Council
UV	Ultraviolet

VI	Visual Information
VOC	Volatile Organic Compound
VRV	Variable Refrigerant Volume
WBDG	Whole Building Design Guide
WBS	Work Breakdown Structure

C-2 DEFINITIONS

Accessioning. The formal act of accepting an object(s) into the category of materials that a museum or historic resources facility holds in the public trust which typically includes the creation of an immediate, brief, and permanent record utilizing a control number for an object or group of objects. An accession record typically includes the accession number, the date and nature of acquisition (i.e. gift, excavation, purchase, bequest), the source, a brief identification and description, condition, place of origin, value, and name of staff member recording the accession.

Archives. An archive is a repository of historically significant material. The Archives Branch of the Naval History and Heritage Command collects, preserves, arranges, describes, catalogs and makes available for use material consisting of paper-based, photographic, and electronic documentation.

Artifact. An object created by people that is indicative of or exemplifies a specific period of time, culture, or activity.

Cataloging. The process of listing something for inclusion in a catalog. In library and information science, the process encompasses the production of bibliographic descriptions of books as well as other types of discovery tools for documents. Today cataloging study and practice has broadened and merged with that of metadata ("data about data contents").

Cold Storage. A Critical Space storage room for film and audio recordings where cold temperatures must be maintained in order to protect and preserve the collections.

Collections. Objects, documents, books, serials, and other media that museums, libraries, archives, manuscript repositories, and historic resource facilities hold in trust for the public. Items are usually considered a part of a collection once they are accessioned or cataloged.

Conservation. A process by which objects are treated with the goal of keeping them in their original or current condition in perpetuity.

Critical Space. An area or space where the respective indoor temperature and relative humidity requirements must be maintained 24 hours/day, 365 days/year in order to protect and preserve naval artifacts, archives, and art.

Curator. A curator is the keeper or custodian of a museum or other collection. The Curator Branch of the Naval History and Heritage Command ensures the proper documentation, care, and preservation of the Navy's historical artifacts, and makes them available to the Navy and to the public in order to develop a better understanding of and fuller support for the Navy.

Electronic Security System (ESS). The integrated electronic system that encompasses interior and exterior Intrusion Detection Systems (IDS), Closed Circuit Television (CCTV) systems for assessment of alarm conditions, Access Control Systems (ACS), Data Transmission Media (DTM), and alarm reporting systems for monitoring, control, and display.

Historic Resource Facility. A type of storage facility that may include one or more of the following functional areas: administrative, archives, artifacts (including historical art, property, artifacts and collections), exhibit programs, library and underwater archaeology.

Histories. Histories is a functional group within the Naval History and Heritage Command, which conducts historical research and analysis, and produces historical knowledge products ranging from scholarly monographs and policy papers, to on-line chronologies and blog postings. The Histories Branch also promotes and supports outside research of naval history.

Immersive Experience. Museum display that simulates an actual environment or historical event and provides the viewer with a feeling of being there.

Integrated Pest Management. The coordination of information about pests and environmental conditions with available pest control methods to prevent unacceptable levels of pest damage while minimizing hazards to people, property, collections, and the environment. IPM programs apply a holistic approach to pest management decision making and consider all appropriate options, including but not limited to pesticides.

Intrusion Detection System (IDS). A system consisting of interior and exterior sensors, surveillance devices, and associated communication subsystems that collectively detect an intrusion of a specified site, facility, or perimeter and annunciate an alarm.

Library. An organized collection of information resources made accessible to a defined community for reference or borrowing. It provides physical or digital access to material, and may be a physical building or room, or a virtual space, or both. A library's collection can include books, periodicals, newspapers, manuscripts, films, maps, prints, documents, microform, CDs, cassettes, videotapes, DVDs, Blu-ray Discs, e-books, audiobooks, databases, and other formats. A library is organized for use and maintained by a public body, an institution, a corporation, or a private individual. Public

and institutional collections and services may be intended for use by people who are unable to purchase an extensive collection themselves, who need material no individual can reasonably be expected to have, or who require professional assistance with their research. In addition to providing materials, libraries also provide the services of librarians who are experts at finding and organizing information and at interpreting information needs. Libraries often provide quiet areas for studying, and they also often offer common areas to facilitate group study and collaboration. Libraries often provide public facilities for access to their electronic resources and the Internet. Modern libraries are increasingly being redefined as places to get unrestricted access to information in many formats and from many sources. They are extending services beyond the physical walls of a building, by providing material accessible by electronic means, and by providing the assistance of librarians in navigating and analyzing very large amounts of information with a variety of digital tools.

Macro Artifact. Artifact that is larger in size than a micro artifact and may need a specialty built crate that takes up more than a 4 ft (1.2m) by 4 ft (1.2m) pallet on the floor. Examples of macro artifacts include large ordnance and cannons, ship control panels, anchors, submarine sails, boats, and submersibles.

Micro Artifact. Artifact that can be placed within a cabinet or storage rack, can be packaged together for bulk storage, or takes up no more than one standard 4 ft (1.2m) by 4 ft (1.2m) pallet. Examples of micro artifacts include objects as small as a uniform button up to objects such as ship's bells or other equipment.

Micro-environment. A climate-controlled and secure space for the display or storage of artifacts within a sealed case or frame. Micro-environments are utilized in facilities where environmental control is not feasible for entire rooms.

Physical Security. That part of security concerned with physical measures designed to safeguard personnel; to prevent or delay unauthorized access to equipment, installations, material, and documents; and to safeguard them against espionage, sabotage, damage, and theft.

Preservation. A branch of library and information science concerned with maintaining or restoring access to artifacts, documents, and records through the study, diagnosis, treatment and prevention of decay and damage. It should be distinguished from conservation, which refers to the treatment and repair of individual items to slow decay or restore them to a usable state.

Processing. A systematic means of bringing an artifact, document, or record into the collection. Processing includes formally accessioning the artifacts, documents, or records, cataloguing, photographing/scanning, packing and/or housing them for storage, and creating a written and/or electronic record of this documentation.

Records. All books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics, made or received by an agency of the United States Government under Federal law or in connection with

the transaction of public business and preserved or appropriate for preservation by that agency or its legitimate successor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the Government or because of the information value of data in them. Materials made or acquired or preserved solely for reference or exhibition purposes, extra copies of documents preserved only for convenience of reference, and stock of publications and of processed documents are not included.

Security Lighting. Security lighting provides illumination during periods of darkness or in areas of low visibility to aid in the detection, assessment, and interdiction of aggressors by security forces. Security Lighting is sometimes referred to as protective lighting.

Sensitive Lighting (SL). Lighting with special characteristics required to be used in areas displaying, handling or storing artifacts or archival materials. See the electrical paragraphs within this FC for detailed information.

Storage Systems. A system of stationary or mobile storage shelving units, cabinets, racks or other storage solutions. High-density mobile systems include storage units, in varying sizes and configurations, on wheeled carriages which travel on recessed or low-profile tracks. High-density mobile systems offer increased storage capacity and can be either motorized or manually operated.

Underwater Archaeology. Underwater Archaeology is a branch under the Naval History and Heritage Command that is tasked to manage and oversee historical underwater archaeology, conservation projects, and activities that relate to the Curator of the Navy. Underwater Archaeology conducts compliance and permitting responsibilities related to cultural resources management and Sunken Military Craft Act compliance as defined in the appropriate directives.

Vault. A room specifically designed to provide resistance to forced and covert entry.

APPENDIX D MUSEUM FUNCTIONAL DATA SHEETS

This appendix further identifies specific design needs for individual spaces within Museums. Building design criteria are provided in a standard Functional Data Sheet (FDS) table format that generally follows the Uniformat II/Work Breakdown Structure (WBS). The Interior Construction/Built-In Equipment category includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window shades or blinds, and recessed projection screens. The Furnishings and Equipment category includes loose or moveable items such as desks, chairs, and shelving.

The Functional Data Sheets are presented as a guide for the designer, planner, or RFP preparer. It is intended that the information in them are the minimum requirements for the respective rooms and spaces. These minimum requirements apply in addition to all other requirements of this FC and other referenced documents. In the event of a mutually exclusive conflict or where both requirements cannot be satisfied, the Functional Data Sheets take precedence. However, if in the best judgment of the designer, a more restrictive requirement is appropriate, the more restrictive requirement may be applied after consulting with the user. Note that blank spaces found in the Functional Data Sheets indicate building components or systems should follow standard guidance per UFC 1-200-01, *General Building Requirements*.

Table D-1 Museum – Vestibule

Description / Usage	Vestibule. Main entrance to the museum.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Storefront system for daylighting and vision into lobby.	
Doors	Heavy duty storefront system to accommodate high visitor traffic.	
Interior Construction / Built-In Equipment	Provide recessed walk-off mat.	
Finishes	**Walls**	Upgraded wall finish system such as wood, stone, or continuation of exterior finishes.
	Floor	Hard surface (terrazzo, stone/porcelain tile, etc.).
	Base	Terrazzo, stone (coordinate with floor material).
	Ceiling	Painted plaster or GWB, or decorative ceiling treatment.
Plumbing		
HVAC	Provide per Chapter 3. Provide only heating in vestibule.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of an average of 5 fc (50 lux) ambient and daylighting with dimmability controls.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Adjacent to Lobby/Main Entrance/Visitor Services.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-2 Museum – Lobby/Main Entrance/Visitor Services

Description / Usage	Lobby/Main Entrance/Visitor Services. Provide dedicated group/tour entrance as required.	
Ceiling Height	Varies.	
Windows		
Doors		
Interior Construction / Built-In Equipment	Reception counter, building directory, bulletin boards, donor recognition display, monitor to display on-going visitor information.	
Finishes	**Walls**	Upgraded wall finish system such as wood, stone, or continuation of exterior finishes.
	Floor	Hard surface (terrazzo, stone/porcelain tile, etc.).
	Base	Terrazzo, stone (coordinate with floor material)
	Ceiling	ACT, exposed structure, acoustic clouds or other specialized ceiling treatments.
Plumbing	Provide per Chapter 3. Provide electric water cooler in proximity of public toilets.	
HVAC	Provide per Chapter 3. Critical area. Design lobby area to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4. FA/MNS flush-mounted remote panel with microphone located at the reception counter.	
Power	Provide per Chapter 3. Coordinate with power requirements for additional special systems.	
Lighting	Provide per Chapter 3 with the additions of 5 fc (50 lux) ambient, day lighting penetrations, and dimmability w/photosensors.	
Communication	**Telephone**	Provide at reception counter.
	Data	Provide at reception counter. Coordinate requirements for ticket sales system.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4. Locate ACS workstation at reception counter unless directed otherwise.
	CCTV	Provide per Chapter 3 & 4.

Acoustics		
Furnishings and Equipment	Benches, Automated External Defibrillator (AED)	
Special Requirements	Consider areas for visitor queuing, wheelchair storage, and visitor screening (x-ray). Include space for visitor coat and personal effects storage.	
Adjacencies/Location within Facility	Vestibule, Museum Store, Public Restrooms, Security, Special Events Area, Theater	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-3 Museum – Museum Store

Description / Usage	Museum Store. Consists of retail area and inventory storage area for museum merchandise. Include shipping/wrapping area and Point of Sale (POS) register area.	
Ceiling Height	10 ft. (3.0 m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors	Recommend storefront system for visibility.	
Interior Construction / Built-In Equipment	Sales counter to accommodate POS register. Modular display and storage systems.	
Finishes	**Walls**	Paint - egghell/satin finish.
	Floor	Carpet tile or resilient flooring material (linoleum, luxury vinyl tile/plank).
	Base	Resilient.
	Ceiling	ACT, exposed structure, acoustic clouds or other specialized ceiling treatments.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of power panels.	
Lighting	Provide per Chapter 3 with the additions of 40 fc (400 lux) ambient, day lighting penetration, dimmability w/ photosensors, and coordination with store display lighting as appropriate.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 and with the addition of infrastructure for non-NMCI system and credit card processing.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	Stand alone system to be coordinated w/ NGO.
Acoustics		
Furnishings and Equipment	Stool at sales counter.	
Special Requirements	May require coordination with NGO. Refer to Museum Store Association (MSA) standards for additional information. Provide storefront wall at front of store for display visibility. Provide storefront door, gate or coiling grille to secure space after-hours, if open to lobby.	
Adjacencies/Location within Facility	Lobby/Main Entrance.	

	For use during project execution by the appropriate Service	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table D-4 Museum – Museum Store Manager Office

Description / Usage	Museum Store Manager Office. Office can be located within or near Museum Store.	
Ceiling Height	8 ft. (2.4m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with the addition of infrastructure for possible Non-NMCI data system connection.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding desking system, task lighting, ergonomic desk chair, side chairs, filing/storage, safe.	
Special Requirements	May require coordination with NGO.	
Adjacencies/Location within Facility	Museum Store. Main lobby.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-5 Museum – Security Office

Description / Usage	Security Office. Optional office for security personnel (in larger museum facilities only).	
Ceiling Height	8 ft. (2.4 m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	Built-in console for monitoring equipment.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4. FA/MNS Remote Panel with microphone.	
Power	Provide per Chapter 3. Coordinate requirements for radio charging system.	
Lighting	Provide per Chapter 3 and dimmable lighting.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	Provide per Chapter 3.
Security	**IDS**	Provide IDS Workstation
	ACS	Provide card reader at entrance and ACS Workstation
	CCTV	Provide CCTV Workstation
Acoustics		
Furnishings and Equipment	Desk, ergonomic chair, storage (file cabinet or shelving), task lighting, guest side chair(s), lockable gun storage, as required.	
Special Requirements		
Adjacencies/Location within Facility	Lobby/Main Entrance, Special Events Area	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-6 Museum – Public Restrooms

Description / Usage	Public Restrooms/Family Restroom/Mothers' Room. Men's, Women's and Family toilet rooms.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	Sink vanities, toilet partitions, mirrors, toilet accessories, diaper changing stations.	
Finishes	**Walls**	Ceramic or porcelain tile (full-height). Provide water-resistant GWB at wet walls.
	Floor	Porcelain tile.
	Base	Ceramic or porcelain tile.
	Ceiling	ACT and/or painted GWB (satin finish).
Plumbing	Provide per Chapter 3. Provide wall-mounted urinals, floor-mounted toilets, and lavatories. Provide a floor drain.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of emergency lighting with battery backup .	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Provide comfortable lounge chair in Mother's Room.	
Special Requirements	Locate one restroom at each floor level. Coordinate with Facility Manager when determining soap and paper product dispensing preferences. Consider child-sized toilet, sink and dispensers and proper mounting heights at Family Restrooms.	
Adjacencies/Location within Facility	Lobby, Exhibit spaces, Education spaces.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-7 Museum – Theater

Description / Usage	Theater. Accommodates large presentations, ceremonies and media viewing.	
Ceiling Height	12 ft. (3.7m) minimum.	
Windows	Not required.	
Doors		
Interior Construction / Built-In Equipment	Fixed seating, audiovisual systems (presentation, sound, lighting, etc.), recessed projection screen, projector mount(s), stage curtain.	
Finishes	**Walls**	Acoustic wall panels, paint (eggshell or satin finish) or other specialized wall treatments.
	Floor	Carpet tile, resilient flooring, stained/sealed concrete.
	Base	Wood or resilient.
	Ceiling	ACT, exposed structure, acoustic clouds or other specialized ceiling treatments.
Plumbing		
HVAC	Provide per Chapter 3. Use demand controlled ventilation or heat/enthalpy recovery when cost effective.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapters 3 and 4 with the addition of flush floor mounted outlets, coordinated with requirements of the planned events.	
Lighting	Provide per Chapters 3 and 4 with the additions of 30 fc (300 lux) ambient with dimmability, and the specialty lighting systems to accomodate the planned events.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapters 3 and 4 with the addition of the infrastructure for video teleconferencing system for presentations and training purposes, non-NMCI data system connection, and flush floor mounted outlets, coordinated with requirements of planned events.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	
Acoustics	NC 55 or greater.	
Furnishings and Equipment	Lecturn/podium	
Special Requirements	May require coordination with NGO. Consider use of tiered floor and stage or platform. Provide audio-visual systems to support museum mission. Provide accommodation for remote VTC and podcasts.	
Adjacencies/Location within Facility	Lobby, Special Events Area	

	For use during project execution by the appropriate Service	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table D-8 Museum – Docent Education/Training Room

Description / Usage	Docent Education/Training Room. Work/lounge space for docents/volunteers.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Built-in casework and lockable cabinets, if sink required. Personnel lockers.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet (resilient flooring near sink area, if provided).
	Base	Resilient.
	Ceiling	ACT.
Plumbing	Provide per Chapter 3. Provide a stainless steel sink with hot and cold water supply and a cleanout. Provide a water connection for icemaker at refrigerator.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of 15 fc (150 lux) ambient and 30 fc (300 lux) task, dimmability or mutilevel switching, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	Consider provision of infrastructure for Video teleconferencing hookup for training purposes.
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Work table, chairs, small touch-down workstations, open library shelving, storage cabinets for materials, refrigerator, lounge chairs, occasional tables.	
Special Requirements		
Adjacencies/Location within Facility	Main lobby, Exhibit area, Education Director	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-9 Museum – Museum Director Office

Description / Usage	Museum Director Office. Private office for museum director.	
Ceiling Height	8 ft. (2.4m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell or satin.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding desking system, task lighting, ergonomic desk chair, side chairs, filing/storage.	
Special Requirements		
Adjacencies/Location within Facility		
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-10 Museum - Curatorial/Historian Office

Description / Usage	Curatorial/Historian Office	
Ceiling Height	8 ft. (2.4m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell or satin.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Verify if snorkel type localized exhaust systems with articulating arms that can be adjusted and manually set to desired positions of users are required.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding desking system, task lighting, ergonomic desk chair, side chairs, filing/storage.	
Special Requirements		
Adjacencies/Location within Facility	Collections Area	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-11 Museum - Computer/IT Office

Description / Usage	Computer/IT Office.	
Ceiling Height	8 ft. (2.4m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell or satin.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3 & 4.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding desking system, task lighting, ergonomic desk chair, side chairs, filing/storage.	
Special Requirements		
Adjacencies/Location within Facility	Administrative Area.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-12 Museum – AV Supervisor Office

Description / Usage	AV Supervisor Office	
Ceiling Height	8 ft. (2.4m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell or satin.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3 & 4.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding desking system, task lighting, ergonomic desk chair, side chairs, filing/storage.	
Special Requirements		
Adjacencies/Location within Facility	Theater.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-13 Museum – Administrative Support Spaces

Description / Usage	Administrative Support Spaces. Includes any administrative support spaces required to include copy, print, central files.	
Ceiling Height	8 ft. (2.4m) minimum	
Windows	Provide, if possible, for exterior views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell or satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3 & 4.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding systems furniture (open office), worktables, storage cabinets, file cabinets.	
Special Requirements		
Adjacencies/Location within Facility	Administrative offices.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-14 Museum – Conference Room

Consider area for wheelchair storage.	Conference Room. Room to support staff meetings, presentations and training.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows	Provide, if possible, for exterior views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Recessed projection screen, projector mount. Visual display system - whiteboards, tackboards, etc.	
Finishes	**Walls**	Paint - eggshell or satin finish. Optional finish treatments (wood wainscott, acoustical wall panels, etc.).
	Floor	Carpet tile.
	Base	Resilient or wood.
	Ceiling	ACT. Could introduce GWB soffits for interest.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with the addition of the infrastructure for video teleconferencing system for presentations and training purposes.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Conference table, chairs (around table and stacking for additional capacity), lectern, storage credenza, mobile flipchart easel.	
Special Requirements	Consider VideoTeleconferencing (VTC).	
Adjacencies/Location within Facility	Administrative area, Museum Director Office.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-15 Museum – Staff Break Room

Description / Usage	Staff Break Room	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Casework with base/wall cabinets; television wall-mount bracket.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient (linoleum, luxury vinyl tile or plank).
	Base	Resilient.
	Ceiling	ACT.
Plumbing	Provide per Chapter 3. Provide a stainless steel sink with hot and cold water supply and a cleanout. Provide a water connection for icemaker at refrigerator.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Tables and chairs, countertop microwave, refrigerator, coffee machine, television, recycling containers.	
Special Requirements	Provide area for recycling containers and vending machines.	
Adjacencies/Location within Facility	Administrative areas.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-16 Museum – Intern Staff Cluster

Description / Usage	Intern Staff Cluster. Space to support NHHC intern programs.	
Ceiling Height	8 ft. (2.4m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with the addition of infrastructure for possible Non-NMCI data system connection.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding desking system or systems furniture (open office), task lighting, ergonomic desk chair, side chairs, filing/storage.	
Special Requirements		
Adjacencies/Location within Facility		
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-17 Museum – Staff Restrooms

Description / Usage	Staff Restrooms. Toilet facilities for building staff.	
Ceiling Height	8 ft. (2.4m) minimum	
Windows		
Doors		
Interior Construction / Built-In Equipment	Sink vanities, toilet partitions (if required), lockers, mirrors, toilet accessories.	
Finishes	**Walls**	Ceramic or porcelain tile (full-height). Provide water-resistant GWB at wet walls.
	Floor	Porcelain tile.
	Base	Ceramic or porcelain tile.
	Ceiling	ACT and/or painted GWB (satin finish).
Plumbing	Provide per Chapter 3. Provide wall-mounted urinals, floor-mounted toilets, and lavatories. Provide a floor drain.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements	Coordinate with Facility Manager when determining soap and paper product dispensing preferences.	
Adjacencies/Location within Facility	Administrative areas (non-public areas)	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-18 Museum – Special Events Area

Description / Usage	Special Events Area. Large open space to accommodate ceremonies, training, and other special events. This space may be a part of the main lobby.	
Ceiling Height	Varies.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Benches, Special mission graphics	
Finishes	**Walls**	Upgraded wall finish system such as wood panels, stone, or continuation of exterior finishes.
	Floor	Hard surface (terrazzo, stone/porcelain tile, etc.). Coordinate with Main Entrance finishes.
	Base	Terrazzo, stone (coordinate with floor material).
	Ceiling	ACT, exposed structure, acoustic clouds or other specialized ceiling treatments.
Plumbing		
HVAC	Provide per Chapter 3. If part of the main lobby, this is a critical area which must be designed to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of 10 FC (100 lux) ambient, daylighting, and dimmability controls to accommodate specific activities.	
Communication	**Telephone**	Provide per Chapter 3 with the addition of flush floor mounted outlets, coordinated with requirements of special events .
	Data	Provide per Chapter 3 with the addition of flush floor mounted outlets, infrastructure for Non-NMCI service , and additional systems (e.g., sound, wireless) coordinated with requirements of special events.
	CATV	Provide per Chapter 3.
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4

Acoustics		
Furnishings and Equipment	Tables, chairs, and podium to provide flexible layout options.	
Special Requirements	May require coordination with NGO.	
Adjacencies/Location within Facility	Lobby, Food Service area	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-19 Museum – Special Events Storage

Description / Usage	Special Events Storage. Include room for storage of chairs, flags, tables, podiums, etc.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete or continuation of adjacent floor finish.
	Base	Resilient.
	Ceiling	Exposed structure - painted.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Table and chair carts, if required.	
Special Requirements		
Adjacencies/Location within Facility	Special Events Area, Kitchen/Catering space.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-20 Museum – Exhibit Area

Description / Usage	Exhibit Area(s). Includes permanent collection gallery, temporary exhibit gallery and art gallery spaces.	
Ceiling Height	Varies. 12 ft. (3.7m) minimum. Consider mix of high bay and low bay ceiling heights depending upon exhibit requirements.	
Windows	Provide only if exterior views are necessary for exhibit enhancement.	
Doors	Provide oversize doors and openings as required for exhibit installation and maintenance.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Painted gypsum wallboard, finish level 4, on 1/2 inch (1.3 cm) FRT plywood. Use 3/4 inch (1.9 cm) FRT plywood on 12 foot (3.7m) high walls.
	Floor	Floor finish materials will vary depending on exhibit layout and design.
	Base	Varies to coordinate with floor finish.
	Ceiling	ACT, exposed structure, acoustic clouds or other specialized ceiling treatments.
Plumbing	Provide per Chapter 3 and 4.	
HVAC	Provide per Chapter 3 and 4. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4. Provide Very Early Warning Smoke Detection.	
Power	Provide per Chapters 3 and 4 with specialty power connections and grids, as appropriate.	
Lighting	Provide per Chapters 3 and 4. All lighting shall be SL, including 1 fc (10 lux) continuous ambient during occupancy, maintenance lighting system (coordinated to sensitivity of the exhibits), exhibit lighting systems with grids as appropriate, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapters 3 and 4 with specialty communication connections and underfloor grids as appropriate
	Data	Provide per Chapters 3 and 4 with specialty communication connections and underfloor grids as appropriate
	CATV	

Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Benches.	
Special Requirements	Art Gallery area - provide flexible art display system for changing exhibits.	
Adjacencies/Location within Facility	Lobby, Special Events Area	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-21 Museum – AudioVisual Room

Description / Usage	AudioVisual Room. Serves as the AV and lighting support areas for exhibits.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	Projection systems, AV racks.	
Finishes	**Walls**	Paint - egghell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	ACT or exposed painted structure.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4. Provide very early warning smoke detection.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3. Coordinate with specialty systems needed for the special events.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3. Coordinate with specialty systems needed for the special events, including microphones, sound, and wireless systems.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Exhibits.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-22 Museum – Education Space – Classrooms

Description / Usage	Education Space - Classroom(s). Utilized for a variety of activities - lectures, children's education, training.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Consider operable folding partitions if required for flexibility. Recessed projection screen, projector mount. Visual display system - whiteboards, tackboards, etc. Built-in casework and lockable storage, if sink required. Consider use of Smartboards.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing	Provide per Chapter 3. If required, provide a stainless steel sink with hot and cold water supply and a cleanout.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 and Chapter 4.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3. Consider provision of infrastructure for Video teleconferencing hookup for training purposes.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Tables and chairs, podium, flip chart/easel	
Special Requirements	Refer to STEM Center Spaces for possible related education spaces. Consider room-darkening shades for training presentations.	
Adjacencies/Location within Facility		

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-23 Museum – Education Space – STEM Center

Description / Usage	Education Space - Science, Technology, Engineering & Mathematics (STEM) Center Spaces. Optional space in larger facilities. Include robotics lab, prep room and storage areas.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Casework, as required, with base/wall cabinets for storage.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT. Will vary depending on location(s).
Plumbing		
HVAC	Provide per Chapter 3. Includes critical areas. For critical areas, design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 and Chapter 4.	
Power	Provide per Chapter 3 and Chapter 4.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	Provide per Chapter 3. Consider provision of infrastructure for Video teleconferencing hookup for training purposes.
Security	**IDS**	
	ACS	
	CCTV	

Acoustics		
Furnishings and Equipment	Lab tables, stools, storage cabinets.	
Special Requirements	STEM space(s) could be scattered throughout the Exhibit areas or centrally located.	
Adjacencies/Location within Facility	Exhibit space, Education Director.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-24 Museum – Education Space – Children's Area

Description / Usage	Education Space - Children's Area. Accommodates children's programs, crafts, etc.	
Ceiling Height	8 ft. (2.4m) minimum. May vary depending on location, if incorporated into Exhibit areas.	
Windows	If separate room, provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Built-in casework to accommodate sink and locked storage. Incorporate child-height casework and sink. Artwork display system.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT. May vary with location.
Plumbing	Provide per Chapter 3. If required, provide a stainless steel sink with hot and cold water supply and a cleanout.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 and Chapter 4.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Tables and chairs (scaled for children). Storage cabinets.	
Special Requirements	Provide artwork posting/display area.	
Adjacencies/Location within Facility	Exhibit area, Education spaces, Education Director.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-25 Museum – Restaurant/Café

Description / Usage	Restaurant/Café. Food service area for museum visitors and staff.	
Ceiling Height	10 ft. (3.0 m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors	Recommend storefront system for visibility.	
Interior Construction / Built-In Equipment	Food service equipment. Casework and storage as required for concessions operations. Sales counter to accommodate Point of Sale (POS) register.	
Finishes	**Walls**	Painted GWB, ceramic tile in wet areas.
	Floor	Porcelain or terrazzo tile.
	Base	Coordinate with floor finish.
	Ceiling	ACT, exposed structure, acoustic clouds or other specialized ceiling treatments.
Plumbing	Provide per Chapter 3. Provide a compartmented stainless steel countertop sink with hot and cold water supply and a cleanout. Provide floor drain. Provide a water connection for icemaker.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of power panels.	
Lighting	Provide per Chapter 3 with the addition of 20 fc (200 lux) task, day lighting penetrations, and dimmability w/ photosensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 and with the addition of infrastructure for non-NMCI system and credit card processing.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Equipment as required for concessions operations, tables and chairs for seating, recycling containers, waste receptacles.	
Special Requirements	May require coordination with NGO. Provide recycling and trash collection area. Locate away from exhibit areas to prevent contamination. Requires access to a loading dock for deliveries.	
Adjacencies/Location within Facility	Lobby, Special Events Area, Kitchen/Catering Space.	

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-26 Museum – Kitchen/Catering Space

Description / Usage	Kitchen, Catering Space. Area to support restaurant and/or catering (smaller museums) for special events food service.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	Food service equipment. Casework, as required, with base/wall cabinets. Paper towel dispenser(s), soap dispenser(s). Dishwasher. Icemaker.	
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Quarry tile, resilient or epoxy flooring system.
	Base	Coordinate with floor finish.
	Ceiling	Painted GWB - epoxy (eggshell/satin finish).
Plumbing	Provide per Chapter 3. Provide a compartmented stainless steel countertop sink with hot and cold water supply and a cleanout. Provide floor drain. Provide a water connection for icemaker at refrigerator or separate icemaker.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3. Coordinate requirements for kitchen and catering equipment.	
Lighting	Provide per Chapter 3 with the addition of 15 fc (150 lux) ambient, 50 fc (500 lux) task, day lighting penetrations, and dimmiability	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Refrigerator, microwave, coffee machine, recycling containers, waste receptacles.	
Special Requirements	Critical to isolate this space from Exhibit space and any Collections areas. May require coordination with NGO.	
Adjacencies/Location within Facility	Special Events Area, Restaurant/Cafe.	

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-27 Museum – Food Service Manager Office

Description / Usage	Food Service Manager Office.	
Ceiling Height	8 ft. (2.4m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with the addition of infrastructure for possible Non-NMCI data system connection.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding desking system, task lighting, ergonomic desk chair, side chairs, filing/storage, safe.	
Special Requirements	May require coordination with NGO.	
Adjacencies/Location within Facility	Food service area(s), Loading dock.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-28 Museum – Exhibit Production/Maintenance

Description / Usage	Exhibit Production/Maintenance. Space used to design, construct and maintain exhibits in-house.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Impact resistant wall protection panels to 4 ft. (1.2m) a.f.f. Epoxy paint (eggshell/satin) finish above.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Ch. 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of power panels and cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 5-25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equip.	Work tables, stools.	
Special Requirements	If exhibits are produced/maintained in-house, this area may include Tool Area, Sign & Framing Area, Lighting Area, Metal Shop, Project Assembly area, Dust Collection area (see individual FDS for these areas).	
Adjacencies/Location within Facility	Loading dock, Exhibit area.	

	For use during project execution by the appropriate Service	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table D-29 Museum – Exhibit Production Manager Office

Description / Usage	Exhibit Production Manager Office. Head of exhibit production shop.	
Ceiling Height	9 ft. (2.4m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding desking system, task lighting, ergonomic desk chair, side chairs, filing/storage.	
Special Requirements		
Adjacencies/Location within Facility	Exhibit Production/Maintenance, Loading dock.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-30 Museum – Metal Shop

Description / Usage	Metal Shop	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction /		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide emergency eyewash station.	
HVAC	Provide per Chapter 3. Verify during design if work such as grinding, sanding, painting and other process operations that generate dust and particulates that can become airborne or accumulate with heavy metals such as lead, hexavalent chromium, cadmium, and other hazardous residue operations is required. If so, metal shop and associated spaces and areas must comply with COMFRC Instruction 7500, and FRC Southeast Instruction 5103.15B. Includes critical areas. For critical areas, design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of power panels and cable reels.	
Lighting	Provide per Chapter 3 with the additions of 50 fc (500 lux) task, day lighting penetrations, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4

Acoustics		
Furnishings and Equipment	Workbenches.	
Special Requirements	This space may be included within Exhibit Production/Maintenance.	
Adjacencies/Location within Facility		
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-31 Museum – Lighting Shop

Description / Usage	Lighting Shop.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of power panels and cable reels.	
Lighting	Provide per Chapter 3 with the additions of 50 fc (500 lux) task, day lighting penetration and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	Work tables, stools.	
Special Requirements	This space may be included within Exhibit Production/Maintenance.	
Adjacencies/Location within Facility		
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-32 Museum – Design and Printing

Description / Usage	Design and Printing. Includes layout/design work area for production of graphics and exhibit design.	
Ceiling Height	9 ft. (2.7m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient or sealed concrete.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Work tables, stools.	
Special Requirements	Provide space for required graphics production equipment (scanners, large format printers, copiers, etc.). This space may be included within Exhibit Production/Maintenance.	
Adjacencies/Location within Facility	Exhibit Production/Maintenance.	

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-33 Museum – Tool Room

Description / Usage	Tool Room.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of power panels.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Workbenches, stools, tool storage cabinets.	
Special Requirements	This space may be included within Exhibit Production/Maintenance.	
Adjacencies/Location within Facility		
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-34 Museum – Sign and Framing Shop

Description / Usage	Sign and Framing Shop. Production of tile panels and framing for exhibits, gallery, etc.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide emergency eyewash station.	
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Provide snorkel type localized exhaust systems with articulating arms that can be adjusted and manually set to desired positions of users where required.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of power panels and cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 5-25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	Work tables, storage cabinets, stools/chairs.	
Special Requirements	This space may be included within Exhibit Production/Maintenance.	
Adjacencies/Location within Facility		

	For use during project execution by the appropriate Service	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table D-35 Museum – Project Assembly Shop

Description / Usage	Project Assembly Shop. Includes space for dust collector.	
Ceiling Height	9 ft. (2.7) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of power panels and cable reels.	
Lighting	Provide per Chapter 3 with the addtion of 50 fc (500 lux) task, day lighting penetrations, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	Work tables, stools, storage cabinets.	
Special Requirements	This space may be included within Exhibit Production/Maintenance.	
Adjacencies/Location within Facility		

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-36 Museum – Exhibit Production Storage

Description / Usage	Exhibit Production Storage. Storage for equipment and materials used to produce exhibits.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Shelving and storage cabinets, as required.	
Special Requirements		
Adjacencies/Location within Facility		

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-37 Museum – Collections Receiving

Description / Usage	Collections Receiving & Processing. For intake and processing of artifacts submitted to museum.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide a stainless steel sink with hot and cold water supply and a cleanout.	
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels	
Lighting	Provide per Chapter 3 with the additions of SL, 5-25 fc (50 - 250 lux) ambient and 75 fc (750 lux) task, dimmability, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	Flat work tables.	
Special Requirements		
Adjacencies/Location within Facility	Loading Dock.	

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-38 Museum – Archival Collections Processing

Description / Usage	Archival Collections Processing. Optional space. For intake and processing of archives submitted directly to museum.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4. Provide Very Early Warning Smoke Detection.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 - 25 fc, (50 to 250 lux) ambient and 75 fc (750 lux) task, dimmability, SL, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 + SIPRNet. Coordinate with the Certified Tempest Technical Authority (CTTA).
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	No cameras allowed with space.
Acoustics		
Furnishings and Equipment	Flat work tables (standing height).	
Special Requirements	Possibly Top Secret (classified materials). Restricted access. Separate from Collections Processing. Locate for control/isolation.	
Adjacencies/Location within Facility		

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-39 Museum – Holding and Staging Area

Description / Usage	Holding and Staging Area. Area to allow exhibit climatization.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - painted.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 5-25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Work tables, stools.	
Special Requirements		
Adjacencies/Location within Facility	Loading dock, Processing area.	

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-40 Museum – Curatorial Research Lab

Description / Usage	Curatorial Research Lab. Workspace where incoming objects are examined.	
Ceiling Height	9 ft. (2.7m) minimum	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment	Casework (stainless steel countertops) with base/wall cabinets.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient or sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide emergency shower/eyewash station. Provide one- or two-compartment stainless steel countertop sinks with hot and cold water supply and cleanouts. Provide emergency eyewash stations adjacent to sinks.	
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Provide snorkel type localized exhaust systems with articulating arms that can be adjusted and manually set to desired positions of users where required. Verify if fume hoods and ventilated safety cabinets are also required by the end user.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of power panels and cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 5-25 fc (50 to 250 lux) ambient and 75 fc (750 lux) task, dimmability, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.

Acoustics		
Furnishings and Equipment	Stainless steel work tables, stools.	
Special Requirements		
Adjacencies/Location within Facility	Archival Collections Processing.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-41 Museum – Artifact Storage (Clean Room)

Description / Usage	Artifact Storage (Clean Room)	
Ceiling Height	9 ft. (2.7m) clear minimum	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - painted.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Coordinate locations of temperature and humidity data loggers with end user.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4. Provide very early warning smoke detection.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with addition of SL, 1 fc (10 lux) ambient and 75 fc (750 lux) task, dimmability, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Work tables and shelving, as required.	
Special Requirements		
Adjacencies/Location within Facility	Collections Storage.	

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-42 Museum – Building Manager Office

Description / Usage	Building Manager Office. Facilities management space.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding desking system, task lighting, ergonomic desk chair, side chairs, filing/storage.	
Special Requirements		
Adjacencies/Location within Facility	Loading dock.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-43 Museum – Building Management Storage

Description / Usage	Building Management Storage. Used to store surplus building products/supplies such as light bulbs, cleaning and paper products.	
Ceiling Height	8 ft. (2.4m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Storage cabinets and shelving.	
Special Requirements		
Adjacencies/Location within Facility	Building Manager Office, Loading dock.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-44 Museum – Janitorial Space

Description / Usage	Janitorial Space. Space for custodial supplies and equipment.	
Ceiling Height	8 ft. (2.4m) clear mininum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	Include mop/broom rack, utility shelf.	
Finishes	**Walls**	Ceramic tile wainscot (4 ft. (1.2m) high) or fiber-reinforced or rigid vinyl panel wall protection wainscot (4 ft. (1.2m) high). Epoxy paint - semi-gloss finish above.
	Floor	Porcelain tile or sealed concrete.
	Base	Ceramic tile.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide a mop sink and keyed hose bibb.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Storage cabinet (optional).	
Special Requirements		
Adjacencies/Location within Facility	Restrooms, Public areas.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-45 Museum – Break Room - Building Staff

Description / Usage	Break Room - Building Staff. Provide separate break room for each group that must accommodate three-personnel rotations to include: 1) Security/Guard Forces 2) Building Management Group.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Casework with base/wall cabinets, television wall-mount bracket, lockers.	
Finishes	**Walls**	Paint - eggshell/satin finish. Full-height ceramic tile at shower/wet areas. Water resistant GWB at wet areas.
	Floor	Resilient (linoleum, luxury vinyl tile or plank). Porcelain tile at shower floor/base and wet area.
	Base	Resilient. Porcelain tile.
	Ceiling	ACT. Painted GWB.
Plumbing	Provide per Chapter 3. Provide a stainless steel sink with hot and cold water supply and a cleanout. Provide a water connection for icemaker at refrigerator. Provide a floor drain at shower(s).	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Tables and chairs, countertop microwave, refrigerator, coffee machine, television, recycling containers.	
Special Requirements	Provide separate shower room for shift workers. Provide area for recycling containers and vending machines.	
Adjacencies/Location within Facility	Locate near personnel areas supported.	

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-46 Museum – Elevators

Description / Usage	Elevators. Elevator meeting all IBC requirements at each floor.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Stainless steel or plastic laminate panels.
	Floor	Hard surface (stone/porcelain tile, etc.) or resilient. Continue adjacent space floor finish.
	Base	Stainless steel.
	Ceiling	Panels as offered by elevator manufacturer.
Plumbing	Provide per Chapter 3.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of 5 fc (50 lux) ambient.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Lobby.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-47 Museum – Elevator Machine Room

Description / Usage	Elevator Machine Room.	
Ceiling Height	8 ft. (2.4m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Adjacent to Elevator(s).	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-48 Museum – Electrical Room

Description / Usage	Electrical Room. Room to house electrical panels and equipment.	
Ceiling Height	8 ft. (2.4m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Mechanical room, Service entry, Facility maintenance office.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-49 Museum – Telecom Room

Description / Usage	Telecommunications/Server Room. Room to house communications distribution.	
Ceiling Height	8 ft. (2.4m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of 50 fc (500 lux) per UFC 3-580-01, Telecommunications Building Cabling Systems Planning and Design.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	ESS Closet	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-50 Museum – ESS Closet

Description / Usage	Electronic Security Systems (ESS) Closet. Room to house electronic security system equipment.	
Ceiling Height	8 ft. (2.4m) clear minimum	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Telecom Room	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-51 Museum – Mechanical Rooms

Description / Usage	Mechanical Rooms. Room housing HVAC equipment.	
Ceiling Height	8 ft. (2.4m) clear minimum	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed - painted.
Plumbing	Provide per Chapter 3.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Electrical room, Service entry, Facility Maintenance office.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-52 Museum – Stairwells

Description / Usage	Stairwells	
Ceiling Height	Exposed.	
Windows		
Doors	Fire-rated as required.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient stair system (treads, risers, platforms, etc.).
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements	Locate per Life Safety requirements. Consider use of monumental stair in lobby or public gathering space - finishes to continue or complement lobby finishes.	
Adjacencies/Location within Facility	Lobby, Public Gathering.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-53 Museum – Loading Dock(s)

Description / Usage	Loading Dock(s). Area for shipping/receiving as well as building waste removal.	
Ceiling Height	Varies.	
Windows		
Doors	Minimum 8 ft. (2.4m) wide x 8 ft. (2.4m) high coiling overhead door. Size may vary depending on objects entering the facility. Provide personnel door.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	High Performance Architectural Coating (HIPAC). Service corridors leading to loading dock to receive impact resistant wallcovering wainscot (4 ft. (1.2m) high) with HIPAC above wainscot.
	Floor	Sealed concrete.
	Base	None. Service corridors to receive resilient base.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. If restroom is required in this area by end user, verify if shower is also required.	
HVAC	Provide per Chapter 3. If loading dock is enclosed, provide a unit heater or infrared heater at the entrance of the loading dock, and a vehicle exhaust removal system for trucks.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of 10 fc (100 lux) and photocell controlled exterior lights.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements	Lifts may be stored in this space. Optional: flash freezer for decontamination.	
Adjacencies/Location within Facility	Service entry, Exhibit maintenance and collection storage/holding.	

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-54 Museum – Shipping and Receiving

Description / Usage	Shipping & Receiving. Secure staging area for crating and uncrating of exhibits and objects.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	8 ft. (2.4m) wide x 8 ft. (2.4m) high rolling coil door. Size may vary depending on objects entering the facility.	
Interior Construction / Built-In Equipment	Staff mailboxes.	
Finishes	**Walls**	Impact resistant wallcovering wainscot (4 ft. (1.2m) high), epoxy paint (eggshell/satin finish) above.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - painted.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 5-25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Packing tables, stools, storage cabinets.	
Special Requirements		
Adjacencies/Location within Facility	Loading Dock	

	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table D-55 Museum – Equipment Storage

Description / Usage	Equipment Storage. Storage for forklift, pallet jacks, carts, etc.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Minimum 8 ft. (2.4m) wide x 8 ft. (2.4m) high coiling overhead door.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Loading dock.	
	For use during project execution by the appropriate Service	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

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APPENDIX E HRF FUNCTIONAL DATA SHEETS

This appendix further identifies specific design needs for individual spaces within Historic Resource Facilities. Building design criteria are provided in a standard Functional Data Sheet (FDS) table format that generally follows the Uniformat II/Work Breakdown Structure (WBS). The Interior Construction/Built-In Equipment category includes anything physically attached or plumbed to the building such as counters, cabinets, casework, toilet accessories, window shades or blinds, and recessed projection screens. The Furnishings and Equipment category includes loose or moveable items such as desks, chairs, and shelving.

The Functional Data Sheets are presented as a guide for the designer, planner, or RFP preparer. It is intended that the information in them are the minimum requirements for the respective rooms and spaces. These minimum requirements apply in addition to all other requirements of this FC and other referenced documents. In the event of a mutually exclusive conflict or where both requirements cannot be satisfied, the Functional Data Sheets take precedence. However, if in the best judgment of the designer, a more restrictive requirement is appropriate, the more restrictive requirement may be applied after consulting with the user. Note that blank spaces found in the Functional Data Sheets indicate building components or systems should follow standard guidance per UFC 1-200-01, *General Building Requirements*.

Table E-1 HRF – Archives and Library – Unclassified Research Room

Description / Usage	Archives & Library - Unclassified Research Room. General research space where the public can review unclassified archive and library collections.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint- eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 fc (50 lux) ambient and 50 fc (500 lux) task, multi-level switching, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Work tables, chairs, task lighting, microform readers, shelving as required.	
Special Requirements	This space can be shared by Archives & Library. Note that some microform readers are floor mounted and require a significant footprint.	
Adjacencies/Location within Facility	Library - Restricted Research; Archives - Administrative Spaces.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-2 HRF – Archives – Reception Area

Description / Usage	Archives - Reception Area	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of an avg. of 50 fc (500 lux) ambient and daylighting with dimmable controls.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	Provide per Chapter 3.
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Reception workstation, side chairs for waiting, file cabinets and storage as required. May include personal lockers for storage of visitor items.	
Special Requirements	Visitor personal effects must be collected/stored. Provide area for printers, as required. Provide window between Reception and Archives and Library - Unclassified Research Room.	
Adjacencies/Location within Facility	Archives - Offices, Archives - Research areas.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-3 HRF – Archives – Office Space

Description / Usage	Archives - Office Space. To include conference space, if required.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Workstations, ergonomic task chairs, task lighting, side chairs, filing and storage.	
Special Requirements	Centrally locate within Archives area. Include space for required copier, printers, scanners and any common storage requirements. Provide private office space for supervisors to meet FOIA requirements.	
Adjacencies/Location within Facility	Archives - Storage areas, Archives - Reception Area, Archives - Research areas.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-4 HRF – Archives – Break Room

Description / Usage	Archives - Break Room	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Casework with base/wall cabinets.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing	Provide per Chapter 3. Provide a stainless steel sink with hot and cold water supply and a cleanout. Provide a water connection for icemaker at refrigerator.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with addition of daylighting and dimming controls.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Tables and chairs, countertop microwave, refrigerator, coffee machine, recycling containers.	
Special Requirements	Provide area for recycling containers.	
Adjacencies/Location within Facility	Archives Office spaces.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-5 HRF – Archives – Classified Research

Description / Usage	Archives - Classified Research. Top Secret research space where the classified documents can be viewed.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 15 fc (150 lux) ambient, 30 fc (300 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with the addition of SIPRNET. Coordinate with the Certified Tempest Technical Authority (CTTA).
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	No cameras allowed within space.
Acoustics		
Furnishings and Equipment	Storage cabinets and shelving, as required. Work tables, chairs. Microform readers.	
Special Requirements	Top Secret space - locate within boundaries of Top Secret/Open Storage area. Provide SIPRnet. Provide in accordance with SECNAV M-5510.36, Department of the Navy Information Security Program.	
Adjacencies/Location within Facility	Near Archives - Admin. Space.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-6 HRF – Archives – Declassification

Description / Usage	Archives - Declassification Room. Classified workspace for team review of documents to determine classification status.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 15 fc (150 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	No cameras allowed within space.
Acoustics		
Furnishings and Equipment	Workstations, ergonomic task chairs, task lighting, microform readers.	
Special Requirements	Locate within boundaries of Top Secret/Open Storage area.	
Adjacencies/Location within Facility	Near Archives - Storage Areas.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-7 HRF - Archives - Classified Cold Storage

Description / Usage	Archives - Classified Cold Storage. Space for storage of classified archives to include negatives, photos, motion picture, micorforms and audio recording items.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	High density mobile storage, as required.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Concrete with epoxy coating. Provide per Chapter 4.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. For storage of color photos, design to 34 deg F (1.1 deg C) dry bulb and 35% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 32 deg F (0 deg C) to 36 deg F (2.2 deg C) and 32% RH to 38% RH for indoor cooling and heating conditions. For storage of color motion picture film, design to 38 deg F (3.3 deg C) and 30% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 36 deg F (2.2 deg C) to 40 deg F (4.4 deg C) and 27% RH to 33% RH for indoor cooling and heating conditions. For storage of black and white motion picture film and audio recording items, design to 52 deg F (11.1 deg C) and 30% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 50 deg F (10 deg C) to 54 deg F (12.2 deg C) and 27% RH to 33% RH for indoor cooling and heating conditions. If personnel will be working on color photos and color motion picture film, provide a holding area for these items to acclimate prior to personnel handling them. Design holding area for color photos to 55 deg F (12.8 deg C) and 35% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 53 deg F (11.7 deg C) to 57 deg F (13.9 deg C) and 32% RH to 38% RH for indoor cooling and heating conditions. Design holding area for color motion picture film to 50 deg F (10 deg C) and 30% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 48 deg F (8.9 deg C) to 52 deg F (11.1 deg C) and 27% RH to 33% RH for indoor cooling and heating conditions. For storage of black and white photos, negatives, and slides, design to 62 deg F (16.7 deg C) dry bulb and 35% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 60 deg F (15.6 deg C) to 64 deg F (17.8 deg C) and 32% RH to 38% RH for indoor cooling and heating conditions. Verify and coordinate with user if microclimate/microenvironment is desired and/or recommended to satisfy these conditions.	

Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3. Coordinate requirements for Emergency Power.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 fc (50 lux) ambient and 30 fc (300 lux) task, multi-level switching, and occupancy sensors.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Storage cabinets/shelves - consider use of wire shelving to promote air circulation and inhibit condensation. Microform storage cabinets with 6 inch (152mm) drawers.	
Special Requirements	Restricted access.	
Adjacencies/Location within Facility	Archives - Classified Storage, Archives - Unclassified Cold Storage.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-8 HRF – Archives - Unclassified Cold Storage

Description / Usage	Archives - Unclassified Cold Storage. Space for storage of unclassified archives to include negatives, photos, motion picture, microforms and audio recording items.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	High density mobile shelving, as required.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Concrete with epoxy coating. Provide per Chapter 4.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. For storage of color photos, design to 34 deg F (1.1 deg C) dry bulb and 35% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 32 deg F (0 deg C) to 36 deg F (2.2 deg C) and 32% RH to 38% RH for indoor cooling and heating conditions. For storage of color motion picture film, design to 38 deg F (3.3 deg C) and 30% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 36 deg F (2.2 deg C) to 40 deg F (4.4 deg C) and 27% RH to 33% RH for indoor cooling and heating conditions. For storage of black and white motion picture film and audio recording items, design to 52 deg F (11.1 deg C) and 30% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 50 deg F (10 deg C) to 54 deg F (12.2 deg C) and 27% RH to 33% RH for indoor cooling and heating conditions. If personnel will be working on color photos and color motion picture film, provide a holding area for these items to acclimate prior to personnel handling them. Design holding area for color photos to 55 deg F (12.8 deg C) and 35% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 53 deg F (11.7 deg C) to 57 deg F (13.9 deg C) and 32% RH to 38% RH for indoor cooling and heating conditions. Design holding area for color motion picture film to 50 deg F (10 deg C) and 30% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 48 deg F (8.9 deg C) to 52 deg F (11.1 deg C) and 27% RH to 33% RH for indoor cooling and heating conditions. For storage of black and white photos, negatives, and slides, design to 62 deg F (16.7 deg C) dry bulb and 35% RH for indoor design cooling and indoor design heating conditions. Temperature and relative humidity operating ranges must be 60 deg F (15.6 deg C) to 64 deg F (17.8 deg C) and 32% RH to 38% RH for indoor cooling and heating conditions. Verify and coordinate with user if microclimate/microenvironment is desired and/or recommended to satisfy these conditions.	

Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 fc (50 lux) ambient and 30 fc (300 lux) task, multi-level switching, and occupancy sensors.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Storage cabinets and shelving, as required. Microform storage cabinets with 6 inch (152mm) drawers - to support Library & Archives. Consider use of wire shelving to promote air circulation and inhibit condensation.	
Special Requirements	Restricted access.	
Adjacencies/Location within Facility	Archives - Classified Cold Storage, Archives - Unclassified Storage	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-9 HRF – Archives – Unclassified Storage

Description / Usage	Archives - Unclassified Storage.	
Ceiling Height	10 ft. (3.0m) minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment	High-density mobile shelving.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Concrete with epoxy coating. Provide per Chapter 4.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 45% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 40% RH to 50% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 15 fc (150 lux) ambient and 30 fc (300 lux) task, multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Work table, chairs, oversize cases, map files/cases, microform readers.	
Special Requirements	Note that some microform readers are floor mounted and require a significant footprint.	
Adjacencies/Location within Facility	Archives - Classified Processing; Archives - Classified Storage.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-10 HRF – Archives – Classified Storage

Description / Usage	Archives - Classified Storage. Top Secret/Open Storage space.	
Ceiling Height	10 ft. (3.0m) minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment	High-density mobile shelving.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Concrete with epoxy coating. Provide per Chapter 4.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 45% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 40% RH to 50% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 15 fc (150 lux) ambient, 30 fc (300 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with the addition of SIPRNET. Coordinate with the Certified Tempest Technical Authority (CTTA).
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	No cameras allowed withn space.
Acoustics		
Furnishings and Equipment	Storage cabinets and shelving, as required. Map files. Oversize shelving.	
Special Requirements	Locate within Top Secret/Open Storage area. Provide in accordance with SECNAV M-5510.36, Department of the Navy Information Security Program.	
Adjacencies/Location within Facility	Archives - Unclassified Storage; near Archives - Admin. Area.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-11 HRF – Archives – Secure Space

Description / Usage	Archives - Secure Space. Compartmented space to provide higher level of security storage.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Concrete with epoxy coating. Provide per Chapter 4.
	Base	Resilient.
	Ceiling	Painted GWB - eggshell/satin finish.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 45% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 40% RH to 50% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 15 fc (150 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapters 3 and 4 with the addition of SIPRNET and JWICS. Coordinate with the Certified Tempest Technical Authority (CTTA).
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	No cameras allowed within space.
Acoustics		
Furnishings and Equipment	Work tables, chairs, storage cabinets and shelving as required.	
Special Requirements	Refer to UFC 4-010-05, Sensitive Compartmented Information Facilities Planning, Design, and Construction, JWICS	
Adjacencies/Location within Facility	Locate within Top Secret/Open Storage area, Locate within Archives - Classified Storage.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-12 HRF – Archives – Classified Processing

Description / Usage	Archives - Classified Processing. Space where archives are reviewed and classification status is determined for storage.	
Ceiling Height	10 ft. (3.0m) minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Concrete with epoxy coating. Provide per Chapter 4.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 68 deg F (20 deg C) dry bulb and 45% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 40% RH to 50% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 fc (50 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	No cameras allowed within space.
Acoustics		
Furnishings and Equipment	Work tables, stools, shelving as required.	
Special Requirements	Locate within boundaries of Top Secret/Open Storage area. Strict supervision and restricted access.	
Adjacencies/Location within Facility	Archives - Classified Receiving; Archives - Decontamination; Archives - Storage Areas.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-13 HRF – Archives - Decontamination Room

Description / Usage	Archives - Decontamination Room. Classified space for isolation of incoming archival materials which may contain mold and/or pest infestation.	
Ceiling Height	10 ft. (3.0m) minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Concrete with epoxy coating. Provide per Chapter 4.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, bi-level or multi-level switching. and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	No cameras allowed within space.
Acoustics		
Furnishings and Equipment	Large work tables, stools, hazardous material containers, as required.	
Special Requirements	Locate within boundaries of Top Secret/Open Storage area. Strict supervision and restricted access.	
Adjacencies/Location within Facility	Archives - Classified Receiving; Archives - Classified Processing.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-14 HRF – Archives - Classified Receiving

Description / Usage	Archives - Classified Receiving. Top Secret/Open Storage. Receiving and processing area for classified materials.	
Ceiling Height	10 ft. (3.0m) minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Concrete with epoxy coating. Provide per Chapter 4.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 68 deg F (20 deg C) dry bulb and 45% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 40% RH to 50% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 fc (50 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	No cameras allowed within space.
Acoustics		
Furnishings and Equipment	Work tables, ergonomic task chairs, side chairs, book trucks/carts, shelving, microform readers.	
Special Requirements	Locate within boundaries of Top Secret/Open Storage area. Strict supervision and restricted access.	
Adjacencies/Location within Facility	Archives - Classified Processing, Archives - Unclassified Storage, Archives - Decontamination Room, Loading Dock.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-15 HRF – Library – Office Space

Description / Usage	Library - Office Space	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Desks/workstations, ergonomic task chairs, task lighting, file and storage cabinets, shelving.	
Special Requirements	Provide area for copier and printers. Cataloging offices require larger space to accommodate equipment (carts, tables).	
Adjacencies/Location within Facility	Library - Book Stacks, Library - Reference/Circulation, Library - Reading Rooms for supervision.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-16 HRF – Library – Reference/Circulation Desk

Description / Usage	Library - Reference/Circulation Desk. Main point of customer service interaction. Includes check-out area.	
Ceiling Height	10 ft. (3.0m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Tackboards.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 68 deg F (20 deg C) dry bulb and 42% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 40% RH to 45% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of 5 fc (50 lux) ambient, 50 fc (500 lux) task, daylighting with dimmability, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Circulation desk components, book carts/trucks, work tables, chairs, carrels, task lighting, dictionary stand, mobile storage system (as required). Provide lockers for researchers' personal items.	
Special Requirements	Reference UFC 4-740-20, Libraries, during space design. Circulation desk should have visual access into entire library space.	
Adjacencies/Location within Facility	Main Entry, Library - Book Stacks, Archives & Library - Unclassified Research Room.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-17 HRF – Library – Catalog Area

Description / Usage	Library - Catalog Area. Accessible computer terminal areas with library material database processing and entry. Area can be located within Library office space.	
Ceiling Height	10 ft. (3.0m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 68 deg F (20 deg C) dry bulb and 42% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 40% RH to 45% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of 30 fc (300 lux) ambient, 50 fc (500 lux) task, daylighting with dimmability, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Carrels for computer terminals, work tables, seating, task lighting.	
Special Requirements	Refer to UFC 4-740-20, Libraries.	
Adjacencies/Location within Facility	Library - Reference/Circulation desk, Library - Book Stack Area.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-18 HRF – Library – Book Stack Area

Description / Usage	Library - Book Stack Area.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows	No windows.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 42% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 40% RH to 45% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addtion of mobile stacks AFCI protected.	
Lighting	Provide per Chapter 3 with the addition of 30 fc (300 lux) ambient and occupancy sensors. Coordinate lighting layout (perpendicular) with stacks.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Book stacks, reference tables, carrels.	
Special Requirements	Reference UFC 4-740-20, Libraries, during space design.	
Adjacencies/Location within Facility	Library - Reference/Circulation Desk, Library - Catalog Area.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-19 HRF – Library – Special and Rare Collection

Description / Usage	Library - Special & Rare Collection. Storage of special collection books and manuscripts.	
Ceiling Height	10 ft. (3.0m) minimum.	
Windows	No windows.	
Doors		
Interior Construction / Built-In Equipment	High-density mobile shelving.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 62 deg F (16.7 deg C) dry bulb and 42% RH for indoor design cooling conditions, and 60 deg F (15.6 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 60 deg F (15.6 deg C) to 64 deg F (17.8 deg C) and 40% RH to 45% RH for indoor cooling conditions, and 58 deg F (14.4 deg C) to 62 deg F (16.7 deg C) and 37% RH to 45% RH for indoor heating conditions. Coordinate locations of temperature and humidity data loggers with end user.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 fc (50 lux) ambient and 30 fc (300 lux) task, multi-level switching, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Reference work tables for processing, chairs, flat files, compact storage shelving (as required).	
Special Requirements	Restricted access. Provide storage for oversize book collection. Vault construction.	
Adjacencies/Location within Facility	Library - Restricted Research Room; Library - Reference/Circulation Desk.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-20 HRF – Library – Restricted Research Room

Description / Usage	Library - Restricted Research Room. Space for visitors to reference special and rare collection materials.	
Ceiling Height	10 ft. (3.0m) minimum.	
Windows	No windows.	
Doors		
Interior Construction / Built-In Equipment	Provide interior windows for viewing/supervision of space from Reference/Circulation.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 42% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 40% RH to 45% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, bi-level or multi-level switching. and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Display case, work tables, chairs, storage shelving.	
Special Requirements	Refer to UFC 4-740-20, Libraries. Restricted access with controlled entry/locks.	
Adjacencies/Location within Facility	Library - Reference/Circulation, Library - Special and Rare Collection.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-21 HRF – Histories – Office Space

Description / Usage	Histories - Office Space	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Desks/workstations, ergonomic task chairs, task lighting, file cabinets/shelving, bookshelves.	
Special Requirements	Provide area for copier and printers.	
Adjacencies/Location within Facility	Library, Archives	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-22 HRF – Histories – Conference Room

Description / Usage	Histories & Archives - Conference Room. This room may be shared by Histories and Archives groupings.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Recessed projection screen, projector mount. Visual display system - whiteboards, tackboards.	
Finishes	**Walls**	Paint - eggshell/satin finish. Optional finish treatments (wood wainscott, acoustical wall panels, etc.).
	Floor	Carpet tile.
	Base	Resilient or wood.
	Ceiling	ACT. Could introduce GWB soffits for interest.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with addition of daylighting and dimming controls.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	
Acoustics	NIC 50	
Furnishings and Equipment	Conference table, chairs (around table and stacking for additional capacity), lecturn, storage credenza, mobile flipchart easel.	
Special Requirements		
Adjacencies/Location within Facility	Histories and Archives office areas.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-23 HRF – Histories – Microform Area

Description / Usage	Histories - Microform Area. Darkened space for storing and viewing microforms..	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 40% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 37% RH to 45% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 7.5 fc (75 lux) ambient, 30 fc (300 lux) task, occupancy sensors and bi-level or multi-level switching or dimmable controls.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Worktables, chairs, microform storage cabinets, task lighting, microform readers.	
Special Requirements	Note that some microform readers are floor mounted and require a significant footprint.	
Adjacencies/Location within Facility	Histories- Office Space.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-24 HRF – Histories – Storage Room

Description / Usage	Histories - Storage Room. Central filing space.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with vacancy sensor.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Work table, chairs, file/storage cabinets, as required.	
Special Requirements		
Adjacencies/Location within Facility	Histories - Office Space	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-25 HRF – Histories – Oral History Room

Description / Usage	Histories - Oral History Room. Space for recording unclassified interviews.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	Soundproof construction.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3. Where individual sound-proof recording booths are required, provide a fire alarm system notification appliance (speaker/strobe) for each booth.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 15 fc (150 lux) ambient and 50 fc (500 lux) task, multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with addition of SIPRNET and infrastructure for Video teleconferencing hookup for conferencing purposes. Coordinate with the Certified Tempest Technical Authority (CTTA).
	CATV	
Security	**IDS**	Yes.
	ACS	Yes.
	CCTV	
Acoustics	NC 50.	
Furnishings and Equipment	Work tables, chairs, storage shelves.	
Special Requirements	Provide VTC capability.	
Adjacencies/Location within Facility	Histories - Office Area.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-26 HRF – Histories – Classified Oral History Room

Description / Usage	Histories - Classified Oral History Room. Space for recording classified interviews.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	No windows.	
Doors		
Interior Construction / Built-In Equipment	Soundproof construction.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, bi-level or multi-level switching. and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with addition of SIPRNET and infrastructure for Video teleconferencing hookup for conferencing purposes. Coordinate with the Certified Tempest Technical Authority (CTTA).
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Work tables, chairs, storage shelves.	
Special Requirements	Classified space. Restricted access - locate within boundaries of Top Secret/Open Storage area. Provide VTC capability.	
Adjacencies/Location within Facility	Histories - Office Area.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-27 HRF – Histories – Classified Office Space

Description / Usage	Histories - Classified Office Space. Classified space.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	No windows due to security requirements.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 - 25 fc, (50 to 250 lux) ambient and 75 fc (750 lux) task, dimmability, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with the addition of SIPRNET. Coordinate with the Certified Tempest Technical Authority (CTTA).
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	No cameras allowed within space.
Acoustics		
Furnishings and Equipment	Desks/workstations, ergonomic task chairs, task lighting, file cabinets/shelving, bookshelves.	
Special Requirements	Restricted access - locate within boundaries of Top Secret/Open Storage area. Provide area for copier and printers.	
Adjacencies/Location within Facility	Histories - Office Space.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-28 HRF – Artifact – Office Space

Description / Usage	Artifact - Office Space. Include Curators, Materials Handlers, Materials Techs, Supervisory Curator. Can be combined with Artifact - Processing.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile, if not located within another space.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Workstations, ergonomic task chairs, task lighting, side chairs, filing and storage.	
Special Requirements	Provide area for associated printers and copier.	
Adjacencies/Location within Facility	Shipping/Receiving, Loading Dock, Artifact - Processing, Artifact - Storage.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-29 HRF – Artifact – Conference Room

Description / Usage	Artifact - Conference Room. Staff meetings, presentations, and training.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows	Provide, if possible, for exterior views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Recessed projection screen; projector mount. Visual display system - whiteboards, tackboards, etc.	
Finishes	**Walls**	Paint (eggshell or satin finish). Optional finish treatments (wood wainscott, acoustical wall panels, etc.) could be introduced.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT. Could introduce GWB soffits for interest.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with addition of infrastructure for Video teleconferencing hookup for training purposes.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Conference table, chairs (around table and stacking for additonal capacity), lecturn, storage credenza, mobile flipchart easel.	
Special Requirements	Consider VideoTeleconferencing (VTC)	
Adjacencies/Location within Facility	Artifact - Office Space.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-30 HRF – Artifact – Record Storage

Description / Usage	Artifact - Record Storage	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors	Pair - standard doors.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	File cabinets and storage cabinets, as required.	
Special Requirements		
Adjacencies/Location within Facility	Artifact - Processing, Artifact - Office Space, Artifact - Loan Artifact Processing.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-31 HRF – Artifact – Technical Library

Description / Usage	Artifact - Technical Library. Internal research area.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 15 fc (150 lux) ambient and 50 fc (500 lux) task, multi-level switching. Coordinate lighting layout (perpendicular) with stacks.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	No cameras allowed in space.
Acoustics		
Furnishings and Equipment	Shelving, work tables, chairs.	
Special Requirements	Scanner.	
Adjacencies/Location within Facility	Artifact - Office Space.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-32 HRF – Artifact – Conservation Area

Description / Usage	Artifact - Conservation Area. Include lab and storage space.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment	Casework (as required), stainless steel tops with base/wall cabinets.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide emergency shower/eyewash station. Provide stainless steel industrial trough sink with hot and cold water supply and cleanouts. Provide washing machine hook-up.	
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Provide snorkel type localized exhaust systems with articulating arms that can be adjusted and manually set to desired positions of users where required. Verify if fume hoods and ventilated safety cabinets are also required by the end user. Provide clothes dryer exhaust.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels, washer and dryer connections, and local power panels.	
Lighting	Provide per Chapter 3 with the addition of SL, 15 fc (150 lux) ambient and 75 fc (750 lux) task, dimmable controls, and occupancy sensors.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4

Acoustics		
Furnishings and Equipment	Work tables (stainless steel), storage cabinets and shelving, as required. Washer and dryer.	
Special Requirements	Locate away from archive storage areas.	
Adjacencies/Location within Facility	Artifact - Storage Areas.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-33 HRF - Artifact – Uniform and Textile Storage

Description / Usage	Artifact - Uniform and Textile Storage.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment	High-density mobile shelving.	
Finishes	**Objects -**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Coordinate locations of temperature and humidity data loggers with end user.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 fc (50 lux) ambient and 30 fc (300 lux) task, multi-level switching, and occupancy sensors.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4

Acoustics		
Furnishings and Equipment	Storage cabinets (with filter vents), flat files (flags), shelving as required.	
Special Requirements		
Adjacencies/Location within Facility	Artifact - Storage Areas; Artifact - Accessioning, Artifact - Decontamination.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-34 HRF – Artifact – Micro Artifact Storage

Description / Usage	Artifact - Micro Artifact Storage. Includes artifact processing area.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment	High-density mobile shelving, pallet racks.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 15 fc (150 lux) ambient and 30 fc (300 lux) task, multi-level switching, and occupancy sensors.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Storage cabinets and shelving, as required.	
Special Requirements		
Adjacencies/Location within Facility	Shipping/Receiving, Artifact - Accessioning, Artifact - Decontamination.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-35 HRF – Artifact – Processing Area

Description / Usage	Artifact - Processing Area. Space for processing artifacts that can be located with Artifact storage areas.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment	Casework with base/wall cabinets.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - painted.
Plumbing	Provide per Chapter 3. Provide a stainless steel sink with hot and cold water supply and a cleanout.	
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Provide fume hood.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the addition of SL, 15 fc (150 lux) ambient, 75 fc (750 lux) task, dimmable controls, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Yes.
	ACS	Yes.
	CCTV	
Acoustics		
Furnishings and Equipment	Work tables (stainless steel), shelving and storage cabinets, as required.	
Special Requirements	Scanner, Provide flammable storage cabinets as required.	
Adjacencies/Location within Facility	Located within larger Artifact storage spaces (both Micro and Macro).	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-36 HRF – Artifact – Macro Artifact Storage

Description / Usage	Artifact - Macro Artifact Storage. Includes macro artifact processing area.	
Ceiling Height	20 ft. (6.1m) clear minimum.	
Windows		
Doors	Overhead coiling door - 12 ft (3.7m) x 12 ft. (3.7m).	
Interior Construction / Built-In Equipment	Pallet racks for large artifact storage.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide stainless steel industrial trough sink with hot and cold water supply and cleanouts.	
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Coordinate with user on location of exhaust system for hazardous materials (i.e.; radium).	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the addition of SL, 15 fc (150 lux) ambient and 30 fc (300 lux) task, multi-level switching, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Storage cabinets and shelving, as required. Work tables, stools at Processing Area.	
Special Requirements		
Adjacencies/Location within Facility	Shipping/Receiving, Artifact - Accessioning, Artifact - Decontamination.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-37 HRF – Artifact – Cold Storage

Description / Usage	Artifact - Cold Storage	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to -25 deg F (-31.7 deg C) dry bulb for indoor design cooling and indoor design heating conditions. Temperature operating range must be -30 deg F (-34.4 deg C) to -20 deg F (-28.9 deg C) for indoor cooling and heating conditions. Verify and coordinate with user if microclimate/microenvironment is desired and/or recommended to satisfy these conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 fc (50 lux) ambient and 30 fc (300 lux) task, multi-level switching, and occupancy sensors.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	Storage cabinets and rack shelving, as required.	
Special Requirements		
Adjacencies/Location within Facility	Artifact - Accessioning, Artifact - Decontamination, Artifact - Storage Areas.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-38 HRF – Artifact - Classified Storage

Description / Usage	Artifact - Classified Storage.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment	Pallet racks and high-density mobile shelving, as required.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, bi-level or multi-level switching. and occupancy sensors.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapters 3 & 4.
	ACS	Provide per Chapters 3 & 4.
	CCTV	Provide per Chapters 3 & 4.
Acoustics		
Furnishings and Equipment	Storage cabinets, as required.	
Special Requirements	Restricted access. Provide open floor space for larger artifacts.	
Adjacencies/Location within Facility	Artifact - Storage Areas.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-39 HRF – Artifact – Weapons Storage

Description / Usage	Artifact - Weapons Storage. Historic weapons and inert ordinance storage vault.	
Ceiling Height	12 ft. (3.7 m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment	High-density mobile shelving, as required.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Coordinate locations of temperature and humidity data loggers with end user.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the addition of SL, 15 fc (150 lux) ambient and 30 fc (300 lux) task, multi-level switching, and occupancy sensors.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Weapons storage cabinets, as required. Work table. Provide open floor space for larger weapons.	
Special Requirements	Restricted access. Vault construction.	
Adjacencies/Location within Facility	Artifact - Weapons Work/Research Area.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-40 HRF – Artifact – Weapons Work/Research Area

Description / Usage	Artifact Collection - Weapons Work/Research Area. Space outfitted for maintainance of weapons.	
Ceiling Height	12 ft. (3.7 m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - painted.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Coordinate locations of temperature and humidity data loggers with end user. Provide fume hood.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the addition of SL, 15 fc (150 lux) ambient, 50 fc (500 lux) task, and multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Provide work station and storage for weapons specialist. Provide chemical/flammable storage cabinets, as required.	
Special Requirements	Provide cipher lock on entry door. Verify required security and construction level to meet the requirements of this space. Reference OPNAVINST 5530.13C	
Adjacencies/Location within Facility	Artifact - Weapons Storage.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-41 HRF – Artifact – Photo Room

Description / Usage	Artifact - Photo Room. Space for imaging documentation of objects.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Overhead coiling door - 10 ft (3.0m) x 10 ft. (3.0m).	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish (dark gray).
	Floor	Resilient or sealed concrete (dark gray).
	Base	Resilient (dark gray).
	Ceiling	Exposed structure - painted dark gray.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3. Provide dedicated power circuits required for photographic lighting.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 fc (50 lux) ambient, 50 fc (500 lux) task, and dimmable controls.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment		
Special Requirements	3-D scanner.	
Adjacencies/Location within Facility	Artifact - Storage Areas, Artifact - Loan Object Processing, Artifact - Accessioning/Decontamination.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-42 HRF – Artifact – Artifact Loan Processing

Description / Usage	Artifact - Artifact Loan Processing. Artifact receiving, cleaning and packing for loans.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 10 ft. (3.0m) high	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 42% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 40% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels and local power panels.	
Lighting	Provide per Chapter 3 with the addition of SL, 15 fc (150 lux) ambient and 75 fc (750 lux) task, dimmable controls, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	Work tables (stainless steel), stools, shelving and storage cabinets, as required.	
Special Requirements	Scanner.	
Adjacencies/Location within Facility	Artifact - Decontamination, Artifact - Accessioning, Artifact - Photo Room, Artifact - Storage Areas.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-43 HRF – Artifact – Decontamination Room

Description / Usage	Artifact - Decontamination Room. Room for isolation of incoming artifacts which may contain hazardous materials (i.e.; radium) and/or pest infestation.	
Ceiling Height	20 ft. (6.1m) clear minimum.	
Windows		
Doors	Overhead coiling door - 12 ft. (3.7m) x 12 ft. (3.7m)	
Interior Construction / Built-In Equipment	Pallet racks, as required.	
Finishes	**Walls**	Paint - eggshell/stain finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, bi-level or multi-level switching. and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Storage cabinets and shelving, as required. Large work tables, stools, hazaradous material containers, as required.	
Special Requirements		
Adjacencies/Location within Facility	Shipping/Receiving, Artifact - Storage Areas.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-44 HRF – Artifact – Accessioning Area

Description / Usage	Artifact - Accessioning Area. Holding area for incoming artifacts.	
Ceiling Height	15 ft. (4.6m) clear minimum.	
Windows		
Doors	Overhead coiling door - 12 ft (3.7m) x 12 ft (3.7m).	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - painted.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 42% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 40% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 15 fc (150 lux) ambient, 30 fc (300 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Large work tables, stools, filing, storage as required.	
Special Requirements		
Adjacencies/Location within Facility	Artifact - Storage Areas, Shipping/Receiving.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-45 HRF – Artifact – Workshop

Description / Usage	Artifact - Workshop. General work area to include mount making. OPTION: May include provision for paint spray booth for conservation, if required by exhibit designers.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. If paint spray booth is required, provide exhaust system for removal of fumes. Provide snorkel type localized exhaust systems with articulating arms that can be adjusted and manually set to desired positions of users where required for equipment below.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4. NFPA 30 as applicable.	
Power	Provide per Chapter 3 with the addition of cable reels and local power panels.	
Lighting	Provide per Chapter 3 with the addition of an avg. of 50 fc (500 lux) ambient, daylighting, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Miter saw, power and hand tools, workbench, stools.	
Special Requirements		
Adjacencies/Location within Facility	Artifact - Loan Processing, Shipping/Receiving.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-46 HRF – Artifact – Shipping/Receiving Room

Description / Usage	Artifact - Shipping/Receiving.	
Ceiling Height	20 ft. (6.1m) clear minimum.	
Windows		
Doors	Overhead coiling door - 12 ft (3.7m) x 12 ft. (3.7m).	
Interior Construction / Built-In Equipment	Pallet racks, as required.	
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of an avg. 30 fc (300 lux) ambient.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Work tables, stools. Shelving, as required.	
Special Requirements		
Adjacencies/Location within Facility	Artifact - Accessioning, Artifact - Storage Areas.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-47 HRF – Artifact – Equipment Storage

Description / Usage	Artifact - Equipment Storage Area. Storage for forklift, pallet jacks, carts, etc.	
Ceiling Height	15 ft. (4.6m) clear minimum.	
Windows		
Doors	Overhead coiling door - 12 ft. (3.7m) x 12 ft. (3.7m).	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Loading Dock.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-48 HRF – Artifact – Supply Storage

Description / Usage	Artifact - Supply Storage.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - painted.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Shelving and storage cabinets, as required.	
Special Requirements		
Adjacencies/Location within Facility	Artifact - Processing Areas, Artifact - Storage Areas, Artifact - Accessioning.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-49 HRF – Artifact – Exterior Storage Pad

Description / Usage	Artifact - Exterior Storage Pad. Covered area for larger macro artifact storage.	
Ceiling Height	Exposed - 20 ft (6.1m) clear minimum.	
Windows		
Doors	Provide personnel doors to Shipping/Receiving and Macro Artifact Storage area.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	
	Floor	Reinforced concrete slab for heavy objects.
	Base	
	Ceiling	
Plumbing	Provide per Chapter 3 and 4. Provide hose bibbs and drains. Provide freeze proof hydrants in lieu of hose bibbs where climate demands. Connect drains to separate chemical containment system that includes holding tank(s) for Underwater Archaeology.	
HVAC		
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of 0.6 fc (6 lux) and occupancy sensor with integrated photocell.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements	Provide truck access.	
Adjacencies/Location within Facility	Shipping/Receiving, Artifact - Macro Artifact Storage.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-50 HRF - Art – Office Space

Description / Usage	Art - Office Space. Open office area to accommodate Art staff and associated office functions. This space may be combined with Art - Processing Area. May include wall space for artwork display area associated with loan check-out.	
Ceiling Height	9 ft. (2.7m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 - 25 fc, (50 to 250 lux) ambient and 50 fc (750 lux) task, daylighting, dimmability, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Workstations, ergonomic task chairs, task lighting, side chairs, filing and storage.	
Special Requirements	Include space for required copier, printers, scanners and any common storage requirements.	
Adjacencies/Location within Facility	Art - Processing Area, Art - Storage, Near Shipping/Receiving.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-51 HRF – Art – Artist-in-Residence

Description / Usage	Art - Artist(s)-in-Residence. Space for Navy staff artist(s) to produce artwork.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows	Provide for views and daylighting necessary for art production.	
Doors		
Interior Construction / Built-In Equipment	Casework to include sink and base/wall cabinets for storage.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient or sealed concrete.
	Base	Resilient.
	Ceiling	ACT.
Plumbing	Provide per Chapter 3. Provide a stainless steel sink with hot and cold water supply and a cleanout.	
HVAC	Provide per Chapter 3. Verify if exhaust system is required for removal of potential fumes created in this space from paints and solvents.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 - 25 fc, (50 to 250 lux) ambient and 50 fc (500 lux) task, daylighting, dimmability, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Cabinets for art supply storage, work tables, stools, flammable locker, desk, ergonomic task chair, easel, task lighting.	
Special Requirements		
Adjacencies/Location within Facility	Art Gallery, Art - Office Space.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-52 HRF – Art – Break Area

Description / Usage	Art - Break Area. Space used for breaks and lunches. Includes kitchenette for storage, warming and minimal prep of food and area for seating/tables.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows	Provide, if possible, for exterior views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Casework to include sink and base/wall cabinets.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing	Provide per Chapter 3. Provide a stainless steel sink with hot and cold water supply and a cleanout. Provide a water connection for icemaker at refrigerator.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Refrigerator, countertop microwave, coffee maker, tables, chairs, recycling and trash containers.	
Special Requirements	Vending machines.	
Adjacencies/Location within Facility	Art - Office Space.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-53 HRF – Art – Framing Room

Description / Usage	Art - Framing Room. Space to fabricate and assemble frames.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide emergency eyewash station.	
HVAC	Provide per Chapter 3. Verify if exhaust system is required for removal of potential fumes created in this space from paints and solvents. Provide snorkel type localized exhaust systems with articulating arms that can be adjusted and manually set to desired positions of users where required for equipment below.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels and local power panels.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	Tables, stools, workbench, storage for moldings and other framing supplies, mitre saw, dry mount press, frame chopper.	
Special Requirements		
Adjacencies/Location within Facility	Artist-in-Residence, Shipping.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-54 HRF – Art – Processing Area

Description / Usage	Art - Processing Area	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - painted.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, bi-level or multi-level switching. and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	Large work tables, storage as required.	
Special Requirements	Provide space for digitizers and scanners, as required.	
Adjacencies/Location within Facility	Art - Storage, Art - Accessioning.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-55 HRF – Art – Accessioning Area

Description / Usage	Art - Accessioning Area. Intake area for artwork.	
Ceiling Height	12 ft. (3.7m) clear minimum to accommodate larger art.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, bi-level or multi-level switching. and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	Large work tables, filing, storage as required.	
Special Requirements		
Adjacencies/Location within Facility	Art - Processing, Loading Dock.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-56 HRF – Art – Storage

Description / Usage	Art - Storage. Storage space for artwork. May include wall space for artwork display area associated with loan check-out.	
Ceiling Height	12 ft. (3.7m) clear minimum	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment	Art storage units, if mobile high density system.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Coordinate locations of temperature and humidity data loggers with end user.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 30 fc (300 lux) task, and bi-level or multi-level switching. Provide display area lighting per chapter 4 museum exhibit requirements.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equip.	Art Storage Units, if freestanding. Flat files for unframed prints.	
Special Requirements	Mobile bin-type storage units or vertical hanging units. Provide varying bin sizes to accommodate varying artwork formats.	
Adjacencies/Location within Facility	Art - Processing, Loading Dock.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-57 HRF – Art – Secure Storage

Description / Usage	Art - Secure Storage. Locked secure space for designated artwork.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment	Art storage units, if mobile high-density system.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient and bi-level switching.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equipment	Art Storage Units, if freestanding. Flat files for unframed prints.	
Special Requirements	Mobile bin-type storage units or vertical hanging units. Provide varying bin sizes to accommodate varying artwork formats.	
Adjacencies/Location within Facility	Art - Storage.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-58 HRF – Art – Crate Storage

Description / Usage	Art - Crate Storage. Area for storage and assembly of crating materials.	
Ceiling Height	12 ft. (3.7m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft. - 6 inch (1.0m) wide x 10 ft. (3.0m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements	Approximate same size as Art - Storage.	
Adjacencies/Location within Facility	Shipping/Receiving, Loading Dock	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-59 HRF – UA – Office Space

Description / Usage	UA - Office Space. Open office area to accommodate UA staff and associated office functions. Includes reference area for document research.	
Ceiling Height	9 ft. (2.7m) minimum	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - egghsell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics	If adjacent to lab spaces, provide additional sound attenuation.	
Furnishings and Equipment	Workstations (intern and full-time staff), ergonomic task chairs, display cabinets for exhibits, files and storage cabinets as required. Research area - small work table/desk, locking document storage.	
Special Requirements	Provide space to accommodate required printers and copier. Incorporate research area.	
Adjacencies/Location within Facility	Entry, UA -Director Office, UA - Conference Room.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-60 HRF – UA – Director Office

Description / Usage	UA - Director Office.	
Ceiling Height	8 ft. (2.4m) clear minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Freestanding desking system, task lighting, ergonomic desk chair, side chairs, filing/storage.	
Special Requirements		
Adjacencies/Location within Facility	UA - Office Space, Conference Room.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-61 HRF – UA – Conference Room

Description / Usage	UA - Conference Room.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Recessed projection screen, projector mount. Visual display system - whiteboards, tackboards, etc. Map display rail.	
Finishes	**Walls**	Paint - eggshell/satin finish. Optional finish treatments (wood wainscott, acoustical wall panels, etc.).
	Floor	Carpet tile.
	Base	Resilient or wood.
	Ceiling	ACT. Could introduce GWB soffits for interest.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3 with addition of infrastructure for Video teleconferencing hookup for training purposes.
	CATV	Provide per Chapter 3.
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Conference table, chairs (around table and stacking for additional capacity), lectern, storage credenza, mobile flipchart easel.	
Special Requirements	Consider Video Teleconferencing (VTC).	
Adjacencies/Location within Facility	Entry, UA Office space, UA Director office.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-62 HRF – UA – Break Area

Description / Usage	UA - Break Area	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Provide, if possible, for views and daylighting.	
Doors		
Interior Construction / Built-In Equipment	Casework to include sink and base/wall cabinets.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing	Provide per Chapter 3. Provide a stainless steel sink with hot and cold water supply and a cleanout. Provide a water connection for icemaker at refrigerator.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Refrigerator, countertop microwave, coffee maker, tables, chairs, recycling and trash containers.	
Special Requirements	Provide space for vending machines, if required.	
Adjacencies/Location within Facility	UA - Office Space.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-63 HRF – UA – Secure Library

Description / Usage	UA - Secure Library. Management of plan storage for sensitive, unclassified materials.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with addition of SL, 15 fc (150 lux) ambient.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements	Restricted access.	
Adjacencies/Location within Facility	UA Office Space.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-64 HRF – UA – Map/Drafting/Archives Room

Description / Usage	UA - Map/Drafting/Archives Room. Area to read, plot, prepare and store maps.	
Ceiling Height	9 ft. (2.7m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Carpet tile or Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Workstation or tables, as required. Map table (standing height), flat files. Storage cabinets/shelving, as required.	
Special Requirements	Provide space to accommodate 3-D model production equipment, large plotter and scanner.	
Adjacencies/Location within Facility	UA - Office Space, UA - Director Office	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-65 HRF – UA – Collections Storage

Description / Usage	UA - Collections Storage.	
Ceiling Height	15 ft. (4.6m) clear minimum.	
Windows		
Doors	Overhead coiling door - 12 ft. (3.7m) x 12 ft. (3.7m).	
Interior Construction / Built-In Equipment	Overhead crane, pallet racks.	
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3 and 4. Provide emergency eyewash station(s). Provide floor drain that connects to separate chemical containment system that includes holding tank(s) for Underwater Archaeology.	
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 42% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 40% RH to 45% RH for indoor heating conditions. Coordinate with user on location of exhaust system for hazardous materials (i.e.; radium).	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 30 fc (300 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4
	ACS	Provide per Chapter 3 & 4
	CCTV	Provide per Chapter 3 & 4
Acoustics		
Furnishings and Equip.	Forklift.	
Special Requirements	Overhead crane.	
Adjacencies/Location within Facility	UA - Conservation Lab, UA - Field Equipment, UA - Dive Locker.	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-66 HRF – UA – Small Object Storage

Description / Usage	UA - Small Object Storage.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 70 deg F (21.1 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 42% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 68 deg F (20 deg C) to 72 deg F (22.2 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 40% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Shelving and storage cabinets, as required.	
Special Requirements		
Adjacencies/Location within Facility	Could be located within UA - Collections Storage.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-67 HRF – UA – Boat Storage

Description / Usage	UA - Boat Storage. Area used to store trailered boats.	
Ceiling Height	15 ft. (4.6m) clear minimum.	
Windows		
Doors	Provide personnel door to space.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide hose bibbs. Provide freeze-proof hydrants in lieu of hose bibbs where climate demands. Consider rainwater collection system.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of local power panels.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements	Smaller boat storage to be enclosed. Larger boats - provide exterior sheltered area for boats up to 30 ft (9.1m) long (including trailer).	
Adjacencies/Location within Facility	Exterior access.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-68 HRF – UA – Dive Locker and Remote Sensing Equipment

Description / Usage	UA - Dive Locker and Remote Sensing Equipment. Space for dive suits to hang and dry, storage of compressed dive tanks and remote sensing equipment.	
Ceiling Height	10 ft. (3.0 m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3 and 4. Provide compressed air system with air dryer. Coordinate locations of air drops with user. Verify if ceiling hung hose reels are required for compressed air system. Coordinate with user the location of the floor drain(s) for drying area of dive suits.	
HVAC	Provide per Chapter 3. Coordinate with user to provide required air circulation and 45% RH for indoor design cooling conditions, and 40% RH for indoor design heating conditions for drying area of dive suits. Relative humidity operating ranges must be 42% RH to 48% RH for indoor cooling conditions, and 37% RH to 43% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of 20 fc (200 lux) ambient, damp or wet label as appropriate, and occupancy sensors.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Scuba tank racks, as required.	
Special Requirements	Dive tanks storage. Exterior access required.	
Adjacencies/Location within Facility	UA - Collections Storage.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-69 HRF – UA – Field Equipment

Description / Usage	UA - Field Equipment. Storage area for equipment (generators, compressors, etc.).	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Epoxy paint - semi-gloss finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with vacancy sensor.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Storage cabinets.	
Special Requirements	Exterior access.	
Adjacencies/Location within Facility	UA - Dive Locker, UA - Conservation Lab, UA - Collection Storage.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-70 HRF – UA – Demonstration Laboratory

Description / Usage	UA - Demonstration Laboratory. Public viewing and demonstration space.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment	Casework (stainless steel tops) to include base/wall cabinets for storage. Provide viewing glass for spectators.	
Finishes	**Walls**	Epoxy paint - semi-gloss finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3 and 4. Provide emergency shower/eyewash station. Provide stainless steel industrial trough sink(s) with hot and cold water supply and cleanout. Provide emergency eyewash station adjacent to sink. Provide floor drains where required by user that connect to separate chemical containment system that includes holding tank(s) for Underwater Archaeology. Provide compressed air system with air dryer. Coordinate locations of air drops with user. Verify if ceiling hung hose reels are required for compressed air system.	
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb for indoor design cooling and indoor design heating conditions. Design to 50% RH for conserved organic materials, and to 30% RH for conserved metals. Temperature operating range must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) for indoor cooling and heating conditions. Relative humidity operating range must be 47% RH to 53% RH for conserved organic materials, and 27% RH to 33% RH for conserved metals.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of power panels and cable reels.	
Lighting	Provide per Chapter 3 with the addition of SL, 25 fc (250 lux) ambient, 100 fc (1000 lux) task and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	

Acoustics		
Furnishings and Equipment	Stainless steel work tables. Storage cabinets, as required.	
Special Requirements	Provide viewing glass between adjacent Conservation Lab and Administrative Space.	
Adjacencies/Location within Facility	UA - Conservation Lab, UA - Collection Storage, near entry.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-71 HRF – UA – Conservation Laboratory

Description / Usage	UA - Conservation Laboratory.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Overhead coiling door - 12 ft. (3.7m) x 12 ft. (3.7m) from Processing area.	
Interior Construction / Built-In Equipment	Overhead crane. Casework (stainless steel tops) to include base/wall cabinets for storage. Provide viewing glass for spectators.	
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3 and 4. Provide emergency shower/eyewash station. Provide stainless steel industrial trough sink(s) with hot and cold water supply and cleanouts. Provide emergency eyewash stations adjacent to sinks. Provide floor drains where required by user that connect to separate chemical containment system that includes holding tank(s) for Underwater Archaeology. Provide compressed air system with air dryer. Coordinate locations of air drops with user. Verify if ceiling hung hose reels are required for compressed air system.	
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb for indoor design cooling and indoor design heating conditions. Design to 50% RH for conserved organic materials, and to 30% RH for conserved metals. Temperature operating range must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) for indoor cooling and heating conditions. Relative humidity operating range must be 47% RH to 53% RH for conserved organic materials, and 27% RH to 33% RH for conserved metals. Provide fume hoods and/or ventilated safety cabinets as required by the end user.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the additions of cable reels and local power panels.	
Lighting	Provide per Chapter 3 with the addition of SL, 25 fc (250 lux) ambient and 75 fc (750 lux) task, dimmable controls, and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	

Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Stainless steel work tables (open shelf beneath), shelving and storage cabinets as required for tools/glassware, flammable storage cabinets, corrosive material storage cabinets, flat files, vacuum freeze dryer, large chest freezer, refrigerator, microscope (bench-mounted or freestanding), drying oven.	
Special Requirements	Provide deionized water supply. Overhead crane. Fume hood. Provide viewing glass between adjacent Demonstration Lab and Administrative Space.	
Adjacencies/Location within Facility	UA - X-Ray Room, UA - Cold Storage, UA - Collections Storage.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-72 HRF – UA – Photo Room

Description / Usage	UA - Photo Room.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish - dark gray.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint dark gray.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 fc (50 lux) ambient, 50 fc (500 lux) task, and dimmable controls.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements	Light stations, camera mounts.	
Adjacencies/Location within Facility	UA - Conservation Lab.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-73 HRF – UA – Cold Storage

Description / Usage	UA - Cold Storage	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to -25 deg F (-31.7 deg C) dry bulb for indoor design cooling and indoor design heating conditions. Temperature operating range must be -30 deg F (-34.4 deg C) to -20 deg F (-28.9 deg C) for indoor cooling and heating conditions. Verify and coordinate with user if microclimate/microenvironment is desired and/or recommended to satisfy these conditions.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of SL, 5 fc (50 lux) ambient and 30 fc (300 lux) task, multi-level switching, and occupancy sensors.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	UA -Conservation Lab, UA - X-Ray, Processing Area.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-74 HRF – UA – X-Ray Room

Description / Usage	UA - X-Ray Room	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of an avg. of 100 fc (1000 lux) ambient.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements	Provide space for x-ray machine.	
Adjacencies/Location within Facility	UA - Conservation Lab, UA - Cold Storage, Processing.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-75 HRF – UA – Chemical Storage

Description / Usage	UA - Chemical Storage.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Oversize - Pair 3 ft.- 6 inch (1.0m) wide x 8 ft. (2.4m) high.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Epoxy paint - semi-gloss finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3 and 4. Provide emergency eyewash station. Provide floor drain that connects to separate chemical containment system that includes holding tank(s) for Underwater Archaeology.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Flammable storage cabinets, corrosive cabinets, expended chemical storage.	
Special Requirements		
Adjacencies/Location within Facility	Exterior access (for deliveries), UA - Conservation Lab.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-76 HRF – UA – Outdoor Treatment Tanks and Equipment Storage

Description / Usage	UA - Outdoor Treatment Tanks and Equipment Storage. Covered, open area necessary for off-gassing of tanks and outdoor equipment storage (pallets, vats, etc.).	
Ceiling Height	15 ft. (4.6m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Exterior.
	Floor	Sealed concrete.
	Base	
	Ceiling	
Plumbing	Provide per Chapter 3 and 4. Provide drains and chemical spill containment for outdoor treatment tanks. Provide hose bibbs. Consider rainwater collection system (with associated hose bibbs). Provide freeze proof hydrants in lieu of hose bibbs where climate demands. Connect drains to separate chemical containment system that includes holding tank(s) for Underwater Archaeology. Provide compressed air system with air dryer. Coordinate locations of air drops with user.	
HVAC		
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of an avg. of 0.6 fc (6 lux) and occupancy sensors with integrated photocell.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements	Chemical spill containment area required.	
Adjacencies/Location within Facility	UA - Conservation Lab.	

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

Table E-77 HRF – UA – Object Receiving/Processing

Description / Usage	UA - Object Receiving/Processing. OPTION: May include provision for restroom/shower/changing area for decontamination of personnel and artifacts.	
Ceiling Height	15 ft. (4.6m) clear minimum.	
Windows		
Doors	Overhead coiling door - 12 ft. (3.7m) x 12 ft. (3.7m).	
Interior Construction / Built-In Equipment	Overhead crane.	
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3 and 4. Provide washing machine hook-up. Provide shower for personnel decontamination. Connect floor drain from shower to separate chemical containment system that includes holding tank(s) for Underwater Archaeology. Provide restroom in changing area.	
HVAC	Provide per Chapter 3. Critical area. Design to 72 deg F (22.2 deg C) dry bulb and 50% RH for indoor design cooling conditions, and 68 deg F (20 deg C) dry bulb and 40% RH for indoor design heating conditions. Temperature and relative humidity operating ranges must be 70 deg F (21.1 deg C) to 74 deg F (23.3 deg C) and 45% RH to 53% RH for indoor cooling conditions, and 66 deg F (18.9 deg C) to 70 deg F (21.1 deg C) and 37% RH to 45% RH for indoor heating conditions. Provide clothes dryer exhaust.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equip.	Work tables (stainless steel), stools. Forklift. Washer and dryer.	
Special Requirements	Provide shower area for personnel decontamination, if required.	
Adjacencies/Location within Facility	UA - Conservation Lab, Loading Dock	

	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-78 HRF – UA – Hazardous Material

Description / Usage	UA - Hazardous Material. Room for isolation of incoming artifacts which may contain hazardous materials (i.e.; radium).	
Ceiling Height	15 ft. (4.6m) clear minimum.	
Windows		
Doors	Overhead coiling door - 12 ft. (3.7m) x 12 ft. (3.7m)	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3 & 4.	
Power	Provide per Chapter 3 with the addition of cable reels.	
Lighting	Provide per Chapter 3 with the additions of SL, 5 - 25 fc (50 to 250 lux) ambient, 50 fc (500 lux) task, bi-level or multi-level switching. and occupancy sensors.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Storage cabinets and shelving, as required. Large work tables, stools, hazaradous material containers, as required.	
Special Requirements		
Adjacencies/Location within Facility	UA - Object Receiving/Processing, Loading Dock.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-79 HRF - Entries/Vestibule

Description / Usage	Entries/Vestibules. Provide optional employee entrances as required.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows	Consider storefront system for vision and daylighting into lobbies.	
Doors		
Interior Construction / Built-In Equipment	Provide recessed walk-off mat system. Bulletin boards.	
Finishes	**Walls**	Plaster or GWB - painted (exterior finishes could carry into vestibule).
	Floor	Hard surface (stone/porcelain tile).
	Base	Coordinate with floor finish and/or storefront system.
	Ceiling	Plaster or GWB - painted, decorative ceiling treatment.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3. Provide flush-mounted fire alarm/mass notification system remote annunciator and microphone station at main entrance vestibule.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of an avg. of 0.6 fc (6 lux) and photocell controlled.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment	Lockers (half-height), display cases.	
Special Requirements	Provide locker area for visitor item storage.	
Adjacencies/Location within Facility		
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-80 HRF – Public Restroom

Description / Usage	Public Restrooms. Men's and Women's toilet rooms.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	Sink vanities, toilet partitions, mirrors, toilet accessories.	
Finishes	**Walls**	Ceramic or porcelain tile (full-height). Provide water-resistant GWB at wet walls.
	Floor	Porcelain tile.
	Base	Ceramic or porcelain tile.
	Ceiling	ACT and/or painted GWB (eggshell/satin finish).
Plumbing	Provide per Chapter 3. Provide wall-mounted urinals, floor-mounted toilets, and lavatories. Provide a floor drain.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of emergency lighting with battery backup .	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements	Coordinate with Facility Manager when determining soap and paper product dispensing preferences.	
Adjacencies/Location within Facility	Entries	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-81 HRF – Staff Restrooms

Description / Usage	Staff Restrooms. Toilet facilities for faciility staff.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	Sink vanities, toilet partitions (at multiple toilets), lockers, mirrors, toilet accessories.	
Finishes	**Walls**	Ceramic or porcelain tile (full-height). Provide water-resistant GWB at wet walls.
	Floor	Porcelain tile.
	Base	Ceramic or porcelain tile.
	Ceiling	ACT and/or painted GWB (eggshell/satin finish).
Plumbing	Provide per Chapter 3. Provide wall-mounted urinals, floor-mounted toilets, and lavatories. Provide a floor drain.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of emergency lighting with battery backup .	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements	Coordinate with Facility Manager when determining soap and paper product dispensing preferences.	
Adjacencies/Location within Facility	Administrative areas (non-public areas).	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-82 HRF – Janitorial Space

Description / Usage	Janitorial Space. Space for custodial supplies and equipment.	
Ceiling Height	8 ft. (2.4m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment	Include mop/broom rack, utility shelf.	
Finishes	**Walls**	Ceramic tile wainscot (48 ft. high; 1.2m) or fiber-reinforced or rigid vinyl panel wall protection wainscot (4 ft. high; 1.2m). Epoxy paint - semi-gloss finish above.
	Floor	Porcelain tile or sealed concrete.
	Base	Porcelain or ceramic tile (coordinate with wall/floor).
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide a mop sink, floor drain, and keyed hose bibb.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Storage cabinet (optional).	
Special Requirements		
Adjacencies/Location within Facility	Restrooms, Public areas.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-83 HRF – Facilities Management Storage

Description / Usage	Facilities Management Storage. Space used to store surplus building products/supplies such as light bulbs, paints, cleaning and paper products.	
Ceiling Height	8 ft. (2.4m) clear minimum	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment	Storage cabinets, flammable cabinets, as required.	
Special Requirements		
Adjacencies/Location within Facility	Facility Manager office, Loading dock.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-84 HRF – Elevators

Description / Usage	Elevators. Elevator meeting all IBC requirements at each floor.	
Ceiling Height	8 ft. (2.4) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Stainless steel or plastic laminate panels.
	Floor	Hard surface (stone/porcelain tile, etc.) or resilient. Continue adjacent space floor finish.
	Base	Stainless steel (cab finish).
	Ceiling	Panels as offered by elevator manufacturer.
Plumbing	Provide per Chapter 3.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of an avg. of 5 fc (50 lux) ambient.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Entries, public areas.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-85 HRF – Freight Elevator

Description / Usage	Freight Elevator. Elevator used to convey oversize displays, artifacts, equipment, etc.	
Ceiling Height		
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Stainless steel panels (provide hooks for protective blanket installation).
	Floor	Resilient or sealed concrete.
	Base	Stainless steel.
	Ceiling	Panels as offered by elevator manufacturer.
Plumbing	Provide per Chapter 3.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of an avg. of 5 fc (50 lux) ambient.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Loading dock.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-86 HRF – Elevator Equipment Room

Description / Usage	Elevator Equipment Room(s). Room housing required elevator equipment.	
Ceiling Height	Exposed - 8 ft. (2.4) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Elevator, Freight Elevator.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-87 HRF – Stairwells

Description / Usage	Stairwells	
Ceiling Height	Varies.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete with resilient stair system (treads, risers)
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power		
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements	Locate per Life Safety requirements.	
Adjacencies/Location within Facility		
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-88 HRF – Electrical Room

Description / Usage	Electrical Room. Room housing electrical panels and equipment.	
Ceiling Height	8 ft. (2.4m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility		
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-89 HRF – Telecommunications/Server Room

Description / Usage	Telecommunications/Server Room. Room to house communications distribution. May include SIPR and JWICS.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of 50 fc (500 lux) per telecommunications UFC, and bi-level or multi-level switching.	
Communication	**Telephone**	
	Data	Coordinate requirements for exrtra server racks for separate system for artifact area.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	ESS Closet	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-90 HRF – Server Room

Description / Usage	Server Room. May co-locate with IT personnel.	
Ceiling Height	8 ft. (2.4m) minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Resilient.
	Base	Resilient.
	Ceiling	ACT.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of 50 fc (500 lux) per telecommunications UFC, and bi-level or multi-level switching.	
Communication	**Telephone**	Provide per Chapter 3.
	Data	Provide per Chapter 3. Coordinate requirements with telcom room for additional servers.
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility		
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-91 HRF – ESS Closet

Description / Usage	ESS Closet. Room to house electronic security system equipment.	
Ceiling Height	8 ft. (2.4m) clear minimum	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of 50 fc (500 lux) per telecommunications UFC, and bi-level or multi-level switching.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Telecom Room	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-92 HRF – Mechanical Room

Description / Usage	Mechanical Room. Room housing HVAC equipment.	
Ceiling Height	9 ft. (2.7m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3.	
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility		
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-93 HRF – Shipping/Receiving

Description / Usage	Shipping/Receiving. Receiving, unpacking and packing of all packages.	
Ceiling Height	10 ft. (3.0m) clear minimum.	
Windows		
Doors	Mininum 8 ft. (2.4m) wide x 8 ft. (2.4m) high rolling door.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Impact resistant wallcovering wainscot (4 ft. (1.2m) high), epoxy paint (eggshell/satin finish) above.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with the addition of an avg. of 30 fc (300 lux) ambient and bi-level or multilevel switching.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Loading dock.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-94 HRF – Recycling Room

Description / Usage	Recycling Room. Easily accessible room dedicated to collection and storage of materials for recycling. Includes paper, corrugated cardboard, glass, plastics and metals.	
Ceiling Height	8 ft. (2.4m) clear minimum.	
Windows		
Doors		
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements	Coordinate recycling container sizes used by HRF.	
Adjacencies/Location within Facility	Loading dock.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-95 HRF – Equipment Storage Area

Description / Usage	Equipment Storage Area. General storage area for forklift, pallet jacks and carts to support facility.	
Ceiling Height	15 ft. (4.6m) clear minimum.	
Windows		
Doors	Overhead coiling door - 12 ft (3.7m) x 12 ft. (3.7m).	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	Epoxy paint - eggshell/satin finish.
	Floor	Sealed concrete.
	Base	Resilient.
	Ceiling	Exposed structure - paint.
Plumbing		
HVAC	Provide per Chapter 3.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3.	
Lighting	Provide per Chapter 3 with vacancy sensor.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	
	ACS	
	CCTV	
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility	Loading dock.	
	For use during project execution by the appropriate Service agency	
Occupancy	**Staff**	
	Other	
Min. net ft^2 (m^2)		

Table E-96 HRF – Loading Dock

Description / Usage	Loading Dock(s). Area for shipping/receiving as well as building waste removal.	
Ceiling Height	Varies.	
Windows		
Doors	Minimum 8 ft. (2.4m) wide x 8 ft. (2.4m) high coiling overhead door. Provide personnel door.	
Interior Construction / Built-In Equipment		
Finishes	**Walls**	High Performance Architectural Coating (HIPAC). Service corridors leading to loading dock to receive impact resistant wallcovering wainscot (4 ft. (1.2m) high).
	Floor	Sealed concrete.
	Base	
	Ceiling	Exposed structure - paint.
Plumbing	Provide per Chapter 3. Provide washing machine hook-up if required by end user. If restroom is required in this area by end user, verify if shower is also required.	
HVAC	Provide per Chapter 3. If loading dock is enclosed, provide a unit heater or infrared heater at the entrance of the loading dock, and a vehicle exhaust removal system for trucks.	
Fire Protection and Life Safety	Provide per Chapter 3.	
Power	Provide per Chapter 3. Provide washer and dryer connections.	
Lighting	Provide per Chapter 3 with the addition of an avg. of 10 fc (100 lux) and photocell controlled.	
Communication	**Telephone**	
	Data	
	CATV	
Security	**IDS**	Provide per Chapter 3 & 4.
	ACS	Provide per Chapter 3 & 4.
	CCTV	Provide per Chapter 3 & 4.
Acoustics		
Furnishings and Equipment		
Special Requirements		
Adjacencies/Location within Facility		

	For use during project execution by the appropriate Service agency	
Occupancy	Staff	
	Other	
Min. net ft^2 (m^2)		

UFC 4-826-10
15 March 2024

UNIFIED FACILITIES CRITERIA (UFC)

DESIGN:
REFRIGERATION SYSTEMS FOR COLD STORAGE

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UNIFIED FACILITIES CRITERIA (UFC)

DESIGN: REFRIGERATION SYSTEMS FOR COLD STORAGE

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes UFC 4-826-10, Design: Refrigeration Systems for Cold Storage, dated 10 July 2002.

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FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States, its territories, and possessions is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Military Department's responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Technical content of UFC is the responsibility of the cognizant DoD working group. Defense Agencies should contact the respective DoD Working Group for document interpretation and improvements. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide website https://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

The purpose of refrigerated systems for cold storage is to maintain or extend product life. Refrigeration systems for cold storage are applied to processing, manufacturing, and warehousing food, biomedical materials, ice manufacture, and other uses; but the largest application is for the refrigeration and freezing of foods. Refrigerated systems provide much lower temperatures than comfort air conditioning systems. The design, selection, and construction of a refrigeration system is different and can be more intensive than that for a comfort air conditioning system. For this reason, the refrigeration industry has evolved into a separate and distinct industry.

1-2 REISSUES AND CANCELS.

This UFC reissues and cancels UFC 4-826-10, *Design: Refrigeration Systems for Cold Storage* dated 10 July 2002.

1-3 PURPOSE AND SCOPE.

This UFC provides general criteria for the design of new refrigeration systems for cold storage. This document, and all references contained herein, provides guidance to the DoD. They may also be useful to commercial firms engaged in the design and construction of refrigeration systems for cold storage for DoD facilities.

Note that this document does not constitute a detailed technical design, maintenance or operations manual. Rather, its purpose is to identify and utilize the most appropriate Non-Governmental Standards (NGS) by specifying the refrigeration industry codes and standards that best apply, and to include the Tri-service's specific requirements.

1-4 APPLICABILITY.

This UFC applies to all Service elements and DoD contractors involved in the planning, design, and construction of DoD cold storage facilities.

1-5 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-6 CYBERSECURITY.

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance

with UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems*, and as required by individual Service Implementation Policy.

1-7 PRIMARY VOLUNTARY CONSENSUS STANDARD REFERENCE.

This UFC adopts the latest edition of American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Publications listed below as the primary voluntary consensus standard for the Tri-services refrigeration systems for cold storage.

- *ASHRAE Handbook – Refrigeration*

1-8 SECONDARY VOLUNTARY CONSENSUS STANDARD REFERENCES.

This UFC adopts the latest edition of the standards listed below as the secondary voluntary consensus standard for the Tri-services refrigeration systems for cold storage. ASHRAE Standards encompass halocarbon and ammonia refrigeration systems. International Institute of Ammonia Refrigeration (IIAR) refers to ammonia systems exclusively.

- ASHRAE Standard 15
- *ASHRAE Handbook – Applications*
- *ASHRAE Handbook – Fundamentals*
- *ASHRAE Handbook – HVAC Equipment and Systems*
- ANSI/IIAR Standard 2
- *IIAR Ammonia Refrigeration Piping Handbook*

1-9 CONFLICTS IN CRITERIA.

If any conflicts arise between the service's safety criteria and ASHRAE Standard 15, the most stringent requirement will prevail unless discussed and approved by the contracting officer. If a facility is located off of military owned sites, where local jurisdictional authority has control and code requirements that are more stringent than those herein, the local jurisdictional authority shall prevail.

1-10 SUSTAINABLE DESIGN.

It is the policy of the tri-services to incorporate sustainability concepts in the design of all facilities and infrastructure projects to the extent life-cycle cost effective, consistent with budget constraints and customer requirements. This policy applies to renovations and alteration projects as well as new construction; applies to projects regardless of funding source or amount; applies to projects for all customers; and applies to design associated with all procurement methods, including design/build. For further information, see https://www.wbdg.org/ffc/federal-facility-criteria.

1-11 GLOSSARY.

APPENDIX A contains acronyms, abbreviations, and terms.

1-12 REFERENCES.

APPENDIX B contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

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CHAPTER 2 REFRIGERATION SYSTEM DESIGN REQUIREMENTS

2-1 GENERAL.

Design refrigerated systems for cold storage to provide safety, economy, and reliability. Refrigeration design is a specialized field. The design of cold storage refrigerated systems must be performed by an experienced refrigeration design engineer with at least 5 years' experience on at least two projects of similar complexity and scope. Refrigeration designs must be submitted using the "design-bid-build" or "design build" arrangement.

Proposed and utilized equipment manufacturers must have 5 years extensive experience in significantly supported refrigeration design.

2-2 SAFETY.

Safety is paramount. Safety is critical in the design, construction and operation of refrigeration systems for cold storage, especially with ammonia systems. Meet the ASHRAE Standard 15 refrigeration system's safety standards. ASHRAE Standard 15 specifies safe design, construction, installation, and operation of refrigeration systems by establishing safeguards for life, limb, heath and property and prescribing safety standards. This includes, but is not limited to, occupancy classification, restriction on refrigeration use, installation restrictions, design and construction of equipment and systems, operations, and testing.

2-2.1 Equipment Selection and Placement.

Consider equipment selection and its placement for safe accessible maintenance. A safety review of the engineered design and equipment layout is recommended with participation from the owner's site operations and maintenance (O&M) entities.

2-2.2 System Safety Plan and Hazard Analysis.

The designer is required to perform a system safety plan and hazard analysis. Personnel safety measures are required as part of the facility design. Hazards or controlled substances requiring consideration may include, but are not limited, to the following:

- Ozone depleting gases
- Greenhouse gases
- Ammonia
- Pressurized gases
- Flammable gases
- Hazardous gases
- Hot gases and equipment

- Electrical power

2-3 OPERATION AND MAINTENANCE.

Tri-service facilities do not perform the maintenance typical of commercial and industrial facilities. Participation of the site operations and maintenance entities in the design process is critical to a safely operated and maintained facility, plus helps to ensure a successful project. O&M entities will be interviewed up front in the "Charrette" stage of a refrigeration design project. Design charrettes are a key component in the initial stages of any project and must be required. The mechanical designers (specifically the lead mechanical engineer) involved in the refrigeration design and Safety and Environmental Protection personnel must participate in the design charrette.

2-4 ECONOMY.

Design systems to provide the lowest life-cycle cost with maximum energy efficiency and give special consideration to safety and low maintenance. As noted in Section 2-3, the maintaining of Tri-services facilities is not indicative of commercial and industrial facilities. Actual maintenance costs can be hidden and high. Therefore, a simple, high reliability design can be weighed greater than efficiency. Consider this in the life cycle analysis. Also, consider the impact of refrigerant phase-out and replacement costs, and Occupational Safety and Health Administration (OSHA) Regulations (refer to Section 2-6.3.2) to the life cycle analysis of the refrigeration system.

2-5 REFRIGERANT PHASE-OUT AND REPLACEMENT.

The phase-out schedule of refrigerants is briefly defined in the refrigerants chapter of the *ASHRAE Handbook – Fundamentals*. This information can also be found at the United States Environmental Protection Agency's web site https://www.epa.gov/ods-phaseout.

2-6 SYSTEM DESIGN AND SELECTION.

This section addresses the general requirements for the design and selection of a refrigerated system for cold storage. ASHRAE Standards and Handbook are the basis for refrigeration system design, selection, installation, testing, and operating. For ammonia systems, the standards of the International Institute of Ammonia Refrigerators (IIAR) will apply, and if more stringent than ASHRAE Standards, IIAR will prevail.

2-6.1 Facility Design.

Design new refrigerated facilities to meet the considerations for building design that are provided in the refrigerated facility design chapter of *ASHRAE Handbook – Refrigeration*. Cold storage facilities held below freezing can cause under floor ice formation, resulting in floor upheaval. Design sub-floor freeze protection for facilities that are held below freezing, such as air duct systems, electrical heating systems, or heated pipe grids. These systems are detailed in the above-mentioned chapter. Comply with all ASHRAE Standard 15 in its entirety, including but not limited to

equipment placement, ventilation design, door and passageway restrictions, refrigerant monitoring, flame devices, pressure relief and purge piping, refrigerant piping, signs, self-contained breathing apparatus (SCBA), and miscellaneous installation restrictions.

2-6.2 Refrigeration Load.

Determine the refrigeration loads by the calculations in the Refrigeration Load chapter of *ASHRAE Handbook – Refrigeration*.

2-6.3 Refrigeration System Selection.

The primary selection of a refrigeration system, such as halocarbon or ammonia refrigerant, direct expansion or liquid recirculation, must be determined by life cycle cost analysis. Should a system be selected for a design because of other issues, such as safety, reliability, maintainability, simplicity, the preference of the owner, and the recommendations of the design engineer, then the designer must clearly justify their selection in the project's design analysis, and include concurrence from the user and the funding agency.

Perform the design of the entire system, including loading areas, door swing clearances, noise considerations, clearances for maintenance, and pipe sizes and layout/slopes, based on guidance from ASHRAE. On the drawings, indicate that it will be the Contractor's responsibility to coordinate the pipe sizes and layout/slopes with the equipment and piping configurations to be provided. For small systems (systems with 1 or 2 compressors and 1 or 2 coolers; 1 compressor for each cooler), the designer may elect to show only the individual components and their relative layout or schematic with no pipe sizes or slopes. For these types of systems, it will be the Contractor's responsibility to submit shop drawings and calculations to completely define the entire system based on the equipment to be provided. Refer to the *ASHRAE Handbook – Refrigeration*, in the following chapters:

- Liquid Overfeed Systems
- System Practices of Halocarbon Refrigerants
- System Practices for Ammonia Refrigerant
- Secondary Coolants in Refrigeration Systems

2-6.3.1 Refrigerants.

The selection of a refrigerant impacts the project economics and safety. The selection, design, construction, and operation of a refrigeration system must meet ASHRAE Standard 15. Show the occupancy and restrictions on refrigerant quantity and usage on the drawings. Product, occupancy, or other criteria might require a "low-probability system" for the refrigeration system. Low-probability systems are designed so that if a leak occurred, the refrigerant cannot enter the occupied space. Most indirect systems are considered "low-probability systems". An indirect system has a secondary coolant, such as brine, which is cooled or heated by the refrigeration system.

A comprehensive list of refrigerants and refrigerant blends are listed in Table 1 and Table 2 respectively of ASHRAE Standard 34. R-404a is not recommended because it is a nonazeotropic mixture. A leak in a refrigeration system with a nonazeotropic mixture would change the composition resulting in a glide that would become unpredictable. A system leak could cause off performance that ultimately would require a complete refrigerant replacement. R-134a is not recommended for large capacity systems because the density is low and would require larger volume equipment. Ammonia is corrosive, hazardous, and can damage product when released in large quantities. But ammonia is considerably cheaper, much more efficient as a refrigerant, and has easier oil separation capabilities. Halocarbons have a lower toxicity limit than ammonia. All refrigerants can be injurious or even fatal in high enough concentrations and must be handled carefully. If ammonia is not ruled out as a refrigerant, the life cycle analysis will most likely suggest an ammonia system for large (typically above 5000 square feet (464.5 square meters)) cold storage refrigeration applications. Selecting a refrigerant for cold storage design is a function of the refrigeration design temperature and the equipment available. Lubrication oil management becomes critical at lower temperatures, especially when the oil is lighter than the refrigerant.

2-6.3.1.1 Ammonia.

Ammonia is a self-alarming substance that is distinguished by its pungent odor. Persons exposed to ammonia vapors well below the permanently damaging levels will not voluntarily stay in such areas. An ammonia-air mixture in an iron flask does not ignite below 1204 degrees F (651.1degrees C). The US Department of Transportation classifies ammonia as a nonflammable compressed gas for the purpose of transportation. Ammonia is rated a Group B-2L in ASHRAE Standard 34; that classifies ammonia as more toxic than most other refrigerants. Safety requirements are heightened for ammonia, thus the need for special care and attention to safety details in ammonia systems. Since ammonia is lighter than air, adequate ventilation is the best means of preventing accumulation. The challenge with ammonia is to control the magnitude of and promptly correct a leak, in order to avoid injury to people and damage to property and product. It is important that personnel understand the properties of ammonia and be thoroughly trained in its use, safety precautions and application.

2-6.3.1.2 Halocarbons.

Halocarbons are halogenated hydrocarbons that contain one or more of the halides: chlorine, bromine, fluorine, or iodine. Halocarbons are typically rated a Group A-1 in ASHRAE Standard 34; that is a lower toxicity and flammability than ammonia. Halocarbons are widely used because they are considered a safe approach to refrigeration. Economically, halocarbons are significantly more expensive and not as efficient as ammonia.

2-6.3.2 Commercially Designed Mechanical Refrigeration Systems.

The selection and design of a commercial mechanical refrigeration system should be economical, safe, reliable, and simple. A design must be indicative of the refrigeration

industry's trends, with emphasis on simplicity and low maintenance. There are essentially two refrigerant system designs utilized in the cold storage refrigeration market, such as, direct expansion and liquid recirculation. The dominant design is a field constructed ammonia liquid recirculation system utilizing screw compressors and evaporative condensers.

Large systems can have thousands of kilograms of refrigerant. If an ammonia refrigerant system exceeds 10,000 pounds (4536 kg) of ammonia, OSHA 29 CFR 1910 requires implementing a Process Safety Management program (PSM) and a Risk Management Plan (RMP). This would require staff and other operating requirements that can be very expensive to implement and maintain. There is an O&M savings incentive for ammonia refrigeration systems to contain less than 10,000 pounds (4536 kg) of ammonia. The owners of the larger refrigeration systems that have PSM programs try to mitigate safety incidences and their respective magnitude. There is a safety preference for refrigeration systems that contain the least amount of refrigerant to minimize the potential of a possible large release. For these reasons, direct expansion systems are sometimes preferred rather than the more economical recirculation systems.

2-6.3.2.1 Liquid Recirculation.

Liquid recirculation is the mechanical pumping, or gas pressure pumping arrangement, that forces liquid refrigerant into evaporators. More liquid is introduced into the evaporator than can be evaporated, usually by a factor of 3. This system requires additional pumping equipment, liquid-gas separation equipment, and significantly more refrigerant. The advantages of this system are realized during O&M. A liquid recirculation to direct expansion general comparison is as follows:

- Higher initial capital investment
- Contains a significantly larger amount of refrigerant (can be post prohibitive with halocarbons
- Lower operating costs
- Greater operating flexibility to control multiple temperate zones
- Easier maintenance
- Halocarbon recirculation requires large oil separation systems due to much lower separation velocity than ammonia

2-6.3.2.2 Direct Expansion.

Direct expansion is the introduction of refrigerant through an expansion device prior to the evaporator and only vapor leaves the evaporator. It is limited in low temperature applications. Ammonia direct expansion cannot perform much below 0 degrees F (minus 17.8 degrees C) so is not applicable with freezers. A direct expansion to liquid recirculation general comparison is as follows:

- Lower initial capital investment
- Contain significantly less refrigerant
- High operating costs
- Little operating flexibility
- Difficult to balance
- Compressor must be sized for the lowest temperature zone
- Limited low temperature applications with ammonia

Direct expansion with ammonia has two notable maintaining concerns, for example, ammonia is abrasive for a refrigerant, and lubricating oil is not as miscible in ammonia as it is with halocarbons, leading to difficulties in maintaining oil recirculation in ammonia systems.

2-6.3.2.3 Unitary System.

Unitary system is a packaged unit that is designed and built by a manufacturer; that includes retail display cases, walk-in storage coolers, household refrigerators and freezers, and commercial icemakers. Small refrigeration systems may have their design needs met with unitary systems. Unitary units are recommended for small applications due to the typical benefits over field-assembled units. These benefits are lower capital investment, higher reliability of factory assembled equipment, and comprehensive warranties. This equipment must be supported by a local distributor to provide support and parts.

2-6.4 Equipment Selection.

The refrigeration industry relies heavily on equipment manufacturers. Refrigeration equipment manufacturers provide expertise and information regarding equipment and design. Installing new technological advances in equipment is encouraged, but installing prototypes or new unproven technology is not recommended.

2-6.4.1 Materials of Construction.

Most common ferrous and copper base metals can be used with halocarbons. Not recommended are magnesium, zinc, and aluminum alloys containing more than 2% magnesium in contact with the refrigerant. Most common ferrous metals can be used with ammonia. Copper and alloys containing copper, brass, or alloys containing copper in contact with the ammonia refrigerant must not be used.

Contractors often install halocarbon refrigerant systems with the more stringent ammonia specifications for construction efficiencies. Ammonia components are typically more expensive but some halocarbon systems can be competitive with the ammonia specified components by utilizing experienced ammonia installation technicians

2-6.4.2 Compressors.

Compressors are typically of two types: reciprocating and rotary (screw or scroll). Scroll compressors are limited to lower capacity halocarbon systems. Rotary screw and scroll are increasingly popular due to lower maintenance costs. Screw compressors dominate the refrigeration market. This is mainly due to their high reliability, usually capable of operating over 50,000 hours between overhauls, and the selection of capacities of commercially available equipment. Commercially available motor driven capacities range from 25 horsepower (20 kilowatts) to over 1675 horsepower (1250 kilowatts). The recommended compressor for refrigeration service is a screw type compressor that comes as a package unit. The screw compressor package units consist of screw compressor, motor, coupling, oil separator, local logic controller, oil pump and filter. Refer to *ASHRAE Handbook – HVAC Systems and Equipment*.

2-6.4.3 Condensers.

Condensers are air or water-cooled. Halocarbon systems are usually air cooled, but water-cooled units are available. Ammonia systems are more often water-cooled. Properly sized water-cooled condensers result in greater efficiency and lower compressor energy consumption. This is offset by considerably higher maintenance costs, water consumption, and more complex systems than air- cooled. Water-cooled condensers are normally used for larger systems. Refer to *ASHRAE Handbook – HVAC Systems and Equipment*.

2-6.4.4 Cooling Towers.

Cooling towers used for condensing refrigerants are typically the closed circuit evaporative type. Refer to *ASHRAE Handbook – HVAC Systems and Equipment*.

2-6.4.5 Liquid Coolers.

Liquid coolers are heat exchangers that are normally used as liquid chilling systems for secondary coolants. Refer to *ASHRAE Handbook – HVAC Systems and Equipment*.

2-6.4.6 Evaporators.

Evaporators are most commonly fan-coil assemblies using propeller direct drive fans with ECM motors. Coil material must be compatible with the refrigerant used and the environment. Proper air distribution, location and quantity of evaporators depend on the load, size and layout of the refrigerated zone. Refer to *ASHRAE Handbook – Refrigeration*.

2-6.4.7 Piping Systems.

Refer to *ASHRAE Handbook – Refrigeration* and *IIAR Ammonia Refrigeration Piping Handbook*.

2-6.4.8 Piping Insulation.

Refer to *ASHRAE Handbook – Refrigeration* and *IIAR Ammonia Refrigeration Piping Handbook*.

2-6.5 Control Systems.

Design control systems, including control software applications, with safety interlocks, alarms, and shutdowns.

2-6.5.1 Programmable Logic Controller (PLC) Systems.

Provide programmable logic controller (PLC) based systems with ladder logic documentation. Alarms with automatic notification must be integrated. Automatic alarm notification must be first to the area supervisor onsite location. If no response, automatic alarm notification must notify the 24-hour watch. This can be accomplished via a dedicated telephone line.

2-6.5.2 Communication and Data Logging Permit Systems.

Control systems, having communication and data logging permit systems to operate at optimum conditions under transient load conditions. This must include staggered startup of multiple compressors and other refrigeration loads. Due to this, and stored product requirements, refrigerated control systems can become complicated. Recommend simple installations if at all possible. Basic control systems for an ammonia liquid recirculation system have approximately 100 input and output (I/O) signals. These include evaporator pressure regulation, backpressure regulation, capacity control, hot gas bypass, room temperature, and concrete slab temperature.

2-6.5.3 Energy Management Systems/Load Shedders.

Before application of energy management systems/load shedders to refrigeration systems, and related fans and pumps, the designer will ascertain that application will be neither conducive to equipment damage nor counterproductive. Safety trips, compressor slugging, freeze-ups, and loading of circuits may become more likely to occur.

2-6.6 Defrosting.

Spaces maintained at 35 degrees F (2 degrees C) will be defrosted with ambient air. Spaces maintained below 35 degrees F (2 degrees C) and environments that seasonal ambient temperatures are cold enough, will use either a hot-gas or electric-heat defrost system. For safety reasons, electric defrost must be avoided on ammonia systems. For a defrosting system, choose between a timer defrost controller or a demand defrost controller.

Timer defrosting is a time initiated and time terminated control method that has an adjustable defrost duration and number of cycles in a 24 hour period. The timer

defrosting is the most common method of defrosting control. Winter and summer conditions require different defrost duration and cycles. Demand defrost is a defrosting control method initiated by measuring the air pressure drop across the coils. Demand defrost is a more efficient defrost control method.

2-6.7 Seismic Zone Requirements.

The geographical location of a facility determines its seismic zone. The seismic zone locations have requirements for building design and restraint of equipment. Refrigeration facilities for cold storage must meet seismic design requirements. Refer to UFC 3-301-01 Structural Engineering at http://www.wbdg.org and the seismic and wind restraint design chapter of the *ASHRAE Handbook – Applications*.

2-6.8 Refrigerant Management.

The Air Force document, *Refrigerant Management Program*, may be of assistance during the preparation of a facility refrigerant conservation and replacement program. The handbook is available on https://www.wbdg.org/FFC/AF/AFMAN/afman32_7089.pdf.

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APPENDIX A GLOSSARY

A-1 ACRONYMS.

AFCEC	Air Force Civil Engineer Center
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
BIA	Bilateral Infrastructure Agreement
CCR	Criteria Change Request
DoD	Department of Defense
ECM	electronically commutated
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
HVAC	Heating, Ventilating, and Air Conditioning
IIAR	International Institute of Ammonia Refrigeration
I/O	input and output
NAVFAC	Naval Facilities Engineering Systems Command
NGS	Non-Governmental Standards
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
PLC	programmable logic controller
PSM	Process Safety Management Program
RMP	Risk Management Plan
SCBA	self-contained breathing apparatus
SOFA	Status of Forces Agreements
UFC	Unified Facilities Criteria
U.S.	United States

A-2 DEFINITION OF TERMS.

Azeotropic: A precise refrigerant mixture or blend of substances that has properties differing from either of the two constituents.

Design-Bid-Build: Engineering firm furnishes a design, then the design is competitively bid for construction.

Design-Build: Contractor furnishes a designed and constructed facility, usually from a performance specification.

Direct Expansion System: A refrigerant system that has the refrigerant directly entering the air cooling coil.

Flooded Evaporator: A refrigerant system that has liquid refrigerant in the evaporator in amounts larger than can be evaporated and obtains higher efficiencies due to higher heat transfer of wetted surfaces.

Glide: The absolute value of the difference between the starting and ending temperatures of a phase change process by a refrigerant.

Halocarbon: Refrigerant that is a hydrocarbon derivative that contain one or more of the halogens bromine, chlorine, fluorine, or iodine; hydrogen may also be present.

Owner: Tri-service arm having the responsibility of operating and maintaining the subject facility.

APPENDIX B REFERENCES

AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR CONDITIONING ENGINEERS (ASHRAE)

https://www.ashrae.org/

ASHRAE Handbook – Applications

ASHRAE Handbook – Fundamentals

ASHRAE Handbook – HVAC Equipment and Systems

ASHRAE Handbook – Refrigeration

ASHRAE Standard 15, *Safety Standard for Refrigeration Systems*

ASHRAE Standard 34, *Designation and Safety Classification of Refrigerants*

DEPARTMENT OF THE AIR FORCE

Refrigerant Management Program
https://www.wbdg.org/FFC/AF/AFMAN/afman32_7089.pdf

INTERNATIONAL INSTITUTE OF AMMONIA REFRIGERATION (IIAR)

https://iiar.org/

ANSI/IIAR Standard 2, *Standard for the Safe Design of Closed-Circuit Ammonia Refrigeration Systems*

IIAR Ammonia Refrigeration Piping Handbook

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

OSHA 29 CFR 1910, *Occupational Safety and Health Standards*
https://www.osha.gov/laws-regs/regulations/standardnumber/1910

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 1-200-01, *DoD Building Code*

UFC 3-301-01, *Structural Engineering*

UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems (FRCS)*

UFC 4-860-01
23 June 2022

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RAILROAD DESIGN AND REHABILITATION

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FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States, its territories, and possessions is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Military Department's responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Systems Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Technical content of UFC is the responsibility of the cognizant DoD working group. Defense Agencies should contact the respective DoD Working Group for document interpretation and improvements. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

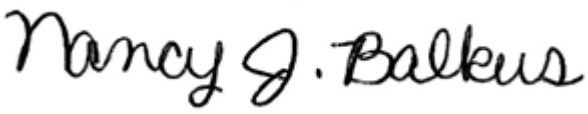
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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

This Unified Facilities Criteria (UFC), UFC 4-860-01, provides requirements for designing and rehabilitating railroad track, terminal and loading facilities. The requirements contained in this UFC apply to Army, Navy, and Air Force facilities unless specifically referenced to a single service. This UFC is not intended as a substitution for thorough review during design by individual Program Managers, Engineers and Operations Staff in the appropriate service.

The desired goal of this UFC is to maintain consistency in railroad tracks, terminals and loading facilities requirements across the Army, Navy and Air Force. This UFC is not intended as an operational manual.

1-2 REISSUES AND CANCELS.

This UFC reissues and cancels UFC 4-860-01FA, *Railroad Design and Rehabilitation*, dated 16 January 2004.

1-3 PURPOSE AND SCOPE.

This UFC provides technical requirements to design and rehabilitate railroad track, terminals, and loading facilities, along with information on construction. This UFC is for railroad lines operated at speeds and traffic volumes lower than common in the commercial industry. The technical requirements on terminal design are for small terminals handling military cargo: primarily tracked or wheeled vehicles and intermodal containers.

This UFC, supplemented with the specified references, provides information for general purposes. Most projects, however, include aspects that are site-specific or uncommon conditions. Designers are encouraged to obtain assistance when encountering unusual or unfamiliar situations.

1-4 APPLICABILITY.

These instructions are applicable to all DoD elements and their contractors involved with railroad design, construction, and rehabilitation.

1-4.1 Applying the Material in this Manual.

Designing a railroad often involves satisfying conflicting objectives. Throughout the process, the designer must prioritize project objectives and decide what objective to sacrifice to satisfy another. Properly balancing these compromises, tailored to each situation, produces an effective railroad design.

1-4.2 New Lines and Terminals.

To design new railroad lines and terminals, utilize Chapters 2 through 3 and 5 through 7 of this instruction. The design process summary is as follows:

a. Determine the traffic and load carrying requirements. Estimate the number of cars to be processed over the line and magnitude of the wheel loads the track must support.

b. Determine the terminal and support facilities requirements. From the type and magnitude of traffic, determine the number, size, location of loading and unloading facilities (terminals), sidings, wyes, and other support facilities and auxiliary tracks.

c. Establish route profile and alignment guidelines. Based on load carrying requirements, maximum desired speed, locomotive pulling capability, and other operating needs and conditions, select maximum effective grade, horizontal and vertical curvature, and other profile and alignment specifications.

d. Select the route. Through an iterative process, select the best route and profile between the terminals and the connecting commercial railroad, usually the nearest commercial railroad line. Include considerations of climate change on flood resiliency in accordance with the installation master plan and UFC 2-100-01 Installation Master Planning.

e. Design the track, roadway, and terminal and support facilities. From the traffic and wheel load estimates and the characteristics of the selected route, determine track, roadway, and drainage requirements.

1-4.3 Rehabilitation.

For rehabilitating existing lines and facilities, refer to Chapters 4 through 7, along with portions of Chapter 2.

1-5 USING THE AREMA MANUAL FOR RAILWAY ENGINEERING.

The American Railway Engineering and Maintenance-of-Way Association’s Manual for Railway Engineering (AREMA) is a standard industry reference and is cited throughout this technical manual. It contains a wide range of guidance with emphasis on commercial lines carrying substantial freight traffic. As a broad range of specifications is often given, proper use of the AREMA manual requires that the designer select the particular specifications most appropriate for a particular project.

The AREMA manual is written primarily for the commercial railroads that have their own company policies and procedures. The material assumes that many details are unnecessary, as a company’s own practices will govern. Therefore, military designers require details in addition to the material contained in the AREMA manual. In addition, requirements for operating on military railroads differ from those commonly found on commercial railroads. In these cases, the design guidance in this technical manual can vary from that found in the AREMA manual. For these reasons, when preparing

designs and specifications, avoid general statements, such as, “meeting AREMA specifications”. Such statements often leave the choice of materials or procedures wide open and lead to an undesirable or unsatisfactory product. When designing, clearly specify the work task and the acceptable construction materials.

1-6 OVERARCHING CRITERIA OR REGULATORY REQUIREMENTS.

Ensure designs meet all applicable state and local standards for new construction or rehabilitation. Design standards are typically obtained from the appropriate state departments of transportation or public utilities.

In addition, ensure that any new or rehabilitated track regularly utilized by a commercial railroad complies with that organization’s track requirements. Often commercial railroads require review and approval of the proposed design by their engineering department before operating over the proposed track.

1-7 SOURCES OF ASSISTANCE.

Designers are encouraged to seek assistance when questions arise on the best choice to suit a particular situation or for further interpretation of material in this manual or another reference. Obtain assistance through the Army Transportation Systems Center, Omaha, NE (CENWO-ED-TX) or Air Force AFCEC/COSC.

Installations that depend on a commercial railroad service for routine traffic or during a mobilization, contact the owning commercial organization and at a minimum coordinate the arrangement of the interchange yard and other track configurations to facilitate more convenient service.

1-8 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-9 CYBERSECURITY.

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service Implementation Policy.

1-10 GLOSSARY.

APPENDIX D contains a list of acronyms, abbreviations, and definitions.

1-11 REFERENCES.

APPENDIX E contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

CHAPTER 2 DETERMINING TRAFFIC AND LOAD CARRYING REQUIREMENTS

2-1 INTRODUCTION.

The first step in designing a railroad is determining the type and volume of traffic. Traffic type and volume generally govern the size and arrangement of terminal facilities, the number of auxiliary tracks required, and track structure design. Ensure the traffic handling capability at an installation covers existing and foreseeable requirements to include:

- Mobilization outloading.
- Training exercises.
- Installation supply (routine traffic).

Once assembled, review and approve data on traffic volume and type before proceeding with the design process.

2-2 TRAFFIC TYPE.

Information gathered on traffic type includes:

a. Type of cargo processed.

b. Type and size of freight cars.

c. Manner of cargo loading and unloading.

d. Height and width of cargo (for clearance requirements) carried on open cars (flatcars and gondolas).

e. Special requirements or restrictions for loading, unloading, or moving the cargo, especially hazardous cargo.

f. Determine the required type of loading facilities from this information. Chapter 7 covers planning and design for loading facilities. Table 2-1 lists the most common cargo types along with the freight cars and loading facilities to handle the cargo. Figure 2-1 shows common freight car types.

2-3 TRAFFIC VOLUME.

Estimate the amount of traffic using:

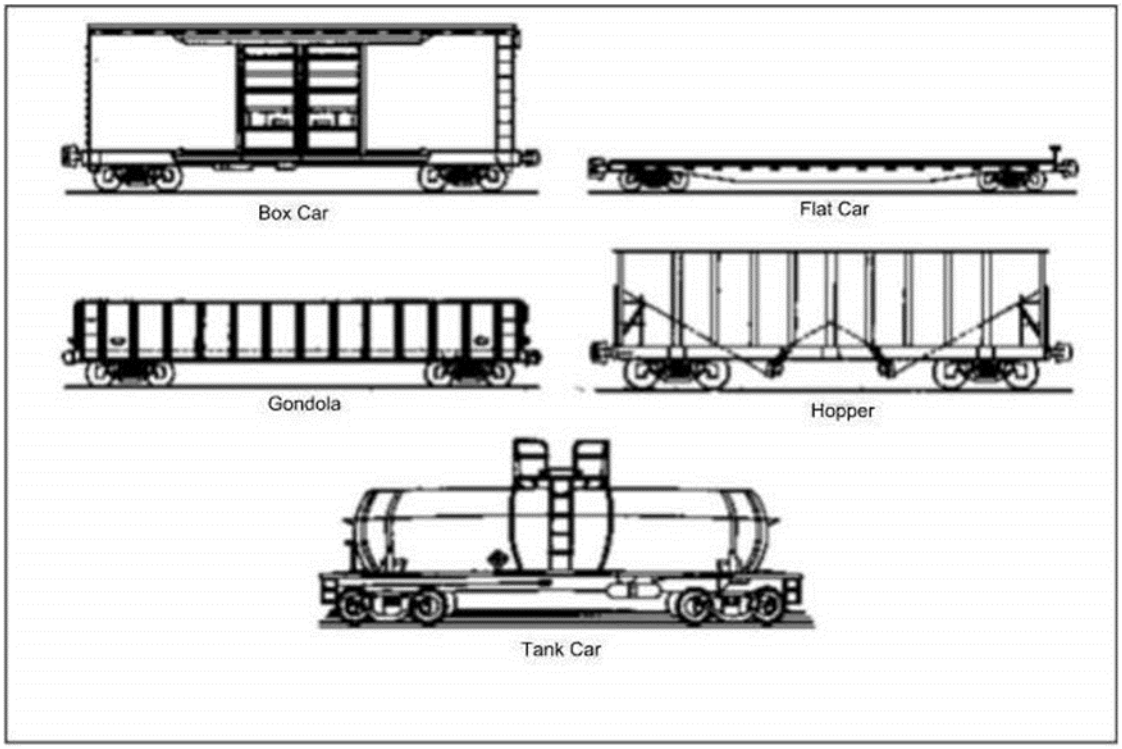
a. Maximum number of cars for each traffic type on the installation at any one time, including empty cars.

b. Longest train to accommodate into or out of the installation.

Table 2-1 Common Cargo Type and Loading Requirements

CARGO	CAR TYPE	LOADING/UNLOADING METHOD	FACILITY REQUIRED
Light wheel 0.25 – 2.5 T (0.23 – 2.27 MT)	Auto racks Bi/Tri-levels	Circus-type loading/unloading - staging area and bridge plates are required	Multi-level end ramp
Heavy wheel 5.0 T – HET (4.5 MT – HET)	Flatcar 40 – 140 T (36.3 – 127 MT)	Circus-type loading/unloading - staging area and bridge plates are required.	Permanent/portable end ramp
Light track (APC, Bradley)	Flatcar 40 – 140 T (36.3 – 127 MT)	Circus-type loading/unloading - staging area and bridge plates are required.	Permanent end ramp
Heavy track (Tank: M1, M60)	Flatcar 140 T (127 MT)	Circus-type loading/unloading - staging area and bridge plates are required.	Permanent end ramp
Engineer equipment (Wheel & track)	Flatcar 40 – 140 T (36.3 – 127 MT)	Special load items - crane access next to track may be required. Bridge plates are needed.	Permanent end ramp
40 ft (12.1 m) Container	COFC	Crane w/spreader bar or Rough Terrain Container Handler (RTCH) and yard tractor /trailer tandems.	Container loading facility
20 ft (6 m) Container	COFC	Crane w/spreader bar or RTCH and yard tractor /trailer tandems.	Container loading facility
Conex	Flatcar Gondola	Crane loading/unloading - crane access required next to track.	None
POL (bulk)	Tankcar	Pumping or dumping through a pipe network.	POL handling facility equipped with spill containment
POL (palletized)	Boxcar	Forklift into warehouse or dock, staging area next to dock may be required.	Side loading ramp equipped with spill containment
POL (containerized)	COFC	Crane w/spreader bar or RTCH and yard tractor /trailer tandems.	Container loading facility equipped with spill containment
Ammunition (palletized)	Boxcar	Forklift onto dock, staging area needed next to dock.	Side loading ramp that meets the quantity-distance requirements
Ammunition (containerized)	COFC	Crane w/spreader bar or RTCH and yard tractor /trailer tandems.	Container loading facility that meets quantity-distance requirements
Miscellaneous breakbulk	Boxcar	Forklift onto dock, staging area needed next to dock.	Side loading ramps

Figure 2-1 Common Freight Cars



c. Maximum number of cars of all types on the installation at any one time, including empty cars.

d. Maximum number of cars that each loading facility or terminal area must process in a single loading or unloading cycle.

2-4 WHEEL LOADS.

The magnitude of wheel loads greatly influences track structure design. While many types of cars and loadings may service an installation, for planning purposes, design for the wheel load of the heaviest type of loaded car that commonly travels a particular track. In many cases, engine wheel loads (Army-owned or commercial railroad) represent the heaviest single load on the track. However, the number of wheels of loaded cars typically far exceed the number of locomotive wheels over much of the track. Therefore, the magnitude of the car wheel load governs in most cases. Check both loading conditions before final design.

Obtain the design wheel load by taking the static wheel load for the heaviest commonly used car and add a factor to account for the dynamic effects of travel speed combined with track and wheel irregularities. Table 2-2 lists suggested design wheel loads for planning purposes. To use the table, select the car type in the first column that most closely matches the heaviest car in common use over the track. For terminal areas and around an installation, where speeds are usually limited to 10 mph (16 km/hr), select the design wheel load in the column labeled “<= 10 mph (16 km/hr).” For track connecting the installation with the commercial railroad where train speed exceeds 10 mph (16 km/hr), use the column labeled “10-25 mph (16-40.2 km/hr).” For track mostly used by

an engine during switching, or where mostly empty cars are stored, or otherwise see only occasional use, select from the column labeled “Light Use.”

2-5 LOCOMOTIVE TRACTIVE EFFORT.

2-5.1 Definition.

When designing a railroad route, it is necessary to know the pulling force a locomotive can exert. This pulling force is known as tractive effort. Tractive effort is maximum at starting and diminishes as speed increases.

2-5.2 Application.

Locomotive tractive effort, along with the route gradient and curvature, largely determines the maximum number of cars pulled over the route in a single train. Alternatively, locomotive tractive effort and minimum desired train size can determine the maximum acceptable grade and curvature on a route.

2-5.3 Tractive Effort Data.

Tractive effort data or graphs are often available for both military and commercial locomotives. When not readily obtainable, estimate the data from the locomotive weight and engine horsepower ratings. See Chapter 3, Paragraph 5.

2-6 TRAFFIC AND TERMINALS.

Once the traffic handling requirements are identified, as described in Chapter 2, Paragraphs 1 to 3, start the process of designing the terminal and support facilities. Determine the number and size (or length) of the required facilities and serving trackage from these traffic requirements. Chapter 7 covers planning and design for terminals.

2-7 SOURCES FOR TRAFFIC INFORMATION.

Obtain information about traffic types, car types, and volume, and mobilization requirements from the Installation Transportation Officer (ITO) and from the installation Transportation System Capability Study prepared by the Transportation Engineering Agency of the Military Traffic Management Command (MTTE-SEF).

Table 2-2 Common Car Types and Design Wheel Loads

Most Common Heavy Car	Design Wheel Load		
	10-25 mph (16-40.2 km/hr)	<= 10 mph (16 km/hr)	Light Use
Box, 40T	20,000 lb	17,600 lb	16,000 lb
Box, 50T	26,250 lb	23,100 lb	21,000 lb
Box, 70T	34,375 lb	30,250 lb	27,500 lb
Flat, 40T	17,500 lb	15,400 lb	14,000 lb
Flat, 50T	23,750 lb	20,900 lb	19,000 lb
Flat, 80T (6-axle)	23,750 lb	20,900 lb	19,000 lb
Flat, 100T (6-axle)	32,500 lb	28,600 lb	26,000 lb
Flat, 140T (6-axle)	38,750 lb	34,100 lb	31,000 lb
COFC, 70T	30,000 lb	26,400 lb	24,000 lb
COFC-Double Stack	50,000 lb	44,000 lb	40,000 lb
TOFC, 70T	30,000 lb	26,400 lb	24,000 lb
Gondola, 40T High Side	18,750 lb	16,500 lb	15,000 lb
Gondola, 50T	22,500 lb	19,800 lb	18,000 lb
Tank, 7500 gallon	16,250 lb	14,300 lb	13,000 lb
Tank, 10,000 gallon	22,500 lb	19,800 lb	18,000 lb
Tank, 20,000 gallon	36,250 lb	31,900 lb	29,000 lb
Hopper, 50T	21,250 lb	18,700 lb	17,000 lb
Hopper, 70T	30,000 lb	26,400 lb	24,000 lb
Hopper, 100T (263 K)	41,125 lb	36,190 lb	32,900 lb
Hopper, 120T (286 K)	44,750 lb	39,380 lb	35,800 lb
Hopper, 125T (315 K)	49,250 lb	43,340 lb	39,400 lb
Locomotive, EMD GP-7 or 9	37,500 lb	33,000 lb	30,000 lb
Locomotive, EMD SW-8	31,250 lb	27,500 lb	25,000 lb
Locomotive, DAV-BES 80T	25,000 lb	22,000 lb	20,000 lb
Locomotive, GE 65T	20,000 lb	17,600 lb	16,000 lb
Locomotive, GE 40T	13,750 lb	12,100 lb	11,000 lb
Locomotive, GE 25T	31,250 lb	27,500 lb	25,000 lb
Locomotive, NRE 3GS21B	41,375 lb	36,410 lb	33,100 lb

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CHAPTER 3 ESTABLISHING ROUTE PROFILE AND ALIGNMENT

3-1 INTRODUCTION.

Use the procedures in this Chapter (along with information on locomotive propulsion force, desired train capacity, propulsion resistances, and train operating requirements) to select the maximum grade and curvature and minimum transitions between grades and reverse curves.

Use these specifications as guidelines as construction costs vary depending on topography and other geological factors. Typically, the information and procedures described in this Chapter are used iteratively with those in Appendix A until a suitable solution is reached. Appendix B gives a sample problem illustrating the determination of a ruling grade. The specifications listed in this chapter are primarily for main running tracks. Chapter 7 gives additional profile and alignment specifications for terminal areas. Paragraphs 2 and 3 of Chapter 5 detail layout of horizontal and vertical curves.

3-2 GRADES AND GRADE RESISTANCE.

3-2.1 Definition.

Railroad grades are designated by the amount of elevation change in 100 ft (30.5 m) of length, expressed in percent. The additional force required to move a train, due to the presence of a grade, is known as grade resistance. Grade resistance equals 20 lb. per ton of train weight per percent grade. Thus, it takes twice the force to pull a train up a 2-percent grade as it does a 1-percent grade to overcome grade resistance. For this reason, the choice of maximum gradient greatly effects route operations.

3-2.2 Ruling Grade.

When a particular grade limits train size (tonnage) and speed over a route, that grade is known as the ruling grade. The ruling grade is not always the steepest grade, as a train’s momentum can carry it over a grade steeper, but shorter, than the ruling grade.

3-2.3 Grade Design Categories.

Table 3-1 lists grade design categories for main running tracks.

Table 3-1 Grade Design Categories for Main Running Tracks

Grade	Description
0.0 to 0.4 %	Light
0.4 to 1.0 %	Moderate
1.0 to 2.0 %	Steep
1.5 %	Suggested Limit for Ruling Grades
2.0 to 3.0 %	Very Steep: Approval required by the AHJ

3-3 ROUTE PROFILE AND TRANSITIONS BETWEEN GRADES.

3-3.1 Profile and Grade Length.

A route's profile is characterized by the steepness of grades and changes in grade along the route. Train operations are enhanced by avoiding frequent changes between ascending and descending grades (a rolling profile). Simplify route design and construction by avoiding frequent changes in grade steepness. Table 3-2 shows recommended minimum grade lengths.

Table 3-2 Recommended Minimum Grade Lengths

Maximum Speed	Between Different Ascending or Descending Grades	Between Ascending and Descending Grades
15 MPH (24.1 km/hr) or Less	500 Feet (152.4 m)	1000 Feet (304.8 m)
Above 15 MPH (24.1 km/hr)	1000 Feet (304.8 m)	1500 Feet (457.2 m)

3-3.2 Transitions between Grades.

Transitions between grades are made with vertical curves. These transitions are necessary for smooth train operation, but they increase the amount of surveying and staking required and are more difficult to construct than uniform grades.

Design guidance for grade transitions is given in Paragraph 2.2 of Chapter 5.

3-4 CURVATURE, CURVE RESISTANCE, AND EFFECTIVE GRADE.

3-4.1 Minimizing Curvature.

In general, sharper curves require more maintenance than gradual curves; they experience more rail side wear and gage widening. They also create more propulsion resistance. Minimizing curvature in a route provides long term benefits.

3-4.2 Curve Design Categories.

Table 3-3 shows curve design categories for main running tracks and terminal tracks.

Table 3-3 Curve Design Categories

Main Running Tracks	
Degree of Curve	**Design Category**
0 - 3	Gradual
3 - 6	Moderate
4	Preferred limit, especially where speeds will exceed 15 MPH (24.1 km/hr)
6 - 8	Sharp
8	Maximum allowable where speeds may exceed 10 MPH (16 km/hr)
10	Maximum allowable where speeds will not exceed 10 MPH (16 km/hr)
Terminal Tracks	
Degree of Curve	**Design Category**
10	Preferred limit, especially for lead tracks and where number 9 or 10 turnouts are the smallest recommended turnout size per Chapter 6
12	Maximum allowable

See Chapter 5, Paragraph 3 for additional horizontal curve design information.

3-4.3 Combining Curves.

When designing a route, accomplish changes in direction uniformly. Avoid a series of curves connected by short tangents. Where the distance between adjacent curves of

the same direction is less than 300 ft (91.4 m), try to combine the two curves into one long curve of smaller degree (see Figure 3-1). Combining closely spaced curves usually provides advantages of less design work, easier construction, and reduced long-term track maintenance.

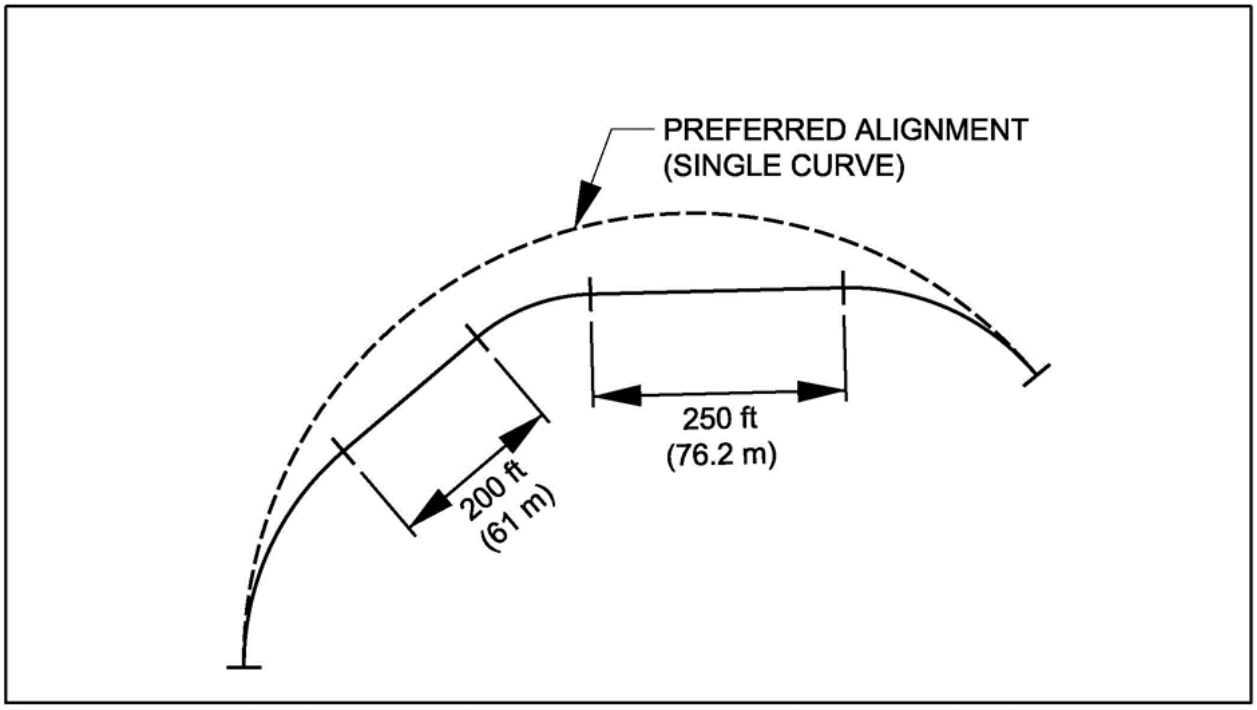
3-4.4 Curve Resistance.

Curvature adds to propulsion resistance at an average rate of 0.8 lb for each ton (.4 kg for each Metric ton) of train weight for each degree of curve. As a 1-percent grade adds resistance of 20 lb per ton (10 kg per Metric ton), a 1- degree curve is then equivalent in resistance to a 0.04-percent grade.

3-4.5 Curve Compensation.

When laying out a route, account for the additional resistance due to curvature. This procedure is known as curve compensation. Compensating a grade for curvature is almost always required for ruling grades and is recommended for grades in moderate and higher categories. Curve compensation is sometimes omitted where curves are very short or of gradual degree.

Figure 3-1 Combining Curves



When calculating curve compensation, reduce grades on curved track by the following:

Equation 3-1. Grade Reduction

$$G_r = 0.04 \times D$$

Where:
G_r = Amount of grade reduction (percent)
D = Degree of curvature (decimal degrees)

3-4.6 Actual and Effective Grade.

Table 3-4 illustrates curve compensation for a 1-percent grade. As shown, if a train travels around a long curve of 4 degrees on a 1-percent grade (uncompensated), the combined resistance is equal to a 1.16 percent grade. To maintain an effective grade (as experienced by the train) of 1-percent, the actual grade constructed through the 4-degree curve must be limited to 0.84-percent. Since the actual grade is reduced, compensating for curvature requires a longer track length to reach a given elevation.

Table 3-4 Curve Compensation for a 1 Percent Grade

Degree of Curve	Uncompensated Grade		Compensated Grade	
	Actual	Effective	Actual	Effective
1	1.00	1.04	0.96	1.00
2	1.00	1.08	0.92	1.00
3	1.00	1.12	0.88	1.00
4	1.00	1.16	0.84	1.00
5	1.00	1.20	0.80	1.00
6	1.00	1.24	0.76	1.00

3-5 LOCOMOTIVE TONNAGE RATING.

3-5.1 Definition.

The maximum train weight a locomotive can pull over a route is known as its tonnage rating. Tonnage ratings are affected by many factors, but locomotive tractive effort and ruling gradient are among the most important.

3-5.2 Application of the Procedures.

The procedures for estimating locomotive tractive effort and tonnage ratings presented below are simplified versions intended for route design purposes. Do not use these procedures to make-up and dispatch actual trains.

3-5.3 Tonnage Requirements, Locomotive Assignments, and their Effect on Route Design.

Design the route to allow trains of sufficient size to travel over the finished line. Determine the maximum train size from usable locomotive tractive effort and the gradients and curvature along the line. When designing, verify tonnage requirements with the appropriate transportation officers, as well as understand the general operating plan for routine traffic, training exercises, and mobilization.

On military railroads using government owned and operated engines, these engines might handle all routine traffic, but during training exercises or mobilization, a commercial engine can handle over-the-road operations, while the installation's engine takes care of switching and short moves. Alternatively, when installations have more than one engine, two engines can be used for maximum tonnage trains. Thus, in addition to tonnage requirements, also understand the local standard practice of locomotive use.

3-5.4 Determining Locomotive Tractive Effort.

3-5.4.1 Locomotive Capability.

Base tonnage ratings on curves when tractive effort curves are available for the locomotives. Otherwise, use expressions in Table 3-5 for tractive effort.

Table 3-5 Estimating Locomotive Tractive Effort

Speed Range	**Tractive Effort**
Starting to 10 MPH (16 km/hr)	TE = 30 x HP
Over 10 MPH (16 km/hr)	TE = 300 x HP / V
TE = Tractive Effort (in pounds) HP = Locomotive Rated Engine Horsepower V = Traveling Speed (MPH)	

3-5.4.2 Adhesion Limit.

Regardless of locomotive power, wheel rail adhesion limits the usable tractive effort. For design purposes, do not exceed W/4 usable locomotive tractive effort, where W is the weight of the locomotive in pounds.

3-5.5 Determining Tonnage Rating.

While tonnage ratings are commonly given in gross trailing tons (total weight of cars and loads), a convenient practice is to express tonnage ratings as the number of loaded cars a locomotive can pull, using an average or representative car and load for estimating purposes. Use Equation 3-2, along with Table 3-6 for selecting design car gross weight based on the nominal car carrying capacity. The constants 3 and 20 in Equation 3-2 indicate that an average car has a rolling resistance of 3 lb (1.4 kg) for each ton of its gross weight and that all equipment requires 20 lb (9.1 kg) to lift each ton of weight up each percent of grade. Any curvature on the maximum grade is assumed to be grade compensated, as described in Paragraph 4 of Chapter 3.

Equation 3-2. Design Gross Car Weights

$$N_{cars} = \frac{TE}{[3 + (20 \times \%G)]W_g}$$

Where:
N_{cars} = Number of cars locomotive can pull
TE = Usable locomotive tractive effort at desired speed (lb)
%G = Maximum ascending gradient long enough to contain the whole train (percent)
W_g = Gross weight of representative car (tons), from Table 3-6

Table 3-6 Design Gross Car Weights

Nominal Car Capacity Tons (MT)	70 (63.5)	80 (72.6)	90 (81.6)	100 (90.7)	120 (109)	140 (127)
Design Gross Weight Tons (MT)	105 (95.2)	115 (104)	125 (113)	135 (122)	160 (145)	190 (172)
Note: 140-ton (127 MT) cars (nominal capacity) are representative of those carrying 2 M1 Tanks.						

For field check, car capacity is normally stenciled on the side of each car in pounds. Capacity is labeled as CAPY on each car. For example, the marking on a 70-ton car would appear as: CAPY 140000.

3-6 TRIAL RULING GRADE.

Determine a trial percentage for the ruling grade for the first stages of route selection using Equation 3-3. The 0.15 constant in the equation indicates that the average rolling resistance for each car is equivalent to pulling the car up an additional 0.15-percent grade.

Equation 3-3. Trial Percentage for the Ruling Grade

$$G = \frac{TE}{20(W_{eng} + N_{cars} \times W_g)} - 0.15$$

Where:
G = Effective ruling gradient (percent), where the grade length is equal or greater than train length
TE = Usable locomotive tractive effort (pounds)
W_{eng} = Weight of Engine(s) (tons)
N_{cars} = Number of cars in train
W_g = Average gross weight of a car (tons)

As described in Paragraph 4 of Chapter 3, grade compensate all curvatures within the limits of the ruling grade. A ruling grade that is steeper, but shorter, than the calculated ruling grade can be used if the total train resistance of the cars on the grade and the cars off the grade does not exceed usable locomotive tractive force.

CHAPTER 4 REHABILITATION: TRACK, BRIDGES, AND TERMINALS

4-1 DEFINITION AND APPLICATION.

As used here, “rehabilitation” refers to work that falls between routine maintenance and new construction. It is often categorized as repair, minor construction, or a combination of the two. Rehabilitation involves restoring facilities to a “like new” condition and/or upgrading existing facilities to current design standards or installation requirements.

During the planning process, first establish current and future installation requirements. If subsequent investigations and analyses show that existing facilities can meet installation requirements through improving their condition and/or minor modifications, then rehabilitation is an appropriate option. Consider rehabilitation when:

- Routine track inspections reveal multiple defects that require speed restrictions or taking a track out of service.
- The track is not maintained or is out of service for an extended period.
- The track sustained multiple derailments.
- The condition of the track jeopardizes the facility’s mission.

4-2 INSTALLATION REQUIREMENTS AND FACILITY EVALUATION.

Review installation traffic and load carrying requirements, as described in Chapter 2. Then, crosscheck structural and operational requirements according to the criteria in Chapters 5, 6, and 7. Evaluations determines whether the track and facilities meet installation (mission) requirements, and if not, how they are deficient. Make these determinations through condition, structural, and operational evaluations.

4-3 CONDITION EVALUATION.

4-3.1 Level of Detail Required.

Condition evaluations occur in three stages or levels, depending on the size and scope of the project.

4-3.1.1 First Stage.

At the first stage, make a quick condition assessment based on recent inspection reports and inventory data and conduct a brief field survey. This assessment establishes the general rehabilitation requirements.

4-3.1.2 Second Stage.

The second stage is an evaluation for developing a rehabilitation plan. This information requires sufficient detail to determine the work needed at each location and to develop cost estimates for planning and budgeting purposes.

4-3.1.3 Third Stage.

At the third level, determine the exact work requirements, quantities, and locations for final contract plans and specifications.

4-3.2 Track.

Evaluate track condition based on the criteria given in UFC 4-860-03 and other major rehabilitation requirements. In addition, estimate major deficiencies expected within the next 3 to 5 years if rehabilitation is not performed. If the installation has more than five miles of track, consider using automated hi-rail track geometry testing to measure track gage, the horizontal curvature of the track, cross-level, and warp. The hi-rail geometry testing can measure approximately 15 miles of track per day, which would take several days to measure using manual, hand-held equipment. The hi-rail equipment uses GPS to track the location of the inspection results. This produces reports and interactive computer maps of the results that aid in preparing rehabilitation plans. Perform tie inspections, joint inspections, and turnout inspections using manual methods when utilizing hi-rail track geometry testing. Record current track deficiencies on a field report form.

Before completing the rehabilitation plan, perform an internal rail inspection if one has not been performed within the last 5 years. Thoroughly inspect all turnouts in the track intended for rehabilitation, including operation of the points. Figure 4-1 shows an example of the type of turnout inspection information commonly collected. Use other available forms, designed for routine maintenance requirements, if convenient.

4-3.3 Bridges.

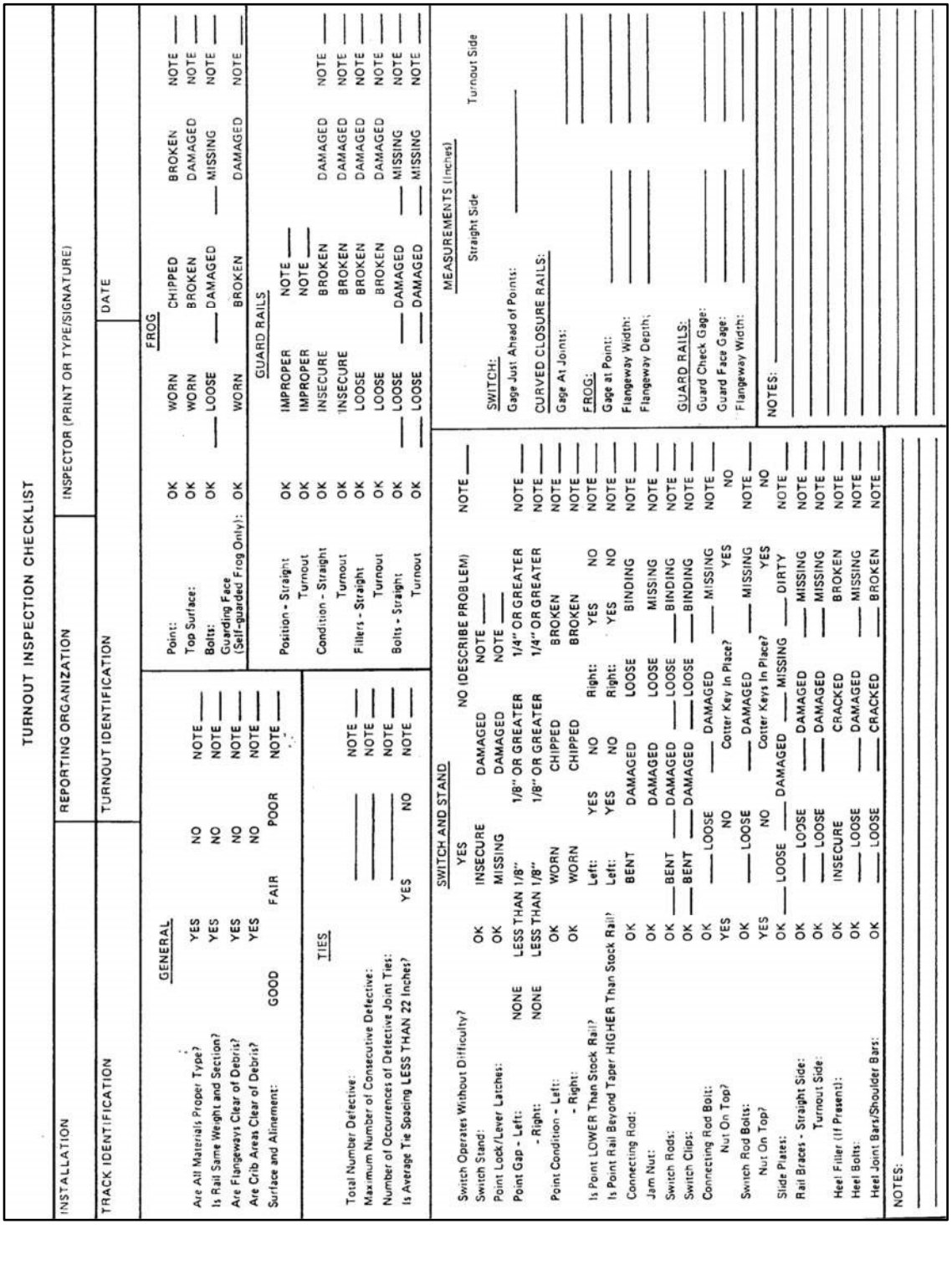
Include a condition assessment of bridges on any line to be rehabilitated. This assessment can come from the last annual inspection, if that inspection is less than 6 months old. Otherwise, conduct a new condition assessment.

If a triennial inspection is due within 6 months for any bridge on a line to be rehabilitated, conduct the triennial inspection and load rating per Chapter 4, Paragraph 4 as part of the rehabilitation plan. If the last annual inspection indicates any significant change in condition of a main bridge member since the previous load rating, thoroughly inspect and load rate at least the included span or spans of the bridge per Chapter 4, Paragraph 4 as part of the rehabilitation plan.

4-3.4 Terminal and Support Facilities.

Evaluate the condition of all terminal and support facilities. Report this evaluation separately from the track evaluation.

Figure 4-1 Example Turnout Inspection Information



TURNOUT INSPECTION CHECKLIST

INSTALLATION | REPORTING ORGANIZATION | INSPECTOR (PRINT OR TYPE/SIGNATURE)

TRACK IDENTIFICATION | TURNOUT IDENTIFICATION | DATE

GENERAL

Are All Materials Proper Type? YES NO
Is Rail Same Weight and Section? YES NO
Are Flangeways Clear of Debris? YES NO
Are Crib Areas Clear of Debris? YES NO
Surface and Alinement: GOOD FAIR POOR

TIES

Total Number Defective: _____ NOTE ___
Maximum Number of Consecutive Defective: _____ NOTE ___
Number of Occurrences of Defective Joint Ties: _____ NOTE ___
Is Average Tie Spacing LESS THAN 22 Inches? YES NO NOTE ___

SWITCH AND STAND

Switch Operates Without Difficulty? YES NO (DESCRIBE PROBLEM) NOTE ___
Switch Stand: OK INSECURE DAMAGED NOTE ___
Point Lock/Lever Latches: OK MISSING DAMAGED NOTE ___
Point Gap - Left: NONE LESS THAN 1/8" 1/8" OR GREATER 1/4" OR GREATER NOTE ___
- Right: NONE LESS THAN 1/8" 1/8" OR GREATER 1/4" OR GREATER NOTE ___
Point Condition - Left: OK WORN CHIPPED BROKEN NOTE ___
- Right: OK WORN CHIPPED BROKEN NOTE ___
Is Point LOWER Than Stock Rail? Left: YES NO Right: YES NO NOTE ___
Is Point Rail Beyond Taper HIGHER Than Stock Rail? Left: YES NO Right: YES NO NOTE ___
Connecting Rod: OK BENT DAMAGED LOOSE BINDING NOTE ___
Jam Nut: OK DAMAGED LOOSE MISSING NOTE ___
Switch Rods: OK ___ BENT ___ DAMAGED ___ LOOSE ___ BINDING NOTE ___
Switch Clips: OK ___ BENT ___ DAMAGED ___ LOOSE ___ BINDING NOTE ___
Connecting Rod Bolt: OK ___ LOOSE ___ DAMAGED ___ MISSING NOTE ___
Nut On Top? YES NO Cotter Key In Place? YES NO
Switch Rod Bolts: OK ___ LOOSE ___ DAMAGED ___ MISSING NOTE ___
Nut On Top? YES NO Cotter Keys In Place? YES NO
Slide Plates: OK ___ LOOSE ___ DAMAGED ___ MISSING ___ DIRTY NOTE ___
Rail Braces - Straight Side: OK ___ LOOSE ___ DAMAGED ___ MISSING NOTE ___
Turnout Side: OK ___ LOOSE ___ DAMAGED ___ MISSING NOTE ___
Heel Filler (If Present): OK INSECURE CRACKED BROKEN NOTE ___
Heel Bolts: OK ___ LOOSE ___ DAMAGED ___ MISSING NOTE ___
Heel Joint Bars/Shoulder Bars: OK ___ LOOSE ___ CRACKED ___ BROKEN NOTE ___

FROG

Point: OK WORN CHIPPED BROKEN NOTE ___
Top Surface: OK WORN BROKEN DAMAGED NOTE ___
Bolts: OK ___ LOOSE ___ DAMAGED ___ MISSING NOTE ___
Guarding Face (Self-guarded Frog Only): OK WORN BROKEN DAMAGED NOTE ___

GUARD RAILS

Position - Straight OK IMPROPER NOTE ___
Turnout OK IMPROPER NOTE ___
Condition - Straight OK INSECURE BROKEN DAMAGED NOTE ___
Turnout OK INSECURE BROKEN DAMAGED NOTE ___
Fillers - Straight OK LOOSE BROKEN DAMAGED NOTE ___
Turnout OK LOOSE BROKEN DAMAGED NOTE ___
Bolts - Straight OK ___ LOOSE ___ DAMAGED ___ MISSING NOTE ___
Turnout OK ___ LOOSE ___ DAMAGED ___ MISSING NOTE ___

MEASUREMENTS (Inches)

Straight Side | Turnout Side

SWITCH:
Gage Just Ahead of Points: _____
CURVED CLOSURE RAILS:
Gage At Joints: _____
FROG:
Gage at Point: _____
Flangeway Width: _____
Flangeway Depth: _____
GUARD RAILS:
Guard Check Gage: _____
Guard Face Gage: _____
Flangeway Width: _____

NOTES: _____

NOTES: _____

4-4 STRUCTURAL EVALUATION.

Perform a structural evaluation for all track, bridges, loading ramps, and other structures needed for railroad and terminal operations to determine current load carrying capacity. Use the computer program described in Chapter 5, Paragraph 6.1 for track structural evaluations.

4-4.1 Bridges.

The design capacity and present condition of the bridges along the route can determine the load-carrying capability of a railroad line. Have a practicing railroad bridge engineer examine and rate all bridges not thoroughly inspected and load rated within the previous three years. Conduct the rating in accordance with the AREMA manual for timber, concrete, and steel bridges.

Most military railroad bridges are of conventional timber design, built to an E60 rating. If these bridges are in very good condition, this capacity suffices for typical military traffic levels, including 140-ton (127 MT) heavy equipment flatcars. According to the AREMA rating guidelines, the in-service rating for bridges in very good condition can exceed their design rating. Additional material on bridge design ratings is found in Chapter 6, Paragraph 2.

4-5 OPERATIONAL EVALUATION.

Perform an operation evaluation on track and facilities to determine general suitability for mission requirements. Begin the evaluation with a check of track and facility capabilities along with basic geometric requirements, including:

- Number of loading and service tracks and usable car capacity of each.
- Car capacity of storage, yard, and auxiliary tracks.
- Clearances.
- Loading ramp height, width, and ramp slope.
- Size of parking and staging areas.
- Size of storage buildings in terminal areas.
- Track geometry.
- Maximum track curvature.
- Minimum turnout size.
- Protection and visibility at road crossings.

For terminals, evaluate the adequacy of lighting, service roads, and security features. For all track and facilities, check the adequacy of drainage. Include previous derailment sites and chronic problem areas in the evaluation.

4-6 THE REHABILITATION PLAN.

4-6.1 Purpose and Content.

The rehabilitation plan justifies the need for the recommended work. Document in the plan a thorough analysis of the existing facilities along with a clear presentation of mission requirements. The plan includes:

- Statement of installation (mission) requirements.
- Description of track and facilities and their current condition.
- Statement of deficiencies, based on condition, structural, and operational evaluations.
- A work plan of remedial actions to correct deficiencies, including an explanation of why the proposed actions were chosen over other alternatives.
- Cost estimates for each item in the work plan. Each of these items is discussed below. Appendix C contains an example track rehabilitation report; a similar format would also be used for bridges and terminal and support facilities. Appendix C presents realistic rehabilitation requirements and illustrates how track rehabilitation is commonly done. Use the plan as a guide in preparing track rehabilitation plans, particularly the sequential description of work.

4-6.2 Mission Requirements.

These are the current and expected future needs for regular traffic, training exercises, and mobilization, including amount and type of cargo, number and type of railroad cars to be handled, and terminal and support facilities requirements.

4-6.3 Description of Track, Bridges, and Facilities.

This includes a written description of facilities and their condition, along with track maps and photographs. If not previously done, assign a unique number or other designation to each track, bridge, and turnout. Mark each track with standard surveyor's stationing to help determine work and material quantities (from track lengths) and work locations, and to provide permanent reference location marks for future track inspections. In general, start track stationing with 0+00 at the point of the switch where the track branches from the main track, or for a main track, at the point where government ownership begins - at the connection with the serving commercial railroad.

4-6.4 Deficiencies List and Analysis.

Included in this section is a description of the major deficiencies found and an explanation of how these conditions interfere with, or prevent, the facilities from effectively supporting the required mission. As part of this explanation, compare the existing facilities to recommended design criteria. Include photographs to document deficiencies.

4-6.5 Work Plan.

The work plan lists recommended remedial actions for correcting deficiencies, along with the intended work limits. Within the work plan, clarify why these actions were chosen, and their advantages and benefits over other alternatives. For example, when a structural analysis indicates the need for a heavier rail section, eliminating the lighter rail often allows the installation to standardize with only one or two rail sections, thus requiring storing fewer sections for maintenance requirements and perhaps eliminating a section for which joint bars or additional pieces of rail are hard to find.

If the rehabilitation plan serves as the final plan and contract specifications, include all details of work in the work plan. Where appropriate, identify elimination of unneeded track, the possibility of re-using track materials elsewhere within the installation where traffic and structural requirements are lower, and the cost-effective sale, transfer (to another installation), or disposal of scrap and salvageable materials. For rehabilitation, re-gage the track if the existing gage is less than 56-1/4 in. (1.429 m) or greater than 57 in. (1.448 m).

4-6.6 Cost Estimates.

For plans for major rehabilitation, base cost estimates by pricing the major work items, with extra allowances for minor work at other locations and additional minor work within the major work locations or work categories. When the rehabilitation plan is done in one stage, the cost estimates must also serve for the contract plans and specifications. In this case, provide a more detailed cost estimate breakdown.

4-7 FINAL PLANS AND SPECIFICATIONS.

4-7.1 Detailed Work Plan.

Clearly define all work for the final contract plans and specifications. If not previously done, conduct a thorough inspection of all included facilities to assure correctness of work requirements, work locations, and work and material quantities.

4-7.2 Marking Parts for Replacement.

Individually mark all ties, rail, joint bars, bridge members, and other components intended for replacement and the limits for all work locations. When marking defective parts, especially ties, bridge members, switch points, and frogs, ensure those items in marginal condition (less than 3 to 5 years additional life) are included and marked for replacement.

4-7.3 Top-of-Rail Profiles.

When adding ballast to the track, and raising the track by 3 in. or more, take top-of-rail profiles (elevations along the top of the rail at 50 to 200-ft (15.2 to 61 m) intervals) to verify the final surface more easily. These profiles help in estimating ballast quantities. This is especially useful for poor existing track surfaces, as low areas require adjustment more than average to restore a smooth final surface.

Initial top-of-rail profiles are useful for track along loading docks to ensure proper car floor height at the dock. Take top-of-rail profiles wherever overhead clearances are tight.

4-7.4 Drainage Profiles and Cross Sections.

Before making final plans and estimates, take ditch profiles and cross sections to determine final ditch gradients and check earthwork quantities. Use these profiles to specify the exact work necessary and to guide the contractor's work in the field.

4-7.5 Handling Scrap and Salvage Materials.

Ensure rehabilitation contracts and specifications require neatly stacking and/or bundling scrap rail and other track materials in a designated storage area for later disposal. Also include, separating salvageable rail and other track material (OTM) by type and weight, stacking or containerizing, and storage in a designated area for reuse by the installation or shipment to another installation.

If the contractor retains scrap materials, the government receives a cost credit for that amount of scrap. This cost credit equals the fair scrap value less a small amount for handling and transporting the material.

4-8 CONSTRUCTION AND ON-SITE INSPECTION.

Quality on-site inspections, during all remedial work, are essential for successful track rehabilitation. While inspection is no substitute for competently performed track work, it assures that all work is performed according with contract specifications. On-site inspection during rehabilitation work can reveal deficiencies or errors that are difficult to detect during a completion inspection, or expensive to correct if discovered after completion. Such items include:

a. Was all excess vegetation removed before ballast was unloaded?

b. For completely rebuilt track in crossings, was the old ballast completely stripped? Was the subgrade properly graded? Was drainage fabric installed? Were all new ties installed?

c. Did the track actually receive a full 3-in. (76 mm) raise (or were the rough spots just smoothed out)?

d. Was every tie tamped? Did each tie get two insertions by the tamper? Did joint ties (on the joint side only) get a third insertion? Likewise, correcting the following items after the work is done is difficult:

- Tie and ballast material not as specified in the contract.
- Old, fouled ballast in shoulders not fully plowed out before new ballast unloaded.
- Culvert improperly positioned, or site not graded properly before culvert was installed.

- Defective concrete or insufficient reinforcing in loading ramp.

Use the same people that prepared the design and specifications to inspect the work.

CHAPTER 5 TRACK AND ROADWAY DESIGN

5-1 ROADWAY.

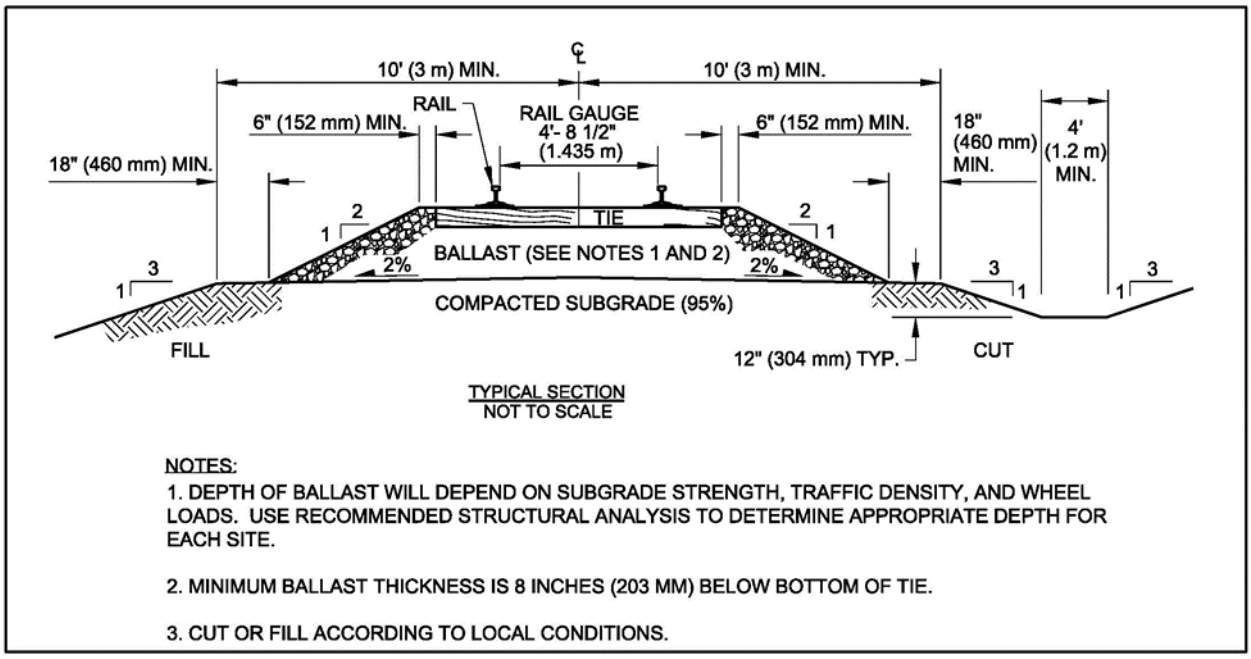
5-1.1 Definition.

The roadway is the strip of land containing the track, ditches, and other facilities needed for the operation of the railroad.

5-1.2 Roadway Width.

Roadway widths are wide enough to accommodate the track, side ditches, portions of embankment or cut slopes, parallel service roads, and other structures and facilities necessary for the operation of the railroad. The roadway must also allow sufficient clearances between the track and adjacent structures, as covered in Chapter 5, Paragraph 4. Figures 5-1 through 5-7 indicate the width required for the basic track structure. The roadway width must also meet the minimum requirements of the serving railroad, whichever is greater.

Figure 5-1 Typical Cross Section – Tangent Track



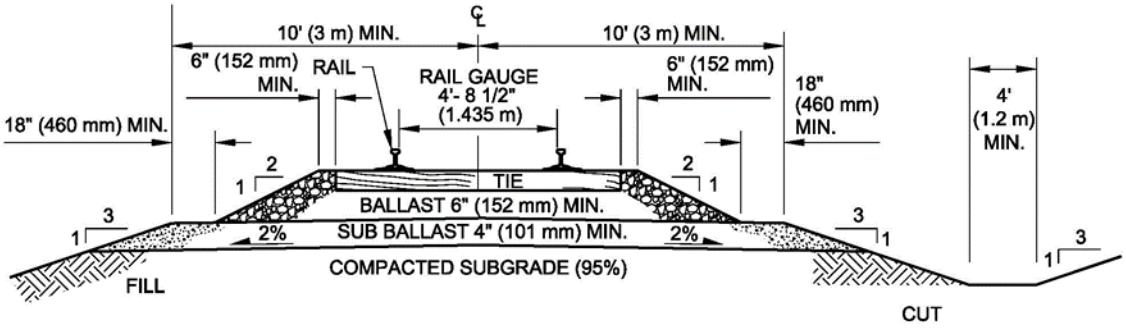
NOTES:

1. DEPTH OF BALLAST WILL DEPEND ON SUBGRADE STRENGTH, TRAFFIC DENSITY, AND WHEEL LOADS. USE RECOMMENDED STRUCTURAL ANALYSIS TO DETERMINE APPROPRIATE DEPTH FOR EACH SITE.

2. MINIMUM BALLAST THICKNESS IS 8 INCHES (203 MM) BELOW BOTTOM OF TIE.

3. CUT OR FILL ACCORDING TO LOCAL CONDITIONS.

Figure 5-2 Typical Cross Section with Sub-Ballast Layer – Tangent Track



TYPICAL SECTION
NOT TO SCALE

NOTES:

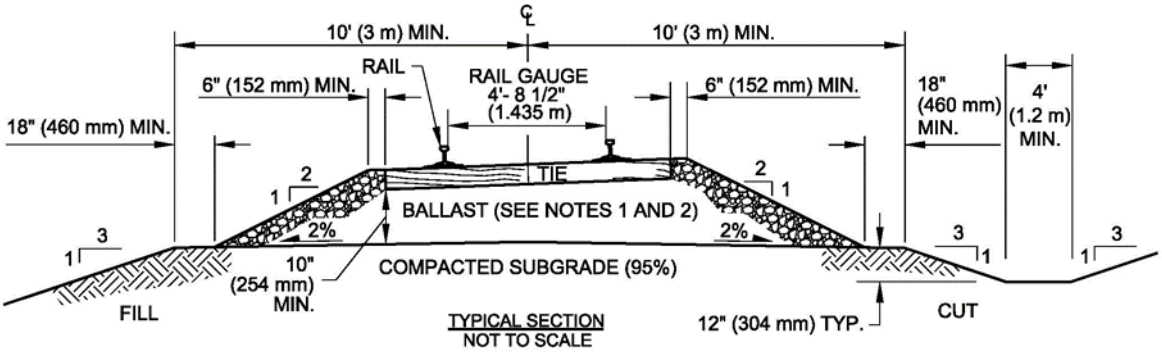
1. DEPTH OF BALLAST SECTION WILL DEPEND ON SUBGRADE STRENGTH, TRAFFIC DENSITY, AND WHEEL LOADS. USE RECOMMENDED STRUCTURAL ANALYSIS TO DETERMINE APPROPRIATE DEPTH FOR EACH SITE.

2. MINIMUM BALLAST/SUB BALLAST THICKNESS IS 10 INCHES (254 MM) BELOW BOTTOM OF TIE.

3. THICKNESS OF BALLAST AND SUB BALLAST MAY BE VARIED TO OBTAIN BEST STRUCTURAL AND ECONOMIC DESIGN WHILE MEETING MINIMUM THICKNESS REQUIREMENTS.

4. CUT OR FILL ACCORDING TO LOCAL CONDITIONS.

Figure 5-3 Typical Cross Section – Curved Track



TYPICAL SECTION
NOT TO SCALE

NOTES:

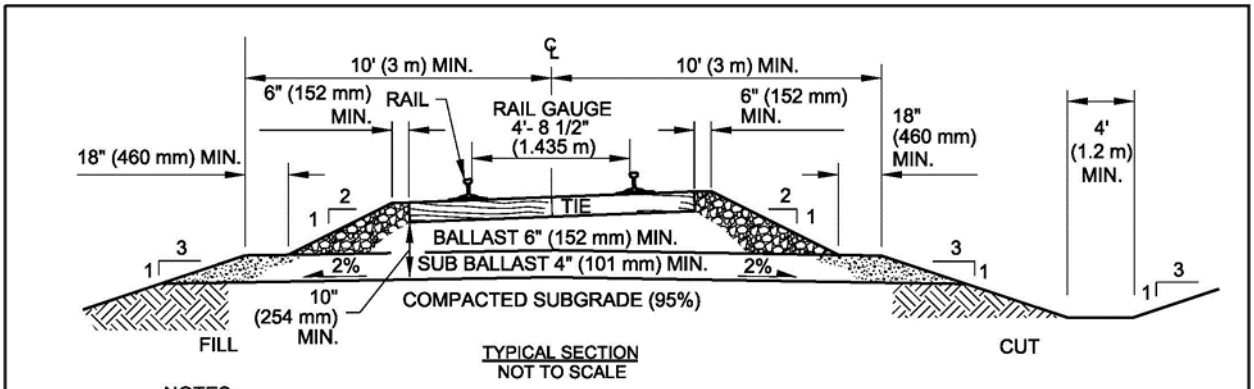
1. DEPTH OF BALLAST WILL DEPEND ON SUBGRADE STRENGTH, TRAFFIC DENSITY, AND WHEEL LOADS. USE RECOMMENDED STRUCTURAL ANALYSIS TO DETERMINE APPROPRIATE DEPTH FOR EACH SITE.

2. MINIMUM BALLAST THICKNESS IS 8 INCHES (203 MM) BELOW BOTTOM OF TIE AT THE INSIDE RAIL OF THE CURVE.

3. ON CURVES OF 6 DEGREEA OR GREATER, USE A BALLAST SHOULDER WIDTH OF 8 INCHES (203 MM).

4. CUT OR FILL ACCORDING TO LOCAL CONDITIONS.

Figure 5-4 Typical Cross Section with Sub-Ballast Layer – Curved Track



NOTES:

1. DEPTH OF BALLAST SECTION WILL DEPEND ON SUBGRADE STRENGTH, TRAFFIC DENSITY, AND WHEEL LOADS. USE RECOMMENDED STRUCTURAL ANALYSIS TO DETERMINE APPROPRIATE DEPTH FOR EACH SITE.

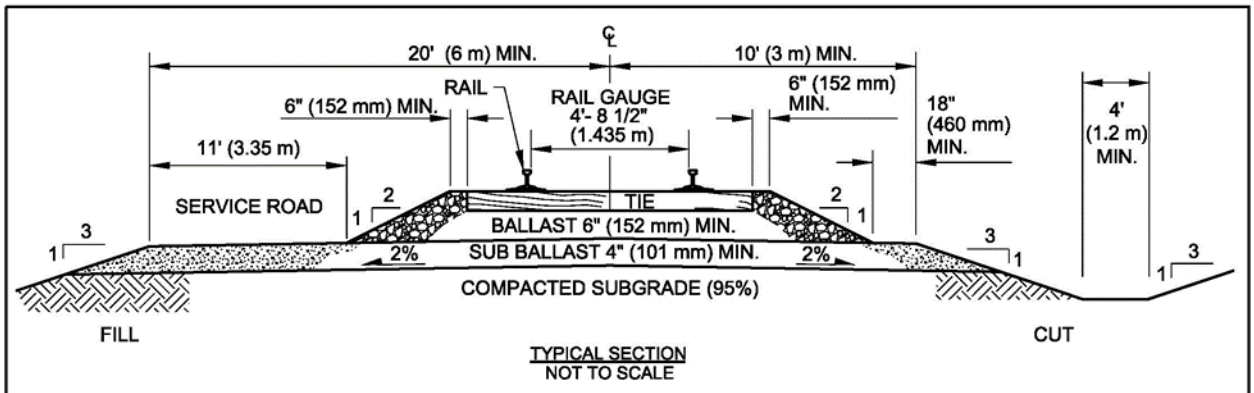
2. MINIMUM BALLAST/SUB BALLAST THICKNESS IS 10 INCHES (254 MM) BELOW BOTTOM OF TIE.

3. THICKNESS OF BALLAST AND SUB BALLAST MAY BE VARIED TO OBTAIN BEST STRUCTURAL AND ECONOMIC DESIGN WHILE MEETING MINIMUM THICKNESS REQUIREMENTS.

4. ON CURVES OF 6 DEGREEA OR GREATER, USE A BALLAST SHOULDER WIDTH OF 8 INCHES (203 MM).

5. CUT OR FILL ACCORDING TO LOCAL CONDITIONS.

Figure 5-5 Typical Cross Section – Track with Adjacent Service Road



NOTES:

1. DEPTH OF BALLAST SECTION WILL DEPEND ON SUBGRADE STRENGTH, TRAFFIC DENSITY, AND WHEEL LOADS. USE RECOMMENDED STRUCTURAL ANALYSIS TO DETERMINE APPROPRIATE DEPTH FOR EACH SITE.

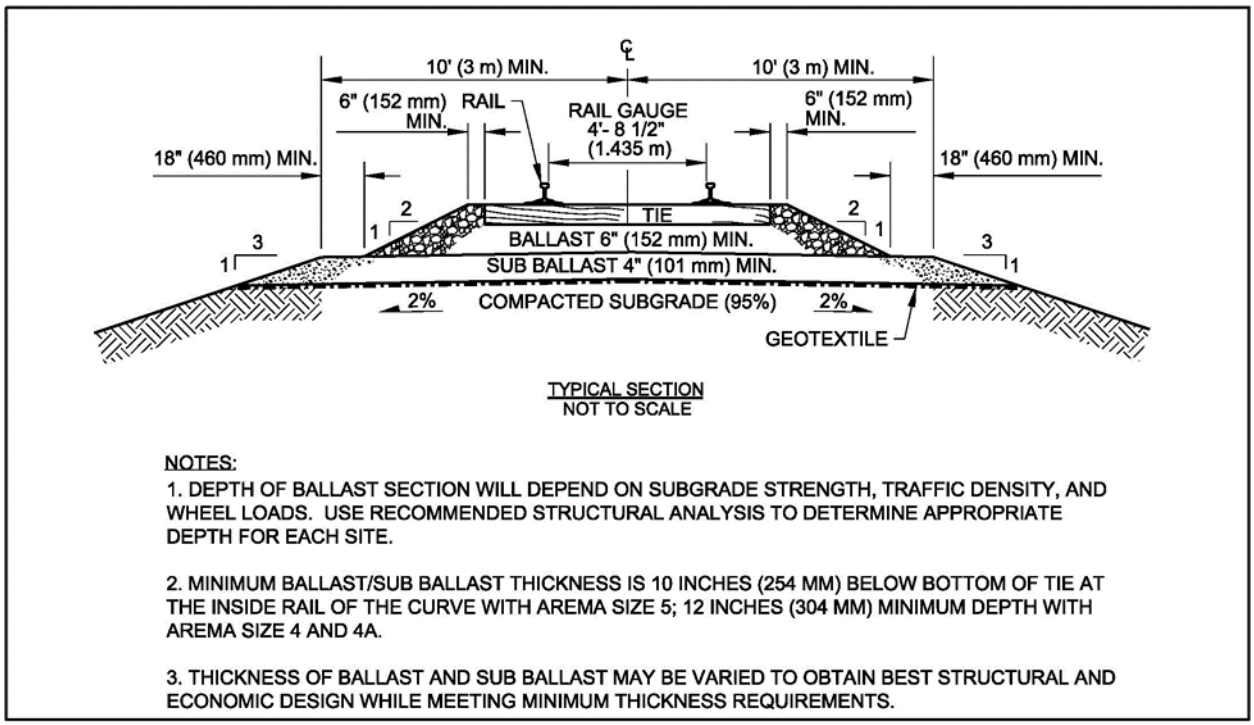
2. MINIMUM BALLAST/SUB BALLAST THICKNESS IS 10 INCHES (254 MM) BELOW BOTTOM OF TIE.

3. TO BE USED ONLY WHERE A SERVICE ROAD IS REQUIRED. SERVICE ROAD TURN AROUND REQUIRED EVERY 2,000 FEET.

4. SUB BALLAST WILL BE A MINIMUM OF 4 INCHES (101 MM) DEEP.

5. CUT OR FILL ACCORDING TO LOCAL CONDITIONS.

Figure 5-6 Typical Cross Section with Sub-Ballast Layer and Geotextile



NOTES:

1. DEPTH OF BALLAST SECTION WILL DEPEND ON SUBGRADE STRENGTH, TRAFFIC DENSITY, AND WHEEL LOADS. USE RECOMMENDED STRUCTURAL ANALYSIS TO DETERMINE APPROPRIATE DEPTH FOR EACH SITE.

2. MINIMUM BALLAST/SUB BALLAST THICKNESS IS 10 INCHES (254 MM) BELOW BOTTOM OF TIE AT THE INSIDE RAIL OF THE CURVE WITH AREMA SIZE 5; 12 INCHES (304 MM) MINIMUM DEPTH WITH AREMA SIZE 4 AND 4A.

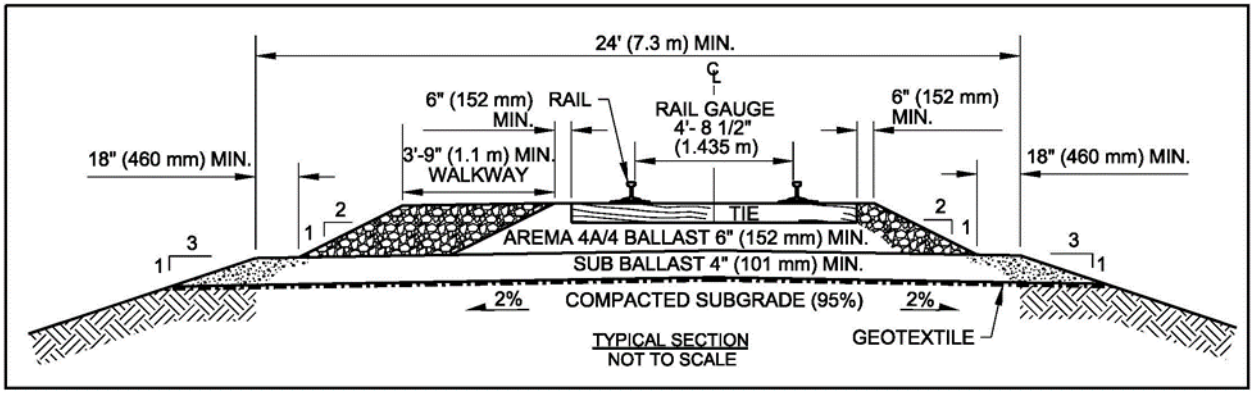
3. THICKNESS OF BALLAST AND SUB BALLAST MAY BE VARIED TO OBTAIN BEST STRUCTURAL AND ECONOMIC DESIGN WHILE MEETING MINIMUM THICKNESS REQUIREMENTS.

5-1.3 Walkways.

Walkways are required around turnout switch stands and next to tracks where personnel regularly walk to inspect railroad cars or access railroad cars to load and/or secure equipment. Walkways require additional roadway width. Walkways are not required where a service road parallels the track.

To facilitate easier walking, construct walkways of smaller-sized ballast than is used for the main track section. AREMA Size 5 ballast is typically used for walkways. A typical cross session showing a track with a walkway is shown in Figure 5-7.

Figure 5-7 Typical Cross Section – Track with Adjacent Walkway



5-1.4 Snow Allowance.

In areas with heavy snowfall, allow for additional roadway width or ditch width to provide sufficient room for snow plowed from the track.

5-2 GRADES AND TRACK PROFILE.

5-2.1 Grades.

Chapter 3 gives gradient criteria for main running tracks. Chapter 7, Paragraph 3 gives gradient criteria for terminal areas.

5-2.2 Vertical Curves.

Vertical curves are required to transition between different grades. Transition rates are different for summits and sags. A summit refers to a convex curve where an ascending grade changes to a flatter grade, where a descending grade changes to a steeper grade, or where an ascending grade changes to a descending grade. Sags are concave curves that occur where an ascending grade changes to steeper grade, where a descending grade changes to flatter grade, or where a descending grade changes to an ascending grade. Note: Avoid locating turnouts in vertical curves. Table 5-1 shows recommended transition rates between grades. Determine the length of track required for these transitions from Equation 5-1. Vertical curves should have a minimum length of 100 ft.

Equation 5-1. Track Transitions

$$L = \frac{G_1 - G_2}{r} \times 100$$

Where:
L = Length of track required for vertical curve (ft)
G1 and G2 = Slope of the two adjacent grades (percent), where ascending grades have a positive value and descending grades have a negative value
r = Rate of change in grade in 100 ft (30.5 m)

Table 5-1 Recommended Transition Rates (r) between Grades

Main Running Track		
Summits	**Sags**	**Operating Application**
0.1	0.05	Average rate where speeds will exceed 15 MPH (24.1 km/hr) and right-of-way length is ample.
0.2	0.1	Average rate where speeds will not exceed 15 MPH (24.1 km/hr) or where transition length is limited.
0.3	0.15	Maximum rate where speeds will exceed 15 MPH (24.1 km/hr).
0.4	0.2	Maximum rate where speeds will not exceed 15 MPH (24.1 km/hr).
Terminal Tracks		
Summits	**Sags**	**Operating Application**
1.0	0.6	Preferred rate for terminal tracks
2	1.2	Maximum rate for terminal tracks

5-2.3 Track Profile.

Avoid a rolling profile (frequent changes in gradient) on main running tracks or terminal tracks in the roadbed or in the final track surface (top of rail elevation). Follow the criteria in Table 3-2 to maintain an acceptably smooth track profile.

5-3 HORIZONTAL CURVES.

5-3.1 Definition.

Railroads are laid out with circular curves using the chord definition. Curvature is measured in degrees, as indicated in Equation 5-2.

Equation 5-2. Curvature

$$D = 2arcsin\left(\frac{50}{R}\right) \text{ or } R = \frac{50}{sin\frac{D}{2}}$$

Where:
D = Degree of curve (decimal degrees)
R = Radius of curve (feet)

5-3.2 Design Criteria.

5-3.2.1 Design Categories.

Table 3-3 shows design categories for horizontal curves.

5-3.2.2 Track Rehabilitation Projects.

During the design of major track rehabilitation projects, to the maximum extent practical, adjust existing curvature to less than 10 degrees for main running tracks and 12 degrees in terminal areas.

5-3.3 Minimum Tangent Length between Reverse Curves.

When curves of different directions immediately follow in sequence (reverse curves), install a length of tangent track between the two curves. The preferred and minimum tangent lengths between reverse curves are:

- Preferred Tangent Length: 100 ft (30.5 m)
- Minimum Tangent Length: 60 ft (18.2 m)

5-3.4 Super Elevation.

For either new design or major rehabilitation, elevate the outer rail in curves above the inner rail by the amount shown in Table 5-2. Ensure designs do not call for a combination of speed and curvature that fall below the bottom-stepped ledger line in the table. Provide ½ inch (13 mm) of super-elevation on all curves in main running tracks wherever possible even when not required by Table 5-2. Do not provide super-elevation in terminal yard tracks.

Provide full super-elevation around the entire curve. For curves with 1-in. (25 mm) super-elevation, run out that elevation (transition back to level) in 40 ft (12.1 m) of tangent at the beginning and end of the curve. Where super-elevation is more than 1in. (25 mm), provide spirals at each end of the curve.

Table 5-2 Design Super-Elevation for Curved Track

Degree of Curvature	Design Operating Speed MPH (km/hr)						
	10 (16)	15 (21.4)	20 (32.2)	25 (40.2)	30 (48.3)	35 (56.3)	40 (64.4)
0.5	NO SUPER-ELEVATION REQUIRED						1.0
1.0					1.0	1.0	1.0
1.5				1.0	1.0	1.5	1.5
2.0			1.0	1.0	1.5	2.0	2.0
2.5			1.0	1.5	1.5	2.0	2.5
3.0		1.0	1.0	1.5	2.0	2.5	3.0
3.5		1.0	1.0	1.5	2.0	2.5	3.0
4.0	1.0	1.0	1.0	1.5	2.0	3.0	3.5
4.5	1.0	1.0	1.5	2.0	2.5	3.5	4.0
5.0	1.0	1.0	1.5	2.0	3.0	4.0	
5.5	1.0	1.0	1.5	2.0	3.0		
6.0	1.0	1.0	1.5	2.0	3.0		
6.5	1.0	1.5	2.0	2.5			
7.0	1.0	1.5	2.0	2.5			
7.5	1.0	1.5	2.0				
8.0	1.0	1.5	2.0				
8.5	1.0						
9.0	1.0						
9.5	1.0						
10.0	1.0						
10.5	1.0	DO NOT DESIGN FOR OPERATION IN THIS RANGE					
11.0	1.0						
11.5	1.0						
12.0	1.0						

Note: Table entries are super-elevation in inches.

5-3.5 Spirals.

When used, design spiral transition curves as shown in Chapter 5, Section 3.1 of the AREMA Manual. Increase super-elevation uniformly from zero at the beginning of the spiral (at the tangent) to the full elevation at the end of the spiral (where full curvature is reached).

Determine spiral length from Equation 5-3.

Equation 5-3. Spiral Length

$$L_s = 40 \times S$$

Where:
L_s = Length of spiral (feet)
S = Full super elevation (inches)

5-3.6 Increase in Gage on Very Sharp Curves.

Where curves of 12 degrees or more are unavoidable, finished track gage is as follows:

Table 5-3 Finished Track Gage

Curvature Range (degrees)	Track Gage in. (m)
12 to 16	56⅝ (1.438)
14 to 16	56¾

5-4 CLEARANCES.

5-4.1 Clearances to Check.

For either new construction or rehabilitation work, ensure the location and position of all tracks are checked for proper clearances before the final design is prepared and after construction is complete. Provide allowances for future track surfacing (adding ballast and raising track) and for small changes in alignment during maintenance.

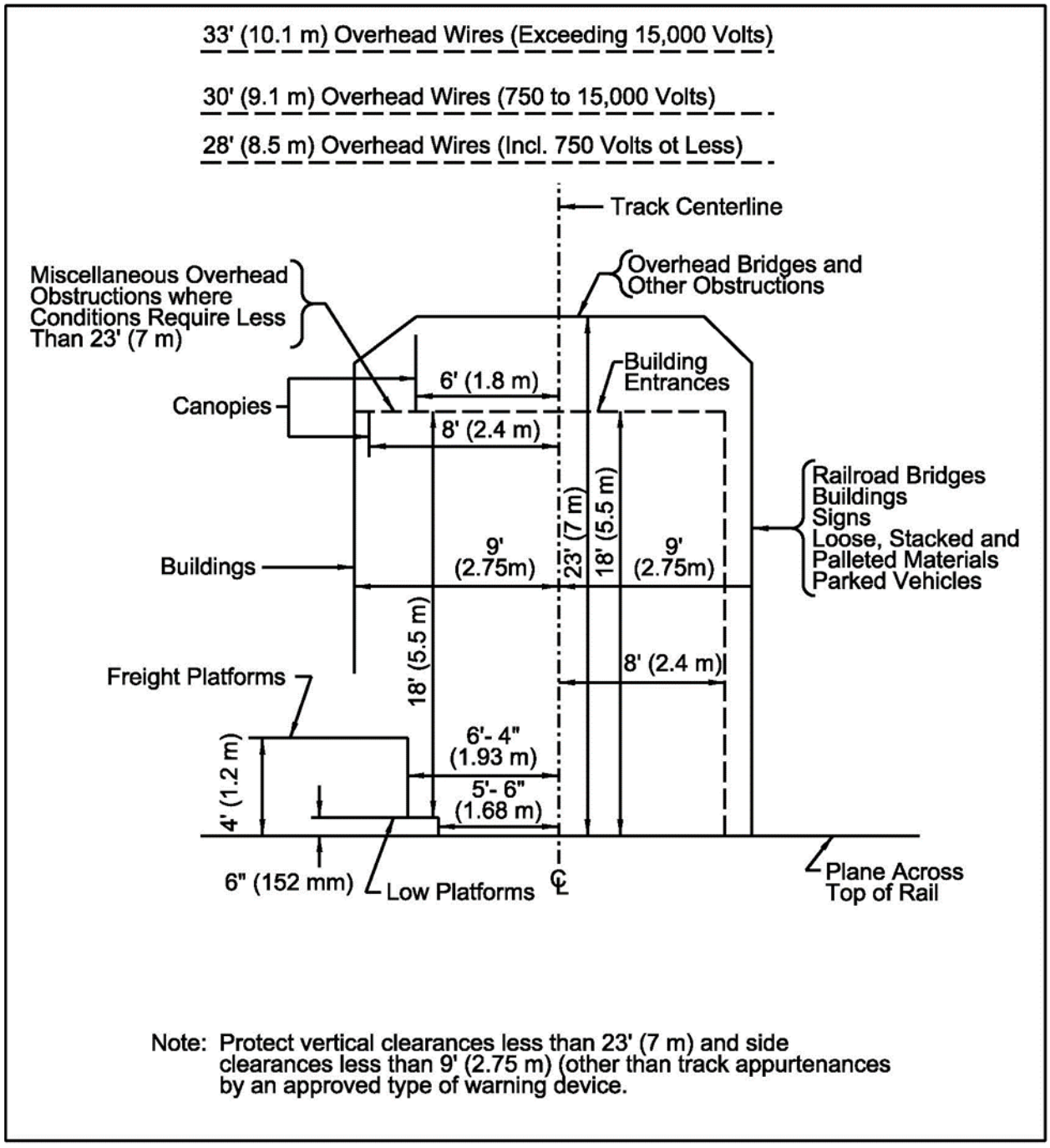
5-4.2 Recommended Minimum.

Minimum clearances are shown in Figure 5-8 and Table 5-4. Vertical clearances are measured from the top of the rail, and horizontal clearances are measured from the center line of track.

5-4.3 State Requirements.

Each State has legal requirements for railroad clearances. These are summarized in a table in Chapter 28, Section 3.6 of the AREMA Manual. When State requirements exceed clearances shown in Figure 5-8 or Table 5-4, use the State requirement.

Figure 5-8 Clearance Diagram for Tangent Track



Note: Protect vertical clearances less than 23' (7 m) and side clearances less than 9' (2.75 m) (other than track appurtenances by an approved type of warning device.

Table 5-4 Overhead and Side Clearances for Tangent Track

Vertical Clearances (from top of rail)	Required Clearance
Overhead wires: (open supply, arc wires, service drops)	
0 to 750 volts	28 ft (8.5 m)
750 to 15,000 volts	30 ft (9.1 m)
15,000 to 138,000 volts	33 ft (10.1 m)
Other overhead wires	28 ft (8.5 m)
Building entrances (including engine-houses)	18 ft (5.5 m)
Overhead bridges	23 ft (7 m)
Other overhead obstructions	23 ft (7 m)
Side Clearances (from track center)	
Buildings	9 ft (2.75 m)
Buildings without platforms requiring delivery of materials	8 ft (2.44 m)
Platforms:	
Freight platforms up to 4' maximum height	6 ft – 4 in (1.93 m)
Low platforms (less than 6" high)	5 ft – 6 in (1.67 m)
Building entrances (other than engine-house)	8 ft (2.44 m)
Canopies over platforms (canopy height < = 18')	8 ft (2.44 m)
Fences, retaining walls, utility poles, and other obstructions	9 ft (2.75 m)
Bridges	9 ft (2.75 m)
Signs	9 ft (2.75 m)
All loose, palleted, and stacked materials	9 ft (2.75 m)
Parked vehicles	9 ft (2.75 m)

Notes: 1. In curves, side clearances will be increased 1½ in. (38 mm) per degree of curvature.

2. For voltages greater than 138,000 volts, see the latest National Electric Safety Code and assume a rail car height of 23 ft. (7 m) to determine required clearance.

5-4.4 Curved Track.

For each degree of curvature, increase side clearances 1-1/2 in. (38 mm) over that required in Figure 5-8 and Table 5-4. When an obstruction is located adjacent to tangent track, but the track begins to curve within 80 ft (24.4 m) of the obstruction, increase the side clearances by the amounts shown in Table 5-5.

Table 5-5 Clearance Increases Adjacent to Curved Track

Distance from Obstruction to Curved Track ft (m)	Increase in Clearance per Degree of Curvature inch (mm)
0 -20 (0 -6)	1½ (38)
21 – 40 (6.4 – 12.1)	1⅛ (28.6)
41 – 60 (12.5 – 18.2)	¾ (19)
61 – 80 (18.6 – 24.4)	⅜ (9.5)

5-4.5 Minimum Track Centers.

The recommended minimum distance between the center lines of adjacent tracks is given in Table 5-6.

Table 5-6 Track Center Distances

Between	Minimum Distance Between Centerlines ft (m)
New Tracks	15 (4.6)
Existing Tracks	14 (4.3)

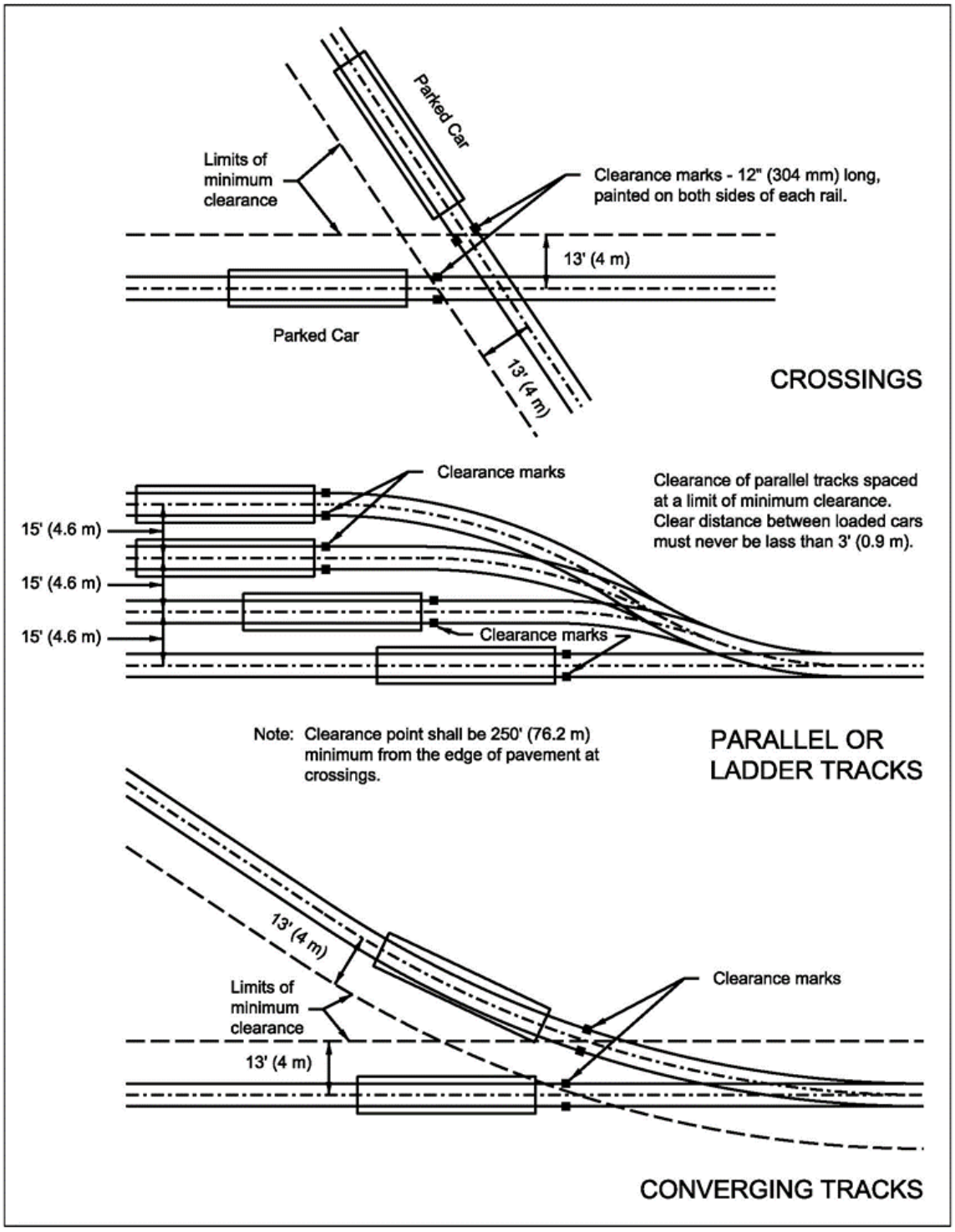
5-4.6 Clearance Points at Turnouts, Ladder Tracks, and Crossings.

Figure 5-9 illustrates how to determine the location of clearance points at turnouts, ladder tracks, and rail crossings. Ensure no rail car or piece of equipment remains standing on a track with any part of it extending past the clearance point (toward the track junction), the clearance point will determine the usable length of sidings, loading, yard, and storage tracks.

- Mark clearance points by a 12-in. (300 mm) yellow bar painted on both sides of the rail base.

- If derails are used, they must be set to derail equipment before it reaches the clearance point.

Figure 5-9 Location of Clearance Points



5-5 TRACK STRUCTURE.

5-5.1 Design Objective.

Among its various functions, the track system distributes the large, concentrated wheel loads longitudinally, laterally, and vertically away from the wheel contact area on the rail surface. A well designed, constructed, and maintained track distributes loads in a relatively uniform fashion, with each component supporting its share of the load. The role of the designer is to select a track structure or changes to an existing track that ensures intended wheel loads are properly supported, without overstressing any of the four main track system components: rail, ties, ballast, and subgrade.

5-5.2 Load Distribution.

As Figure 5-10 shows, when a wheel is centered over a tie, the tie directly beneath the load will generally carry less than half of that wheel load, with the remainder supported by two ties on either side. Beneath the wheel, the pressures are distributed (reduced) approximately as shown in Figure 5-11. With a wheel-rail contact area of about ½ sq in., stresses are reduced from 60,000 psi (414 MPa) at the top of the rail to about 10 psi (.069 MPa) at the depth of the subgrade surface. While the actual load and pressure distributions vary with wheel load, track design, and track condition, the two figures illustrate a realistic case for good track.

Figure 5-10 Example Load Distribution along the Track

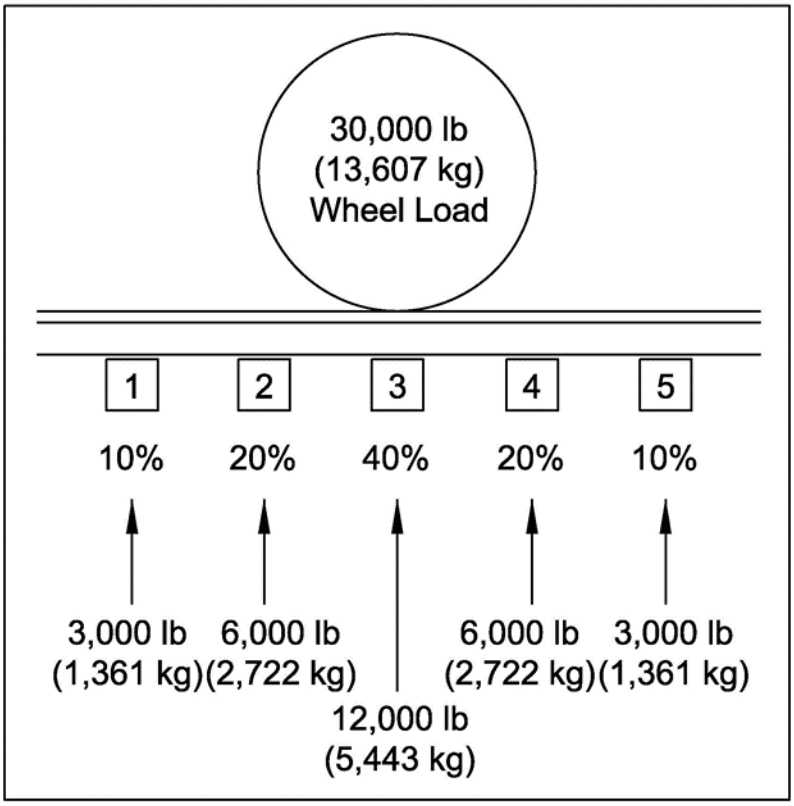
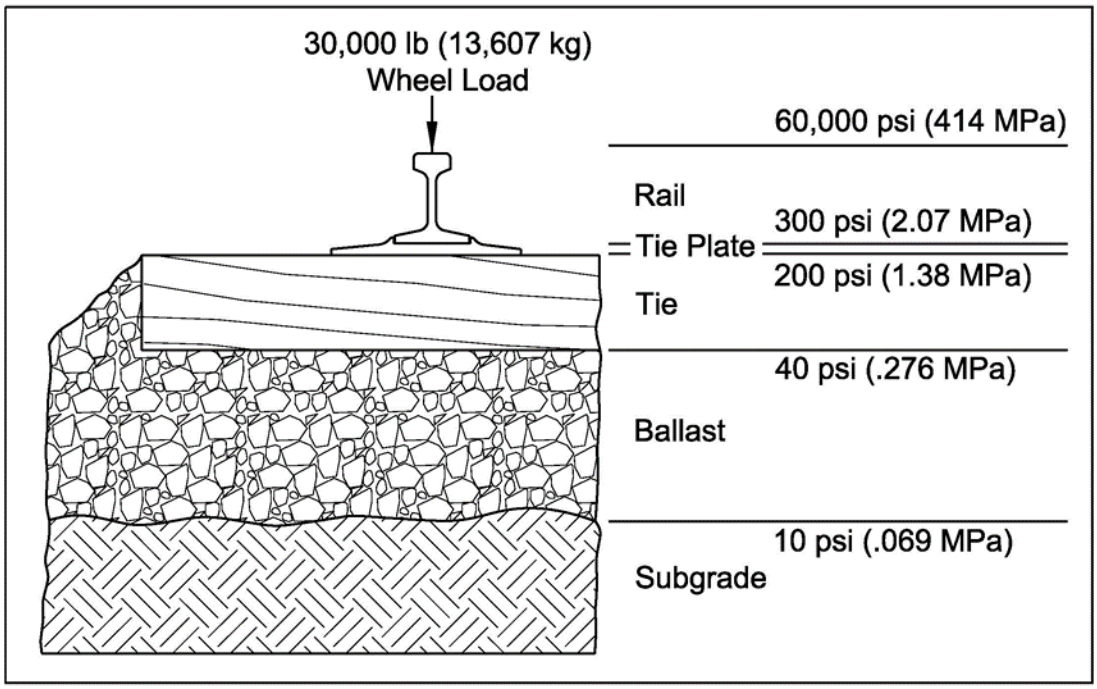


Figure 5-11 Example Vertical Pressure Reduction through the Track



5-5.3 Behavior under Load.

Although track construction is relatively simple, its behavior under load is not. An improvement (or increase in strength) in one track component can increase the load on another. It is not uncommon for an improvement (or increase in strength) of one track component to cause an increased load on another.

5-6 TRACK DESIGN METHODS.

5-6.1 Computer Program Available.

TRACK is the computer program for basic track structure design and is available at the PCASE Internet Site (https://transportation.erdc.dren.mil/pcase/software.aspx) or the Army Transportation Systems Center (CENWO-ED-TX).

5-6.2 Manual Design Procedure.

If computer programs are not accessible or if a computer is unavailable, use the design procedure in Paragraph 7 as an alternative. A disadvantage of this method, however, is that very little data exists to correlate the value of track modulus with the properties of individual rail support components: ties, ballast, and subgrade.

5-7 AREMA DESIGN PROCEDURE (1995-MODIFIED).

5-7.1 Applying the AREMA Method to Military Track.

The AREMA method leaves several choices and judgments open to designers, to be set according to situation and policy. And like most AREMA criteria, the method is also oriented toward those commercial lines that carry medium to heavy traffic volumes (more than 10 million gross tons (9.07 million Metric tons) per year) and operate at medium or higher speeds (more than 40 mph (64.4 km/hr)). The guidance below assumes that most military track operates at relatively low traffic volumes (less than 5 million gross tons (4.54 million Metric tons) per year) and at relatively low speeds (less than 25 mph (40.2 km/hr)), and uses jointed, rather than continuously welded, rail.

For unusual cases where yearly traffic frequencies are expected to exceed 5 million gross tons (4.54 million Metric tons), designers can follow the method directly from Chapter 16 of the AREMA Manual.

5-7.2 Basis for Design.

The AREMA track design method is based on extensive field and laboratory testing conducted between 1914 and 1940. The committee supervising the tests and evaluations was led by Professor Arthur Talbot of the University of Illinois, whose name is often used when referring to the tests and findings. The Talbot Committee found that, when subject to a large number of load repetitions (“millions of groups of car wheels”), the greater the vertical rail deflection under those loads, the faster the track condition deteriorated. From the data and observations collected, AREMA employs a track design method based on limiting or controlling vertical rail deflection.

Figure 5-12 illustrates the general relationship between track deflection and track performance over long time periods. The design criteria in this section limits the deflection of main running tracks to 0.3 in. (7.6 mm) and of auxiliary, storage, spur, and light use tracks to 0.4 in. (10.2 mm). The AREMA track design method uses the beam-on-elastic-foundation model. In this model, the track has two components: the beam, which is the rail, and the elastic foundation, which represents everything below the rail combined. The basic expression in the model relates three main variables: the load on the rail, the stiffness of the track system, and the amount of vertical rail deflection, as shown in Equation 5-4.

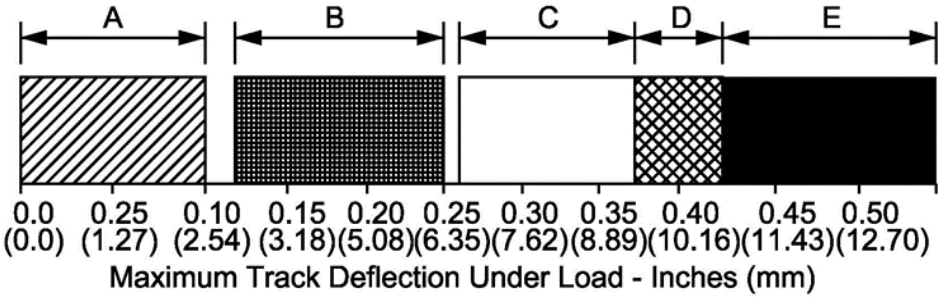
Equation 5-4. Vertical Rail Deflection

$$Y = \frac{P}{(64\ EIu^3)^{.025}}$$

Where:
Y = vertical rail deflection at a point (inches)
P = applied wheel load (including contributions from adjacent wheels) (lb.)
EI = stiffness of the rail, where:
E = modulus of elasticity for steel (30 x 10^6 psi)

I = vertical moment of inertia of the rail section (inches^4)
u = stiffness of rail support, or track modulus (psi)
In this equation, EI represents the stiffness of the "beam" and u the stiffness of the "elastic foundation."

Figure 5-12 Maximum Track Deflection and Long-Term Track Performance



Range	Long Term Track Performance
A	Excessively stiff track.
B	Track of heavier construction which wil hold up well under large traffic volumes (> 15 GT (15.2 MT)).
C	Track suitable for lower thraffic volumes (< 15 GT (15.2 MT)).
D	Sidings and other auxiliary tracks on low traffic lines.
E	Track which will deteriorate quickly: only suitable for occasional movements with cars less than 100 tons (101.6 MT) capacity.

Note: Deflections do not include any play or looseness between track components.

5-7.3 Design Load and Wheel Spacing.

5-7.3.1 Design Load.

Select the design wheel load from Table 2-2, based on the most common, heaviest car expected to travel over the track.

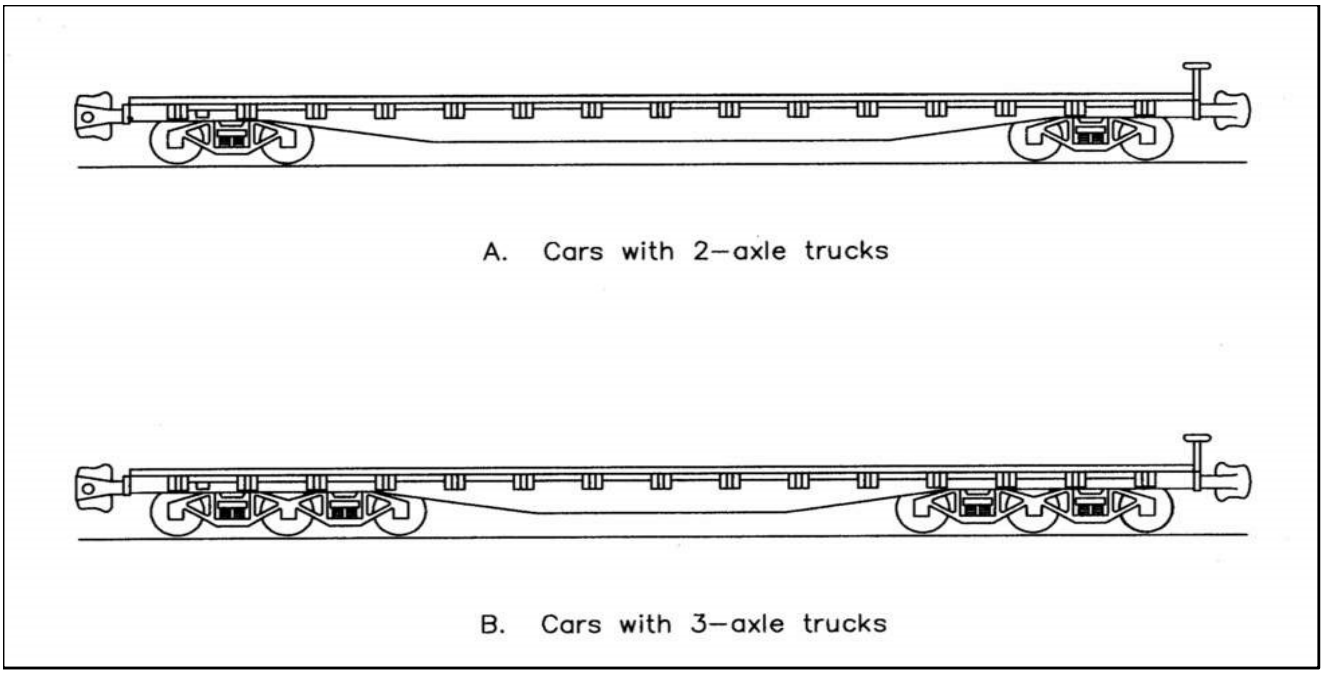
5-7.3.2 Wheel Spacing.

Figure 5-13 shows the two most common wheel configurations. Most cars have two-axle trucks and the design wheel configuration is that in drawing (A), with an average 75-in. (1905 mm) wheel spacing. The 140- ton (127 MT) series flat cars, for carrying M-1 tanks and other heavy vehicles, and some 100-ton (90.7 MT) flat cars have 3- axle

trucks; their design wheel configuration is drawing (B), with 66-in. (1676 mm) wheel spacing.

Evaluate the track assuming that a wheel is centered over a tie, with an adjacent wheel on either side contributing to the loads, deflections, and stresses - as occurs when two cars are coupled together. Referring to Figure 5-13(A), the maximum tie, ballast, and subgrade loads occur under wheels one and four (counting from the left), while the maximum rail bending stress occur at wheels two and three. For the wheel configuration in Figure 5-13(B), the maximum tie, ballast, and subgrade loads occur under wheels two and five, while the maximum rail bending stress occur at wheels three and four. The effect of wheels farther than 100 in. (2540 mm) from the design wheel is negligible.

Figure 5-13 Design Wheel Configurations



5-7.4 Select Track Modulus (u).

The track modulus values listed in Table 5-7 are suggested starting points for design. In the table, track type “main” refers to main running tracks, while “auxiliary” includes sidings, wyes, loading, spur, storage, interchange, and light use tracks.

Table 5-7 Suggested Design Track Modulus Values

Track Type	Design Wheel Load Range – 1,000's of pounds (1,000's of kilograms)					
	20 – 25 (9.1 - 11.3)	25 - 30 (11.3 - 13.6)	30 – 35 (13.6 - 15.9)	35 – 40 (15.9 - 18.1)	40 - 45 (18.1 - 20.4)	45 – 50 (20.4 - 22.7)
Main	1500	1800	2000	2300	2600	2900
Auxiliary	1200	1300	1500	1700	2000	2200

5-7.5 Select Rail Size and Section.

Use Equation 5-5 to determine a minimum rail weight.

Equation 5-5. Minimum Rail Weight

$$W_o = 315 - \frac{21200}{\left(\frac{P}{1120}\right)(\alpha) + 67}$$

Where:
W_o = Weight of rail (lb./yd.)
P = Design wheel load (lb.)
α = Impact factor, where:
α = 1, where design operating speed is 25 mph or less.
α = 1.4, where design operating speed is more than 25 mph.

Select a rail section from Table 5-8 of equal or greater weight than calculated above.

Table 5-8 Rail Sections

Rail Section	Moment of Inertia, I (inches^4)	Section Modulus to Base, Z_b (inches^3)
115 RE	65.6	22.0
132 RE	88.2	27.3
133 RE	86.0	27.0
136 RE	95.4	28.2

5-7.6 Determine Moment and Loading Coefficients.

The moment and loading coefficients account for the effects of wheels adjacent to the design wheel. Adjacent wheels reduce rail moment and increase tie, ballast, and subgrade load. Calculate x_1 using Equation 5-6. (x_1 should normally range between 28 and 40).

Equation 5-6. Distance from Design Wheel Load to Point of Zero Bending

$$x_1 = 82\sqrt[4]{\frac{I}{u}}$$

Where:
x_1 = Distance from design wheel load to point of zero bending moment (inches)
I = Vertical moment of inertia of rail section (in.^{4})
u = Stiffness of rail support, or track modulus (psi)

Determine coefficients C_m and C_d as follows. For most design situations, and for cars with either 2-axle or 3-axle trucks, the rail moment coefficient (C_m) can be taken as 0.8. The load coefficient C_d can be taken from the following table. Intermediate values of Cd can be interpolated.

Table 5-9 Values for C_d

X_1 =		28	30	32	34	36	38	40
Design Wheel Spacing	66 in (1.67 m):	1.24	1.30	1.36	1.44	1.54	1.62	1.70
	75 in (1.91 m):	1.08	1.15	1.22	1.30	1.36	1.42	1.50

5-7.7 Check Rail Bending Stress.

Use Equation 5-7 to check that rail bending stress is less than 32,000.

Equation 5-7. Rail Bending Stress

$$f_0 = \frac{(0.318 P_d C_m X_1)}{Z_b}$$

Where:
f_o = Maximum flexural stress (psi)
P_d = Dynamic (design) wheel load (lb) from Table 2-2
C_m = Moment coefficient
X_1 = Distance from wheel load to point of zero bending moment (inches)
Z_b = Section modulus of rail base, from Table 5-8 (cu in.)

5-7.8 Ties and Tie Spacing.

Choose a trial tie spacing and calculate the maximum rail seat load using Equation 5-8:

Equation 5-8. Maximum Rail Seat Load

$$q_o = \frac{0.39 P_d C_d S}{X_1}$$

Where:
q_o = Maximum rail seat load (lb)
P_d = Dynamic (design) wheel load (lb) from table 2-2
C_d = Load coefficient for adjacent wheels
S = Tie spacing (inches). Typical spacings range from 19.5 in. (495 mm) to 22 in. (558 mm)
X_1 = Distance from wheel load to point of zero bending moment (inches)

Select tie size, either 6-in. x 8-in. x 8.5 ft (152 mm x 203 mm x 2.6 m), or 7-in. x 9-in. x 8.5 ft (178 mm x 229 mm x 2.6 m). Check tie bending stress using Equation 5-9 or 5-10. If f_t is greater than the maximum value of f_t in Table 5-, choose a larger tie size or decrease tie spacing.

Equation 5-9. Bending Stress for 6-in x 8-in (152 mm x 203 mm) Ties

$$f_t = \frac{q_o}{29}$$

Equation 5-10. Bending Stress for 7-in x 9-in (178 mm x 229 mm) Ties

$$f_t = \frac{q_o}{52}$$

Where:
f_t = Flexural stress on underside of tie below rail seat (psi)
q_o = Maximum rail seat load (lb.)

Table 5-10 Maximum Allow Values for f_t

Tie Material	**Maximum Allowable Value for f_t psi (MPa)**
Oak	1400 (9.65)
Mixed Hardwoods	1100 (7.58)
Longleaf Yellow Pine	1000 (6.89)
Douglas Fir	800 (5.52)

5-7.9 Ballast and Subgrade.

Determine ballast surface stress from Equation 5-11, with p_m = 65 psi (.448 MPa) as a suggested limit. If p_m exceeds 65 psi, choose a larger tie and/or decrease tie spacing.

Equation 5-11. Ballast Surface Stress

$$p_m = \frac{q_o}{A_b}$$

Where:
p_m = Ballast surface stress (psi). qo = Maximum rail seat load (lb.)
A_b = Effective bearing area of ½ tie on ballast under one rail (sq. in.)
For 6 x 8 (152 mm x 203 mm) ties, A_b = 270
For 7 x 9 (178 mm x 229 mm) ties, A_b = 312

Select design subgrade bearing capacity (pc) according to results of soil tests or other data. (In the absence of other guidance, the design bearing capacity for cohesive soils is the same as the unconfined compressive strength). Determine ballast depth from Equation 5-12:

Equation 5-12. Ballast Depth

$$h = \frac{\left(50\frac{p_m}{p_c}10\right)^{0.74}}{2.54}$$

Where:
h = Ballast depth in inches
p_m = Ballast surface stress (psi)
p_c = Design subgrade bearing capacity (psi)

5-8 SUBGRADE.

5-8.1 Subgrade Stability and Track Performance.

The subgrade is the prepared earth on which the railroad ballast section and track structure are built. If the subgrade does not have sufficient stability, it will be impossible to maintain proper track alignment, profile (surface), and cross level.

5-8.2 Soil Investigation.

Prior to initial design of the track structure, perform a geotechnical investigation along the proposed alignment to determine soil type, strength, bearing capacity, location of groundwater tables, natural water content, and compaction characteristics. Additional geotechnical borings, laboratory testing, and engineering analysis are required in areas where bridges or other special structures are to be constructed. Chapter 1, Section 1.1 of the AREMA Manual provides recommendations for geotechnical investigations. The

spacing and depth of borings will be project specific and developed with the assistance of a geotechnical engineer.

5-8.3 Design of Cuts and Fills and Subgrade Preparation.

Chapter 1, Section 1.2 of the AREMA Manual provides recommendations for design of cuts and fills and subgrade preparation. Table 1-1-10 of the AREMA Manual indicates soils types and their suitability as railroad subgrades.

5-8.4 Track Structure Design Bearing Capacity - Cohesive Soils.

For cohesive soils, and for track expected to carry the usual military traffic level of less than 5 million gross tons per year, set design bearing capacity for the track structure at the soil's unconfined compressive strength at its natural water content. For unusual cases, where annual traffic volumes are projected at higher than 5 million gross tons (4.5 million Metric tons), use 80 percent of the unconfined compressive strength as the design bearing capacity.

5-8.5 Soil Stabilization.

Information on the use of soil stabilization and the design and construction of soil stabilized subgrades is presented in UFC 3-250-11. In frost areas, use soil stabilizers with caution and only after intensive laboratory testing, including a frost susceptibility test and a freeze-thaw durability test.

5-9 FROST DESIGN MODIFICATIONS.

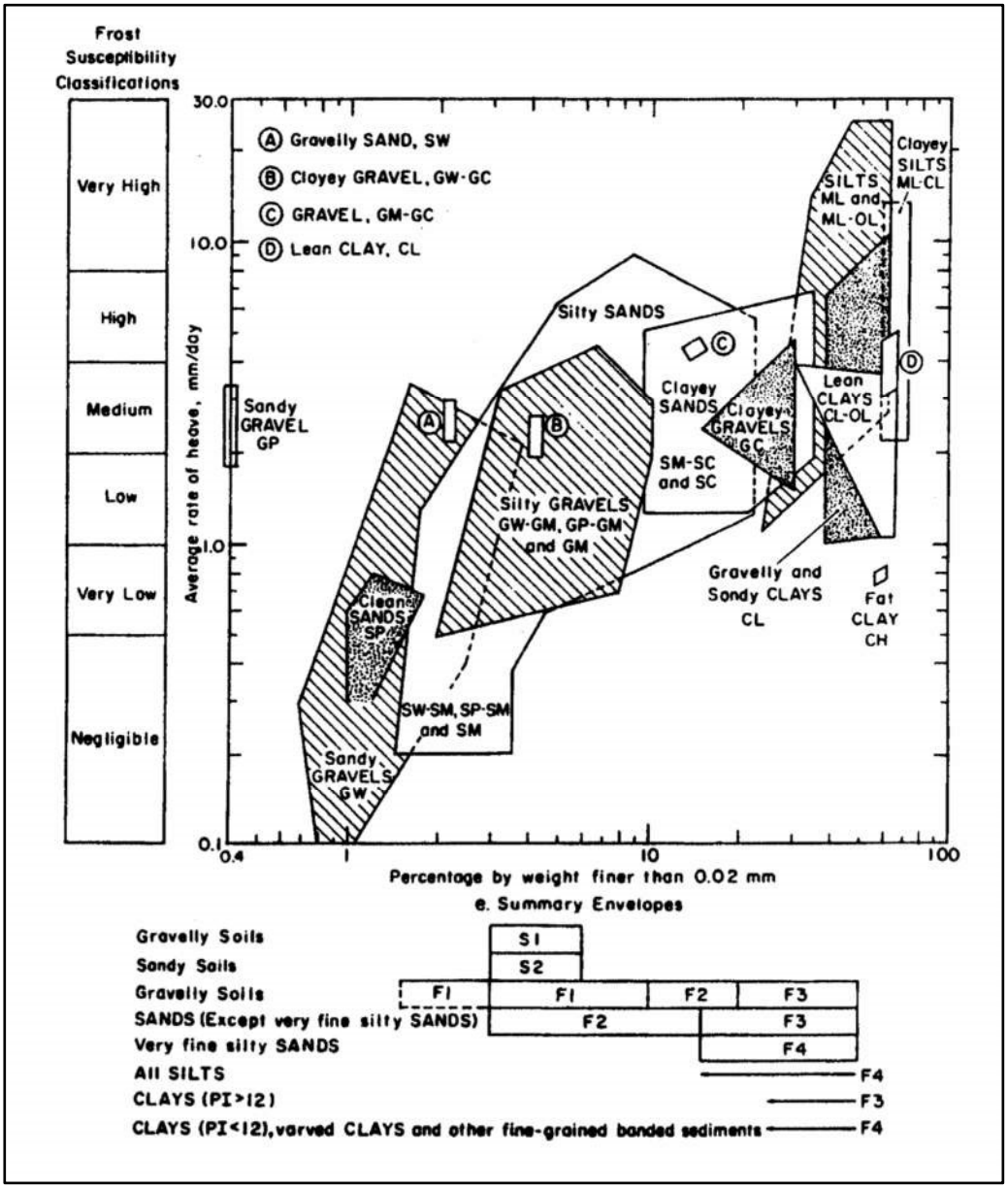
5-9.1 Frost Heave Conditions.

Frost heaving is the rising of the soil due to the growth of ice lenses or ice segregation during freezing. There are three basic conditions that must be present for ice segregation to occur: a frost susceptible soil, a source of water, and freezing temperatures. A change in any of the three conditions impacts the amount of heave.

5-9.2 Identifying Frost Susceptible Soils.

For design purposes, the potential for ice segregation is often expressed as a function of grain (or particle) size. Most organic, non-uniform soils containing 3 percent or more by weight of particles smaller than 0.02 mm are considered frost susceptible. Consider gravel, well graded sands and silty sands, especially those approaching the theoretical maximum density curve, that contain 1.5 to 3 percent of particles smaller than 0.02 mm as possibly frost susceptible and subject to laboratory frost susceptibility tests. Expect considerable ice segregation in uniform sandy soils with greater than 10 percent smaller than 0.02 mm. Figure 5-14 illustrates a method for determining the frost susceptibility of soils.

Figure 5-14 General Method for Determining the Frost Susceptibility of Soils



5-9.3 Water Source.

Usually, the water source is an underlying groundwater table, a perched aquifer, or infiltration from the overlying layers.

5-9.4 Frost Depth.

Future track maintenance costs are reduced if the design depth of frost below the top of the ballast is at least 60 percent of the expected local frost depth. Establish expected frost depth using local records, experience or building practices. If these are unavailable, use the frost depth provided in UFC 3-301-01.

5-9.5 Alternate Frost Depth Procedure.

Use this procedure for fine grained soils of relatively uniform composition at different depths.

Determine the Air Freezing Index - the number of degree days (above and below 32 °F (0 degrees C)) between the highest and lowest points on the cumulative degree day curve for a freezing season. For the design air freezing index, use the 3 coldest years in the last 30 years of record, or use the average index and multiply it by 1.75. (If fewer than 30 years of data are available, use the air freezing index for the coldest year in the last 10-year period). If local records are unavailable, use the values directly from either Figure 5-15 or the PCASE WORLD INDEX program.

Figure 5-15 Design Air Freezing Indexes in CONUS

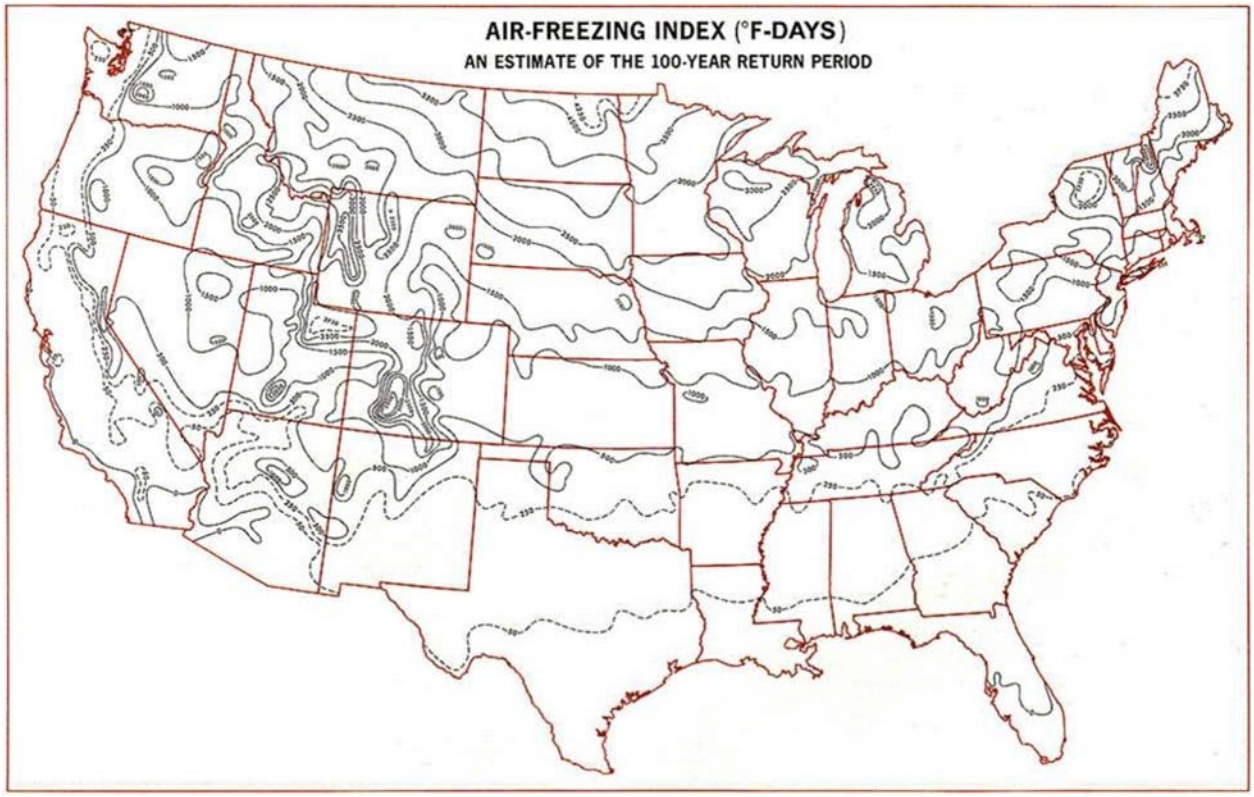
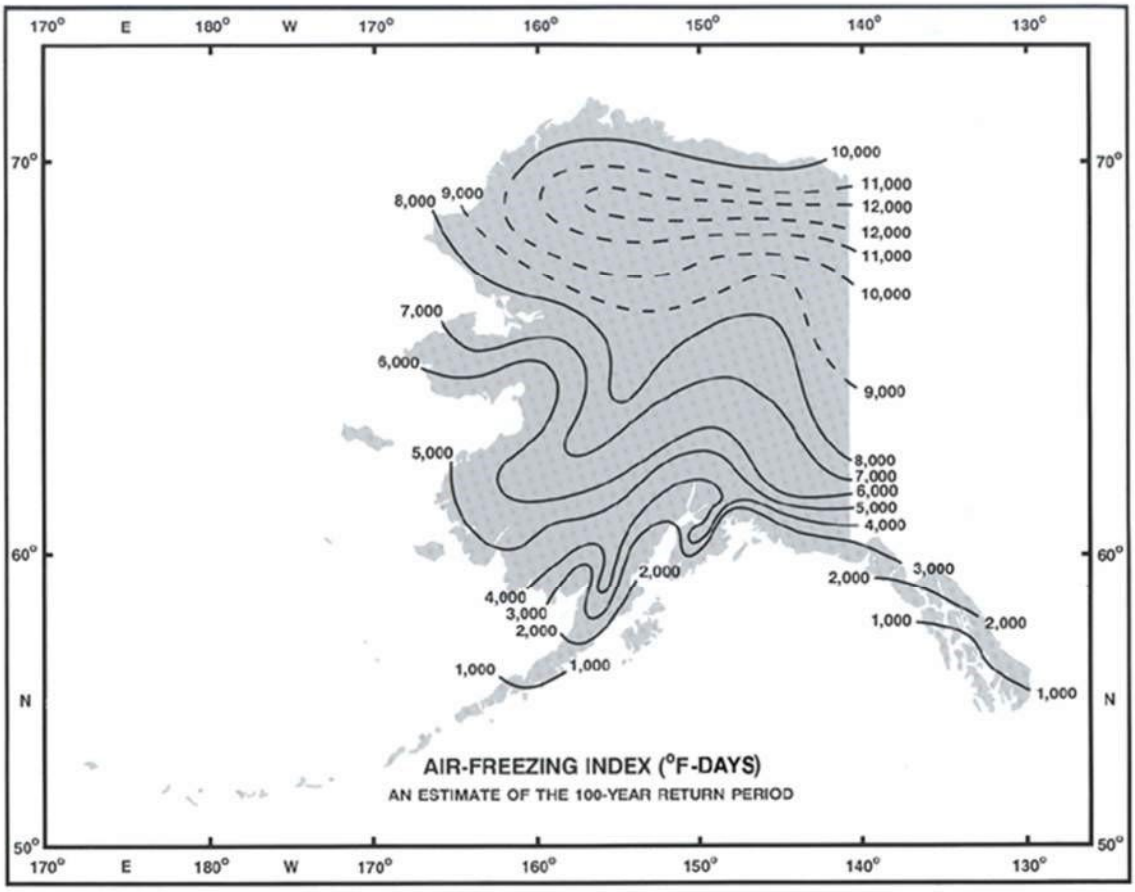
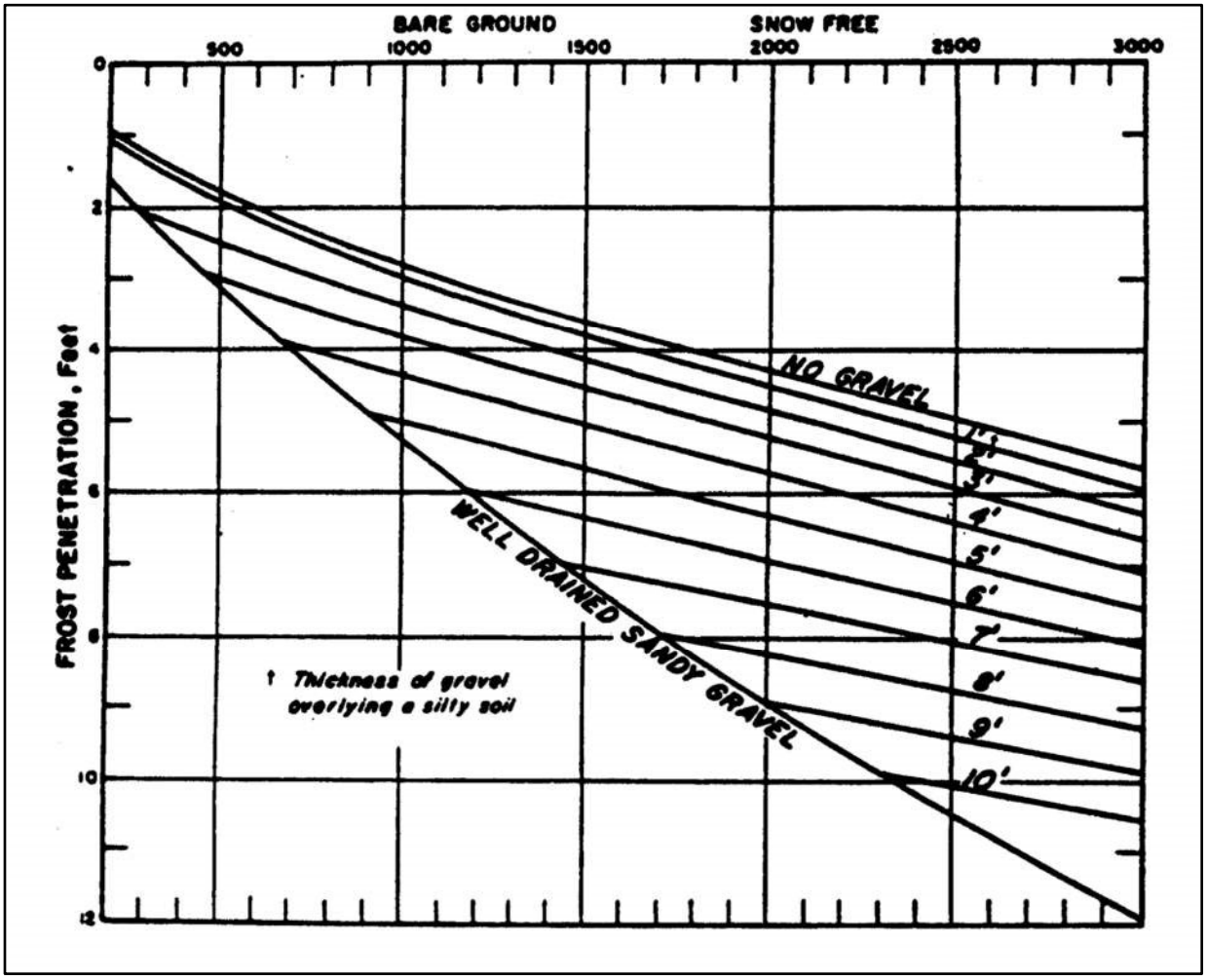


Figure 5-16 Design Air Freezing Indexes in Alaska



Determine the frost depth using Figure 5-17. The gravel thickness in this figure is the total depth of ballast and sub-ballast. Multiply the frost penetration value by 0.6. If the resulting number is smaller than the gravel thickness, then there is an adequate amount of ballast and sub-ballast in the cross section. If the resulting number is larger, additional ballast and/or sub-ballast should be added and the thickness recalculated.

Figure 5-17 Air Freezing Index/Surface Cover/Frost Penetration Relationship



5-9.6 Alternate Design Procedure.

An alternate method of designing for the effects of frost is to reduce the effective strength of the soil to compensate for the thaw-weakening period, similar to a reduced strength pavement design.

5-9.7 Methods for Reducing Frost Effects.

5-9.7.1 Additional Ballast/Sub-ballast.

If more than 40 percent of the total frost depth is in the frost susceptible subgrade, add non-frost susceptible material (clean ballast or sub-ballast) to the roadbed.

5-9.7.2 Geotextiles.

Geotextiles are sometimes used to prevent particle migration at the subgrade/sub-ballast interface during the spring thaw. Contamination of an otherwise clean ballast

and sub-ballast by subgrade soil can turn a non-frost susceptible material into a frost susceptible material. The application of geotextiles is covered in AREMA Chapter 1, Part 10.

5-9.8 Transition Zones.

A gradual transition is required between areas with significantly different frost heave behavior. The transition distributes differential heave over a distance and thus reduces its detrimental effects. Transitions between cuts and fills and at culvert crossings and bridge approaches are typically 75 to 100 ft. (22.9 m to 30.5m) long.

5-9.9 Construction Procedures.

Excavate the subgrade and scarify to a predetermined depth based on field conditions. Then windrow and blade to achieve adequate blending. This ensures a high degree of uniformity of soil conditions and eliminates any isolated pockets of soil with higher or lower frost susceptibility. Remove isolated pockets of either low or high frost susceptible material. In these cases, excavate the soil to the full frost depth and replaced with the surrounding soil. Remove stones (6-in. in diameter or larger) or large roots from any fill in the full depth of the frost penetration. This includes any stones encountered during subgrade preparation. Failure to remove these items results in track roughness as the stones and roots are gradually heaved upward. In rock excavations, provide positive drainage so that no pockets of water are left in the zone of freezing. The irregularity of the isolated pockets can cause non-uniform heaving. At the transition between cut and fill sections, use transition sections as previously discussed. Frequently, rock joints and fractures are full of frost susceptible soil. Clean out rock joints or fractures encountered in the subgrade to the full depth of frost penetration and replace these joints with non-frost susceptible material.

5-10 DRAINAGE.

5-10.1 Importance.

Although not a component of the track or roadbed, drainage (or lack of it) has a major impact on track strength and longevity. Without proper drainage, track will fail to perform as designed or intended.

5-10.2 Design Criteria.

Use UFC 3-201-01, Chapter 3 for design and construction of drainage structures, except as modified by the following paragraphs. If required by a commercial railroad, use more restrictive criteria in lieu of these requirements.

5-10.3 Side Ditches.

Most commonly, drainage is provided by open ditches running parallel to the track. In terminals and in other level areas, use inlets, sub-drainage, or other alternative drainage designs if required.

To prevent a significant loss of strength in the subgrade, ensure side ditches provide ample capacity and flow rate. Design ditch size based on the expected rainfall runoff and the contribution from other drainage that empties into the ditches. Design criteria for estimating runoff and determining ditch size is found in UFC 3-201-01.

5-10.3.1 Capacity and Flow Rate.

To provide adequate capacity, design side ditches to ensure the water surface elevation does not rise above the top of subgrade for the 50-year storm. To provide an adequate flow rate, the minimum gradient for side ditches is 0.30 percent.

5-10.3.2 Sub-drainage.

While not a desirable practice, there are some areas where the bottom of the ballast section cannot be installed or raised above the surrounding ground level, and standard side ditches cannot be dug (or would not provide sufficient flow). In these cases, install sub-drainage as shown in Figure 5-18.

5-10.4 Culverts.

Chapter 1, Part 4 and Chapter 8, Parts 10 and 16 of the AREMA Manual provide design criteria and specifications for railroad culverts. Ensure all culvert pipe conforms to current AREMA recommendations or specifications for culvert pipe under railroads. Size culverts to meet the following hydraulic criteria:

- The water surface elevation for the 25-year storm will not rise above the crown of the culvert.
- The water surface elevation for the 50-year storm will not rise above the top of the subgrade.
- If located in a FEMA-designated floodplain, size the culvert opening to meet FEMA's water surface elevation rise criteria if applicable.

Provide a minimum cover of 2.5 ft. (0.76 m) from the bottom of the tie to the top of the culvert. Less cover is authorized in low clearance situations. Perform a structural analysis to determine the appropriate culvert strength for each situation. Design culverts under track for Cooper E80 loading. Ensure culvert materials provide a life expectancy of 50 years.

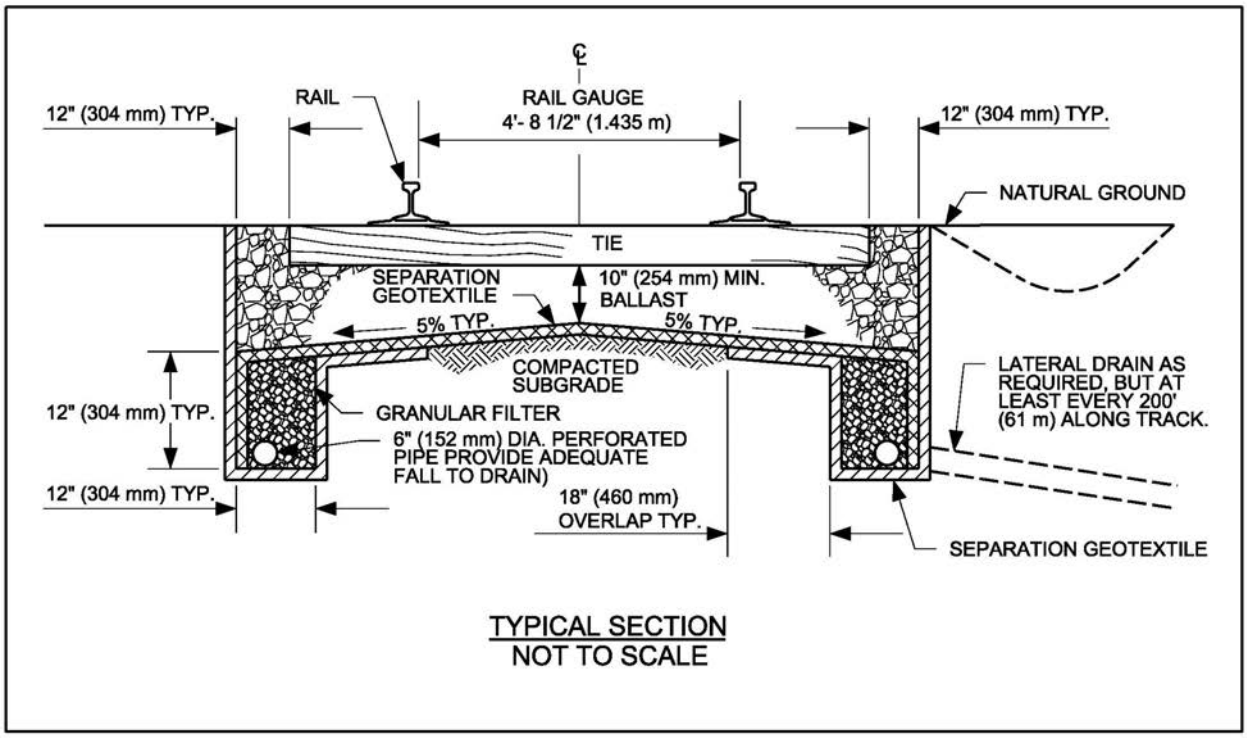
5-10.5 Bridges.

Paragraph 6-2 provides structural design criteria for bridges. Size bridges over waterways to meet the following hydraulic criteria:

- The water surface elevation for the 25-year storm does not rise above the low chord of the bridge.
- The water surface elevation for the 50-year storm does not rise above the top of the adjacent subgrade.

- If located in a FEMA-designated floodplain, size the bridge opening to meet FEMA's water surface elevation rise criteria.

Figure 5-18 Required Sub-drainage where Open Side Ditches cannot be Installed



5-11 GEOTEXTILES.

5-11.1 Application under Track.

Geotextiles are sometimes used under the track to provide for filtration and/or separation of ballast and subgrade or ballast and sub-ballast, drainage functions, or reinforcement of the subgrade. Common locations for the installation of a geotextile under track are:

- Highway-railroad grade crossings.
- Locations with poor subgrade.
- When rebuilding track with a history of excessive loss of profile (surface) and frequent track maintenance requirements.
- Turnouts. See Figure 5-19.
- Bridge approaches. See Figure 5-20.
- Rail crossings.

Recent industry studies have shown that geotextiles have not always been effective under track. Thus, before deciding to install a geotextile, conduct a thorough analysis of the site to assure that a geotextile will accomplish its intended purpose.

5-11.2 Material and Installation Specifications.

Ensure geotextiles, and their installation, conform with the specifications in Chapter 1, Part 10 of the AREMA Manual. Install geotextile under track deep enough that it is not disturbed during tamping/surfacing of the track. It is recommended that geotextile and geogrid be installed underneath a layer of sub-ballast as shown in Figure 5-6 to protect it from damage during tamping/surfacing of the track.

5-11.3 Design Criteria.

Use Chapter 1, Part 10 of the AREMA manual for the design of geotextile and geogrid applications. Geotextile manufacturers provide design guidance on the use of geogrids to support track construction equipment on low strength subgrades.

5-11.4 Drainage Applications.

Lighter weight geotextiles are often useful for drainage applications outside of the track structure, especially in sub-drainage.

Figure 5-19 Geotextile Installation under a Turnout

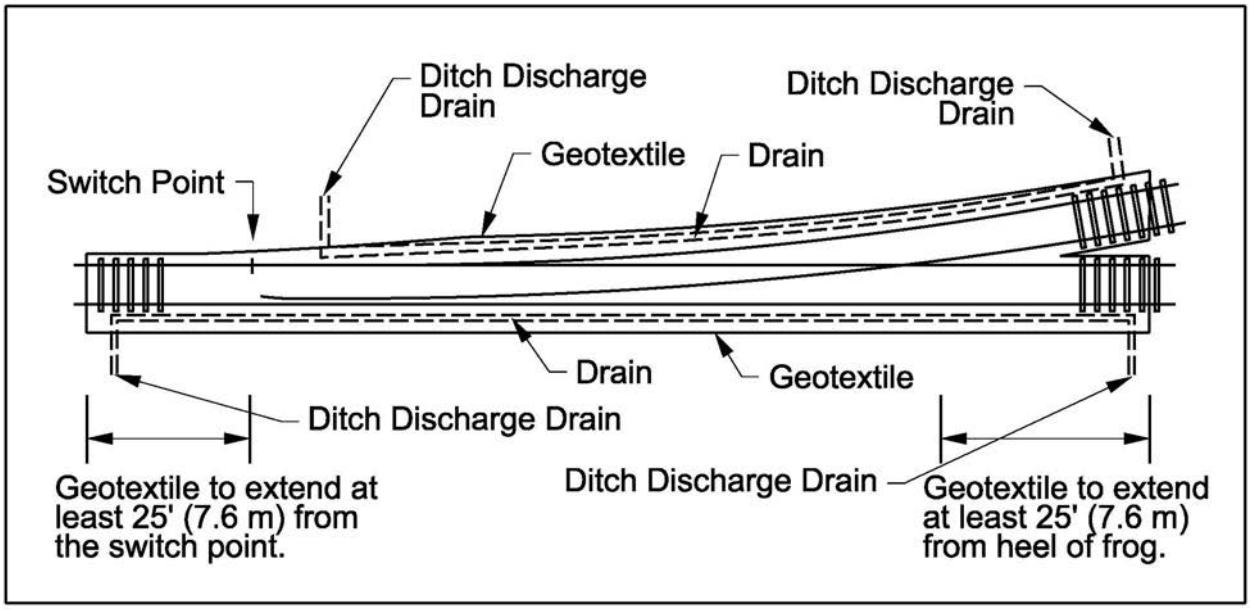
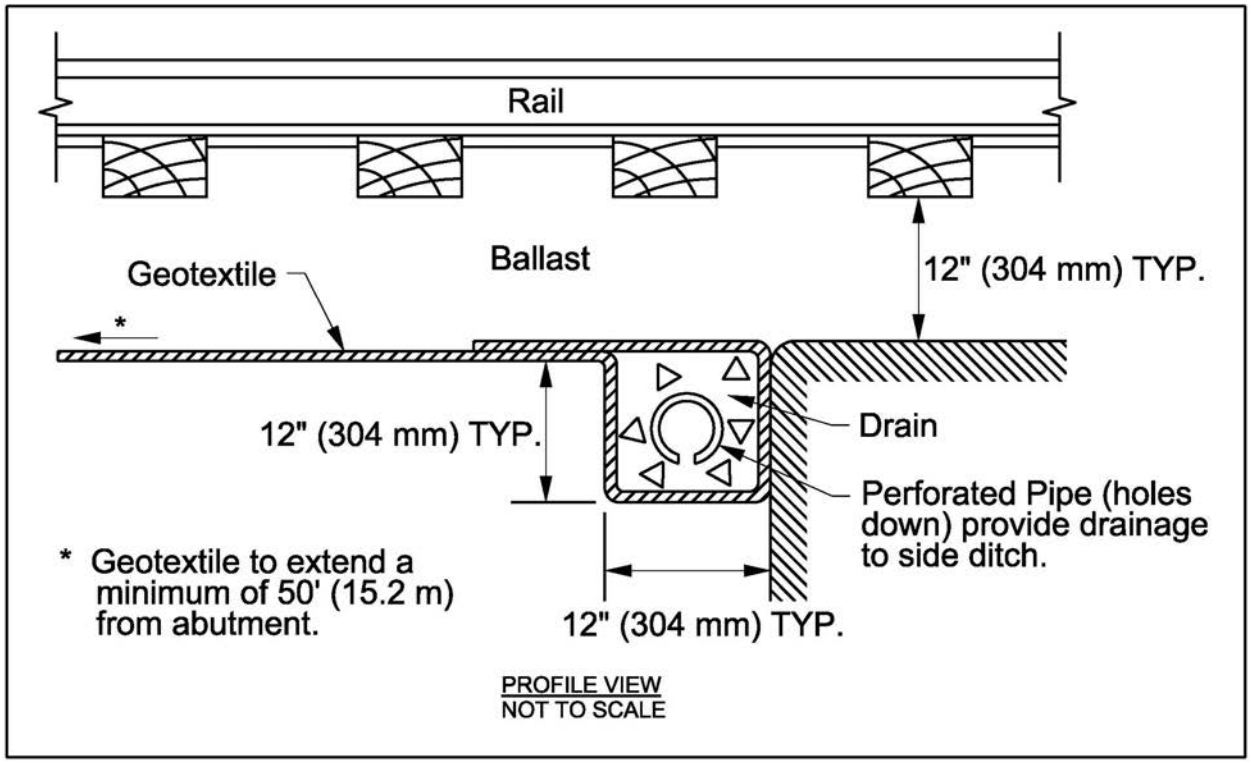


Figure 5-20 Geotextile Installation at a Bridge Abutment



5-12 BALLAST.

5-12.1 Purpose.

Ballast performs four primary functions:

- Distributes wheel loads at reduced pressure to the subgrade.
- Restrains the track laterally and longitudinally.
- Helps maintain track surface.
- Allows track structure to drain.

5-12.2 Material Type.

As ballast depends on high friction and interlock to be effective in restraining track and must also withstand large loads, ensure ballast consist of a hard angular crushed rock or crushed slag.

Common rock materials suitable for ballast are granites, traprocks, quartzites, dolomites, and hard limestones. As limestones degrade, they tend to produce fine particles that cement together, and are thus not the best ballast choice if other hard rock material is economically available. Crushed slag can also vary greatly in quality and suitability for good ballast.

5-12.3 Gradation.

Table 5-11 gives recommended AREMA ballast gradations. Use Size 4A or 4 between the top of the tie and the sub-ballast or subgrade. Use Size 5 ballast around turnouts to construct walkways to facilitate easier walking for switching operations. AREMA ballast Size 4 is identical to ASTM C33 Size 4. ASTM C33 Size 56 is close to AREMA Size 5.

Table 5-11 Recommended Ballast Gradations

Size No.	Nominal Size Square Opening in. (mm)	Amounts Finer Than Each Sieve (Square Opening) Percent by Weight							
		2½ in. (64 mm)	2 in. (50 mm)	1½ in. (37 mm)	1 in. (25 mm)	¾ in. (19 mm)	½ in. (13 mm)	⅜ in. (9.5 mm)	No. 4 (4.75 mm)
4A	2 to ¾ (50 to 19)	100	90-100	60-90	10-35	0-10		0-3	
4	1½ to ¾ (37 to 19)		100	90-100	20-55	0-15		0-5	
5	1 to ⅜ (25 to 9.5)			100	90-100	40-75	15-35	0-15	0-5

For smaller projects, where less than 200 tons (181 Metric tons) of ballast is needed, and where the nearest suppliers do not stock AREMA gradations, substitute the following ASTM gradations: Size 4 for AREMA 4, and Size 56 for AREMA 5.

5-12.4 Depth.

Determine the appropriate ballast depth (or the total of ballast and sub-ballast depth) by conducting a structural analysis using the computer program specified in Paragraph 6. The manual method described in Chapter 5, Paragraph 7 is acceptable, but not preferred.

For wood and engineered composite ties, the minimum depth of ballast from the bottom of the tie to the subgrade is 8 in. (203 mm). If sub-ballast is used, the minimum depth of ballast is 6 in. (152 mm). For steel ties, the minimum depth of ballast from the top of the tie is 10 in. (254 mm) regardless if sub-ballast is used. In most cases, main running tracks require more ballast.

5-12.5 Cross-Section.

Figures 5-1 through 5-6 show standard ballast shoulder widths and side slopes. In finished or resurfaced track, the top of ballast ranges between the top of the tie and 1 in. (25 mm) below. Six inches (152 mm) is the minimum width for shoulder ballast. Increase shoulder ballast width to 12-in. (300 mm) for track with continuously welded rail.

5-13 SUB-BALLAST.

5-13.1 Purpose.

Sub-ballast is a layer of material between the top ballast and subgrade with a gradation finer than the top ballast and coarser than the subgrade. Sub-ballast is often cheaper than top ballast and used to reduce total ballast cost or to provide a filter layer between the top ballast and a fine-grained subgrade. Figures 5-2, 5-4, 5-5, and 5-6 show a sub-ballast layer. It is recommended that sub-ballast be used for all new track construction and for rehabilitations replacing the track structure.

5-13.2 Application.

A sub-ballast layer is recommended for most new construction. In addition to providing a filter to keep subgrade particles from working up into and fouling the ballast, it provides a good mat to distribute loads from the ballast and prevents ballast particles from being pushed into the subgrade. A sub-ballast layer is required whenever:

a. The subgrade contains 85 percent or more (by weight) of silt and clay sized particles, or

b. The subgrade material has a liquid limit greater than 50 and a plasticity index greater than 20.

5-13.3 Material.

Sub-ballast should be a hard, angular, non-cementing material. Aggregate base courses specified by the local state department of transportation are typically good sub-ballast materials and can be considered for use.

5-13.4 Gradation.

Filter layers consist of sub-ballast particles ranging in size from the smallest ballast particles to the largest subgrade particles. Specifying ASTM D1241 Type I, Gradation B or the somewhat finer Gradation C provides an appropriate gradation. Also, aggregate base courses specified by the local state department of transportation typically have appropriate gradations. One of the following gradations must be met if a local aggregate base course material is used:

Table 5-12 Gradations

Sieve Size		1 in. (25 mm)	⅜ in. (9.5 mm)	No.4 (4.75 mm)	No. 40 (425 µm)	No. 200 (75 µm)
Percent Passing	**Gradation 1**	70-100	35-75	25-65	5-30	5-15
	Gradation 2	90-100	50-85	35-65	10-35	5-15

In addition, the materials must meet the following physical requirements:

- Coarse aggregate (that portion retained on the No. 4 (4.75 mm) sieve) composed entirely of crushed stone or crushed aggregate.
- The maximum percent of wear for the coarse aggregate fraction (that portion retained on the No. 4 (4.75 mm) sieve) is 50 percent when tested per ASTM C131.
- For the fraction passing the No. 40 (425 µm) sieve, the maximum liquid limit is 25 and the maximum plasticity index is 6.

5-13.5 Depth.

The sum of the sub-ballast depth and the ballast depth is often referred to as the total ballast depth. When sub-ballast is used, substitute sub-ballast material for a portion of the total ballast depth determined by structural analysis on a one-for-one basis.

A sub-ballast layer can comprise up to 40 percent of the total ballast depth on main running tracks and up to 50 percent on auxiliary and terminal tracks. When used, the minimum sub-ballast thickness will be 4 in. (101 mm) with a minimum ballast thickness of 6 in. (152 mm), resulting in a minimum total ballast depth of 10 in. (254 mm).

5-14 TIES AND TIE SPACING.

5-14.1 Wood Ties.

In most cases, wood is still the most cost-effective tie material. Required specifications for wood ties are found in Chapter 30, Part 3 of the AREMA Manual. The recommended species of wood for cross ties are:

Table 5-13 Recommended Wood Species for Cross Ties

Hardwoods	Softwoods
Ash	Douglas Fir
Beech	Pine
Hickory	Spruce
Red Oak	
White Oak	

Strictly defined, hardwood and softwood refer to a type of tree and not the hardness or density of the wood. However, the hardwoods listed above are denser and generally more durable than the listed softwoods and thus usually more desirable for ties. While softwoods are sometimes preferred on open deck bridges to help absorb impact, they are not recommended for use in turnouts or in curves over 8 degrees where the better spike-holding ability of the denser woods is needed.

5-14.1.1 Species.

Hardwood ties are often sold in species groups such as mixed hardwoods or oak. The mixed hardwoods can comprise, for example, 40 percent oak and 60 percent assorted hardwoods, including gum. Gum is not a preferred species but is commonly used. The oak group is usually a mix of red and white oak and typically costs more than the mixed hardwoods. The use of either mixed hardwood group or oak group ties is acceptable for military installations.

For track with annual traffic volumes of 5 million gross tons (4.5 Metric tons) or less, as is common at military installations, wood ties are more likely to fail from decay rather than mechanical wear or loss of spike-holding ability. Use information from the engineering department of the serving commercial railroad, regional tie suppliers, and local experience to select the most appropriate ties.

5-14.1.2 Cross-Section and Length.

The two common cross-sectional sizes for wood track ties are 7 in. (178 mm) thick by 9 in. (229 mm) wide or 6 in. (152 mm) thick by 8 in. (203 mm) wide. 7x9 (178x229) ties are recommended for areas with higher traffic volumes and wheel loads as well as in turnouts and in road crossings.

Track ties are commonly produced in 8.5 or 9 ft (2.6 or 2.75 m) lengths. Use minimum 8.5-ft (2.6 m) length ties, except for road crossing and turnouts. 10-ft. or 9-ft. (3 m or 3.75 m) long ties are typically used in road crossings. Ties for turnouts vary from 9 to 17 ft (2.75 to 5.2 m) long as indicated in Table 5-14.

Table 5-14 Switch Ties for Standard Turnouts

Frog #	Switch Point Length ft (m)	Lead Distance	Number of Ties of Each Length									Total Ties
			9 ft (2.74m)	10 ft (3.05m)	11 ft (3.35m)	12 ft (3.66m)	13 ft (3.96m)	14 ft (4.27m)	15 ft (4.57m)	16 ft (4.88m)	17 ft (5.18m)	
8	16½ (5.03)	68 ft (20.3 m)	7	13	6	6	4	5	7	6	3	57
9	16½ (5.03)	72 ft-3.5 in. (22 m)	7	13	7	7	6	5	8	6	4	63
10	16½ (5.03)	78 ft-9 in. (24 m)	7	15	8	7	6	6	7	8	4	68

Note: Each tie set includes 2 - 15 ft. (4.6 m) ties for head blocks, which hold the switch stand.

5-14.1.3 Treatment.

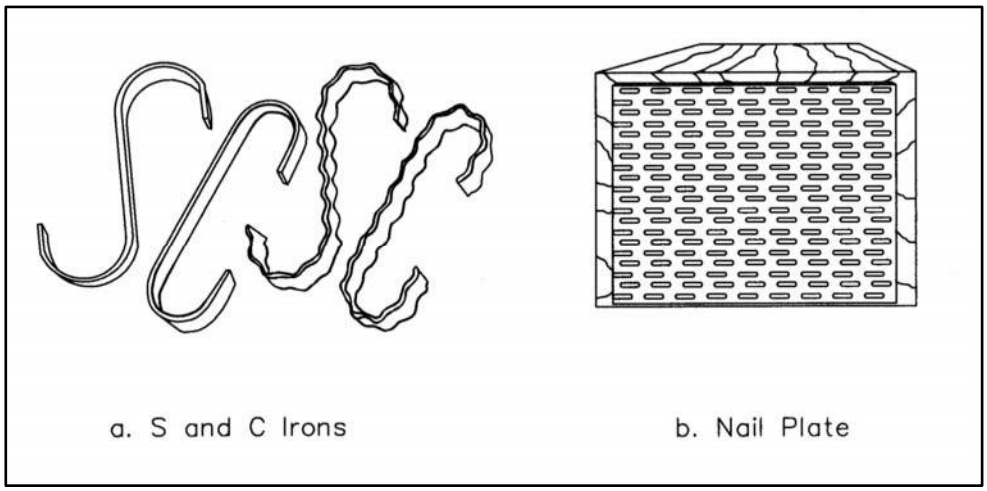
All wood ties will be pressure treated with preservative as specified in AWPA Standard U1, Commodity Specification C, to the requirements of Use category 4 (UC4). The preferred preservative for ties is a creosote solution (CR-S) as specified in AWPA Standard P2. For ties used west of the Mississippi River, a creosote-petroleum solution (CR-PS) as specified by AWPA Standard P3 is used.

In areas of high decay from fungi, insects or severe climactic or exposure conditions, a dual treatment with borate and creosote is recommended to significantly extend tie life. Dual treatment with borate (SBX) is specified in AWPA Standard P25. The average life expectancy of a properly treated wood tie in the CONUS is 25 to 35 years. The life expectancy in high-decay regions of the CONUS is as low as 12 years.

5-14.1.4 Anti-Splitting Devices.

To reduce the tendency of wood to split, anti-splitting devices are often applied to the ends of ties. Anti-splitting devices are recommended for turnout ties but can be specified for standard track ties. Of the two general types, as shown in Figure 5-21, the nail plates are more effective and thus preferred.

Figure 5-21 Anti-Splitting Devices for Tie Ends



5-14.1.5 Pre-Boring.

Once a common practice, the pre-boring of spike holes is no longer recommended.

5-14.1.6 Tie Spacing.

The center-to-center distance between adjacent ties ranges from 19.5 to 22 in. (495 to 558 mm), with a minimum allowable of 18 in. (460 mm) and a maximum of 24 in. (609 mm). For auxiliary and loading tracks, a 21 to 23-in. (533 to 584 mm) spacing is typical. Specify tie spacing after a structural analysis has been performed.

5-14.1.7 Pros and Cons.

The advantages of wood ties include:

- Typically, the most economical tie.
- Are widely available in the CONUS from many suppliers.
- Utilize typical hardware and equipment to attach the rail.
- Can be used in all track situations.
- Are good at surviving derailments.

The disadvantages of wood ties include:

- Short service life in high-decay environments.
- Typically require the use of rail anchors.
- Environmental issues associated with the disposal of defective ties.
- The track gage must be set manually by measuring prior to spiking the rail.

5-14.2 Engineered Composite Ties.

Engineered composite ties are composed of two or more materials in a matrix binder. The components can include recycled materials. Since the matrix often includes plastic, engineered composite ties are often referred to as plastic ties. Engineered composite ties are not widely used, but they have been used at DoD installations in high-decay areas of the CONUS. Due to their resistance to decay, they are well-suited to use in road crossings. They use the same hardware and equipment to attach the rail as is used with wood ties. To increase lateral and longitudinal track stability, engineered composite ties are typically manufactured with surface patterns to mechanically interlock with the ballast. Ensure engineered composite ties conform with the specifications in Chapter 30, Part 5 of the AREMA Manual.

5-14.2.1 Cross-Section and Length.

Engineered composite ties are typically 7 in. (178 mm) thick by 9 in. (229 mm) wide. The length of regular ties is typically 9 ft (2.75 m). Longer lengths are available for use under road crossings and as switch ties in turnouts. Since their dimensions are the same as typical wood ties, they are used to replace wood ties without other modifications to the track.

5-14.2.2 Pre-boring.

Engineered composite tie manufacturers typically recommend pre-boring of spike holes.

5-14.2.3 Tie Spacing.

The spacing for engineered composite ties is the same as for wood ties, usually ranging from 19.5 to 22 in. (495 to 558 mm), with a minimum allowable of 18 in. (460 mm) and maximum of 24 in (609 mm).

5-14.2.4 Pros and Cons.

The advantages of engineered composite ties include:

- Are resistant to decay.
- Have an estimated life span of 50 years.
- Are well-suited for use in road crossings.
- Can be intermixed with wood ties.
- Use the same hardware and equipment to attach the rail as wood ties.
- Can be used in all track situations.
- Defective ties may be recyclable.

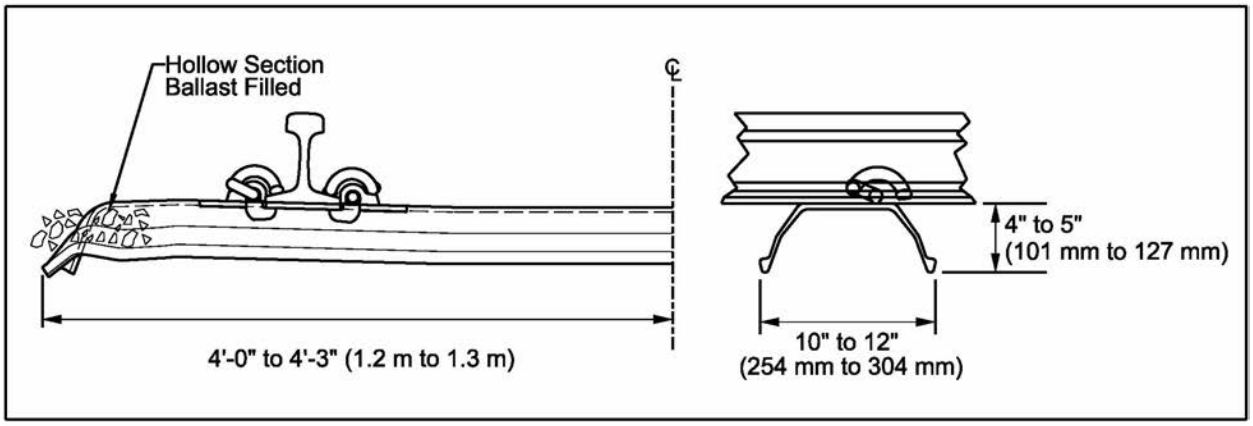
The disadvantages of engineered composite ties include:

- Are more expensive than wood ties.
- There are a limited number of suppliers in the CONUS.
- Are not good at surviving derailments.
- Typically require the use of rail anchors.
- The track gage must be set manually by measuring prior to pre-boring and spiking the rail.

5-14.3 Steel Ties.

The use of steel ties in the CONUS is increasing, particularly in yards, low-speed tracks, and tunnels. Steel ties consist of a hollow shell with an inverted U-shaped cross section as shown in Figure 5-22. The hollow shell is packed with ballast to ensure the bearing area is at the top of the inside shell rather than at the bottom of the tie. This allows for reduced overall ballast thickness, which can make steel ties more economical than wood ties for new track construction in areas where ballast material cost is high. A minimum thickness of 10 in. (254 mm) of ballast, measured from the top of the tie, is required. Place a minimum 4 in. (101 mm) thickness of sub-ballast beneath the ballast. Inspection holes located in the steel tie's top surface allow for visual inspection that the hollow underside has been completely filled and proper ballast tamping has been achieved. Since the sides of the tie are embedded in the ballast, steel ties provide good longitudinal and lateral support of the track. Ensure steel ties conform with the specifications in Chapter 30, Part 6 of the AREMA Manual.

Figure 5-22 Steel Tie



5-14.3.1 Tamping.

Extra care is required when tamping steel ties. Since steel ties are not as tall as wooden ties, reduce the embedment depth of the tamper machine tools to match. Otherwise, proper compaction of the ballast under the steel ties will not be achieved. When steel ties are interspersed with wood ties, it is necessary to make two passes with the tamper: one pass with the tamper machine tools set at the proper depth for wood ties and a second pass to tamp the steel ties with the tamper machine tools set at the reduced insertion depth.

5-14.3.2 Fastening.

Steel ties utilize steel spring clips to attach the rail to the tie. This system tightly clamps the rail to the tie and eliminates the need for tie plates, spikes, and rail anchors. The ties are pre-punched for the fasteners, so track gage is set at the factory. In signalized track and near signalized road crossings, insulators are placed underneath the rail base and between the spring clips and the rail to prevent the steel tie from shunting the electric current between the rails.

The tension strength of the steel material and clamping action of the spring clips result in greater strength to hold gage than other ties. Because of this, steel ties are sometimes interspersed with wood ties (for example, every fifth tie is steel) in sharp curves and other areas where gage widening is a problem.

5-14.3.3 Road Crossings.

When steel ties are placed under a road crossing, the road crossing must be an asphalt crossing with rubber interface. If a different type of crossing is desired or required, use wood or engineered composite ties through the length of the crossing with a transition back to steel ties outside the limits of the crossing. A transition to a different type of tie must be used under roads that will carry tracked vehicles.

5-14.3.4 Turnouts.

Steel switch ties are available for use in turnouts. However, do not intersperse steel switch ties with other types of switch ties in a turnout. Do not use steel ties as the primary tie in track with speeds above 25 mph (40.2 km/hr) since the higher dynamic forces coupled with the stiffness of the steel can accelerate degradation of the ballast. However, it is acceptable to intersperse steel ties with wood ties (for example, every fifth tie is steel) in track with speeds greater than 25 mph (40.2 km/hr).

Steel ties are made of a special type of steel that acquires an initial coating of rust-like oxide that protects the steel from further corrosion. Steel ties are also very resistant to biological decay.

5-14.3.5 Cross Section and Length.

Steel ties are typically wider, but not as deep as wood ties. They can be shorter than wood ties. Typical dimensions of steel ties are shown in Figure 5-22. Longer lengths are available for use in turnouts. The length of switch ties in turnouts varies between manufacturers and will likely vary from the lengths shown in Table 5-14.

5-14.3.6 Tie Spacing.

The typical spacing for steel ties ranges from 20 to 24 in. (508 to 609 mm).

5-14.3.7 Pros and Cons.

The advantages of steel ties include:

- Requires less ballast since the required depth of ballast is measured from the top of the tie rather than the bottom of the tie.
- More economical than wood ties for new track construction in regions where ballast material cost is high.
- Cost effective in certain OCONUS situations with limited access to wood ties.
- Can be compactly stacked like plastic cups to minimize volume for shipping.
- Are resistant to decay.
- Have an estimated lifespan of 50 years or more.
- Can be intermixed with wood ties in existing track.
- Spring clip attachment system eliminates the need for tie plates and rail anchors.
- Spring clips do not loosen over time as occurs with spikes in wood ties.
- Track gage is set at the factory, reducing the chance of improper track gage during installation.

- Are superior to wood and engineered composite ties at holding gage.
- Are good at surviving derailments.
- Defective ties are recyclable.
- Are lightweight, which facilitates handling.

The disadvantages of steel ties include:

- Are more expensive than wood ties when replacing ties in existing track.
- Requires adjustment of the tamping machine tools for less depth compared to wood and engineered composite ties.
- Requires two passes of a tamping machine during surfacing operations when steel ties are interspersed with wood ties.
- Requires extra care during tamping operations to ensure the hollow underside has been completely filled with ballast.
- Should not be used for tracks with speeds greater than 25 mph (40.2 km/hr).
- There is a limited number of suppliers in the CONUS.

5-14.4 Concrete Ties.

Concrete ties are used by some commercial railroads, particularly on lines with the heaviest traffic volumes and in areas with numerous curves. Where used, concrete ties are in track with welded rail and solidly supported with deep ballast sections. Concrete ties are usually not economical on lighter traffic lines and are usually not suitable for use with jointed rail or in track of lighter construction. Also, concrete ties cannot be successfully mixed with wood ties. Thus, concrete ties are not economical and are not recommended for general use in CONUS military track. The use of concrete ties for certain OCONUS applications can be cost effective. These applications include areas where concrete ties are in widespread use and where timber is in short supply. Prior to selecting concrete ties for an installation, conduct an economic analysis.

Concrete ties are prestressed concrete. Wire reinforcement provides the prestressing force, keeping the concrete in compression to prevent cracking. The reinforcement also provides bending strength.

5-14.4.1 Fastening.

Concrete ties utilize steel spring clips to attach the rail to the tie, similar to steel ties. However, a specialized pad must be placed between the base of the rail and the tie. The pad cushions the load, preventing the development of rail and track surface defects. Steel shoulder inserts are cast into the tie to accept the spring clips. This results in the track gage being set at the factory. Insulators are placed between the steel shoulder inserts and the rail base and between the spring clips and the rail to isolate the tie electrically.

5-14.4.2 Road Crossing.

Concrete ties are available for road crossings and for use as switch ties in turnouts. However, the CONUS commercial railroads typically do not use concrete ties in road crossings or in turnouts. Instead, they transition to wood ties and use them throughout the limits of road crossings and turnouts.

5-14.4.3 Subgrade.

Subgrade cross slope must be constant under the length of a concrete tie. Do not locate a subgrade or sub-ballast crown below a concrete tie to avoid over-stressing the tie during ballast placement and tamping.

5-14.4.4 Cross Section and Length.

Concrete ties are typically 10 to 11in. (254 to 279 mm) wide at their base and taper to 7 to 8 in. (178 to 203 mm) wide at the top. The height is typically 8 to 8.5 in. (203 to 216 mm) at the ends of the ties and transitions to 6 to 6.5 in. (152 to 165 mm) between the rails. The typical length of a concrete tie in CONUS is 8 ft.-3in. (2.5 m). The dimensions of concrete ties in OCONUS locations can vary.

5-14.4.5 Tie Spacing.

The typical spacing for concrete ties is 24 in. (609 mm).

5-14.4.6 Pros and Cons.

The advantages of concrete ties include:

- Cost effective in certain OCONUS situations with limited access to wood ties.
- Resistant to decay.
- Have an estimated lifespan of 50 years.
- Spring clip fastening system eliminates the need for tie plates and rail anchors.
- Track gage is set at the factory, reducing the chance of improper track gage during installation.
- Are superior to wood and engineered composite ties at holding gage.

The disadvantages of concrete ties include:

- Are not economical and not recommended for general use in CONUS military track.
- Should not be used with jointed rail.
- Require a thicker ballast section.

- Cannot be intermixed with wood ties.
- Typically requires a transition to wood ties through the limits of road crossings and turnouts in CONUS situations.
- Are not good at surviving derailments.
- Concrete ties are approximately three times heavier than wood.

5-15 RAIL.

5-15.1 Section Designation.

Rail is rolled into different sizes (dimensions) and shapes commonly referred to as "weight" and "section." The weight of a rail is based on how much a rail weighs in pounds per yard of length. The section refers to the cross-sectional shape of the rail.

5-15.2 Selection Criteria.

Perform a structural analysis prior to selection of a rail section. Consider structural requirements, as well as cost and availability of rail sections before making a final selection.

5-15.3 Recommended New Rail Sections.

Weights and sections recommended for new rail purchases are: 115RE and 136RE, with 115RE being the preferred. These are the standard sections recommended by the AREMA.

Rail is purchased in 39- or 80-ft (11.9 or 24.4 m) lengths. Rail 80 ft. (24.4 m) long has the advantage of reducing the number of joints to half that for 39 ft. (11.9 m) rail. For small purchases where the rail is transported by truck, 39 ft. (11.9 m) lengths are more cost effective.

5-15.4 Relay (Secondhand) Rail.

Secondhand rail meeting the specifications in Table 5-15 either as is or after cropping off the ends, can be used for rehabilitation or new construction. Investigate the cost, condition, and availability of matching joint bars and tie plates before selecting relay rail.

Recommended relay rail sections are: 115RE, 132RE, 133RE, and 136RE. Select relay rail to limit the number of different rail weights and sections within the track network. Ensure the section and joint drilling pattern (bolt hole size and spacing) are consistent for a given weight. Due to the varying market for relay rail, recommend allowing the contractor an option to provide an acceptable rail section. Limit selection to sections that are sufficiently plentiful to supply future maintenance purchase requirements: rail, joint bars, frogs and other turnout parts.

5-15.5 Lightweight Rail.

Lightweight rail weighs less than 90 lb. per yd (44.6 kg/m). These weights are no longer manufactured and are only available as secondhand.

Do not use rail weights less than 90 lb. per yd (44.6 kg/m). A structural evaluation is necessary to determine the adequacy of these rail weights. Replace rail not adequate to support the desired wheel loads.

5-15.6 Continuous Welded Rail (CWR).

Continuous welded rail (CWR) is strings of standard rail welded together either in a rail plant or by field welding after installation. CWR is commonly used on commercial railroads and is beneficial in reducing maintenance costs due to rail joints. CWR is not recommended for general use on military track because it:

1. Requires a larger ballast section to provide sufficient track restraint
2. Needs more rail anchors to restrain longitudinal rail expansion
3. Is more subject to buckling in hotter weather and pull-aparts during colder weather
4. Has a higher initial installation cost

If conveniently available, short strings (less than 200 ft. (61 m)) are appropriate for wide road crossings or track in paved areas. CWR is applicable on certain lines that form a long connection to the serving commercial railroad. See Chapter 5, Section 3.1 of the AREMA Manual for additional CWR information.

5-15.7 Field Welds.

Weld rail running through road crossings and for 20 ft. (6 m) on either side of crossings to eliminate joints in these areas. Consider field welding for rail placed in confined loading areas, adjacent to warehouse loading docks, and in other areas where maintenance access to rail joints is difficult.

Accomplish rail welding with special thermite welding kits designed for this purpose and by people with the necessary training and experience in welding rail. Where many welds are performed, some specialized contractors have truck-mounted electric welding units designed for this purpose.

5-15.8 Salvaging Rail.

During track reconstruction, the existing rail and other track materials can often be salvaged for use at other locations on the installation, stockpiled for future construction projects, or sold on the open market as used material. Dispose of lightweight rail, defective rail, and other track materials not suitable for use in track reconstruction or for resale on the open market as scrap or reroll material.

Table 5-15 Dimension and Surface Specifications for Relay (Secondhand) Rail

Length	For Standard 39 ft (11.9 m) lengths: Not more than 10% of lot between 33 ft and 39 ft. (10.1 m to 11.9 m). No rail shorter than 33 ft. (10.1 m).
Vertical Wear	90 lb (44.6 kg) or Larger: Average top wear 5/16 in. (7.9 mm) or less with maximum at any one location of 11/32 in. (8.7 mm)
Side Wear	At least one side must meet the following: 90 lb (44.6 kg) or Larger - Maximum of 5/16 in. (7.9 mm)
Lip or Overflow	Maximum of 1/16 in. (0.8 mm), either as is or obtained by grinding off excess.
Engine Burns	Maximum of 1/2 in. (13 mm) diameter (or 1/4 in. (6.4 mm) wide by 1/2 in. (13 mm) long) and 1/32 in. (0.8 mm) deep. Maximum of four engine burns per rail. Engine burns on no more than 8% of the lot.
End Batter And Chipping	Maximum of 1/8 in. (3.2 mm) when measured 1/2 in. (13 mm) from the rail end with an 18 in. (460 mm) straightedge.
Running Surface Damage	Maximum size of 1/4 in. (6.4 mm) wide by 1/2 in. (13 mm) long and 1/32 in. (0.8 mm) deep. Maximum of four damaged spots in any one rail.
Defects Not Permitted	Bolt hole cracks or breaks, broken base, crushed head, detail or engine burn fractures, head-web or web-base separations, piping, horizontal or vertical split head or web, torch cuts or flame gouges, compound or transverse fissures, deep pitting from corrosion.
Condition and Appearance	Rail must be: free from obvious defects; clean in appearance; straight in line and surface and without kinks; and free from base defects such as plate wear and spike notches.
Internal Inspection	Rail to be ultrasonically inspected before or after installation. Defective sections to be rejected and replaced.
Note: See AREMA Manual Chapter 4, Part 4 for rail defect definitions and illustrations.	

5-16 OTHER TRACK MATERIAL.

5-16.1 Definition.

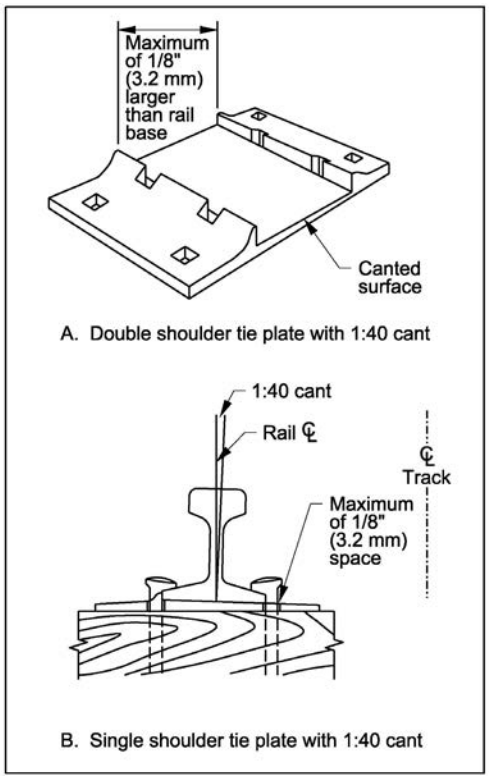
Tie plates, joint bars, bolts, spikes and other miscellaneous hardware used in track construction are commonly referred to as other track materials (OTM).

5-16.2 Tie Plates.

Tie plates vary in length and width. Most sizes are suitable, as long as the spike hole punching (or distance between the shoulders - for double shoulder plates) matches the width of the rail base. For double shoulder tie plates, the distance between the shoulders will be at most 1/8 in. larger than the rail base width. On single shoulder plates, the spike holes on the gage side (opposite the shoulder) must keep the inside face of the spike within 1/8 in. of the rail base when the opposite edge of the base is against the shoulder. See Figures 5-23 (a) and (b).

Use either single or double shoulder tie plates. Single shoulder tie plates are no longer manufactured. Only relay/secondhand single shoulder tie plates are available. Within a given length of track, it is allowable to use tie plates of different lengths and widths, and single shoulder plates can mix with double shoulder plates. However, do not mix plates with different cants: those with level rail seats and those with a 1:40 slope. Tie plates with a 1:40 cant are preferred. Secondhand plates that are not bent, have not lost much material due to corrosion, and otherwise meet the above requirements, are acceptable.

Figure 5-23 Tie Plates

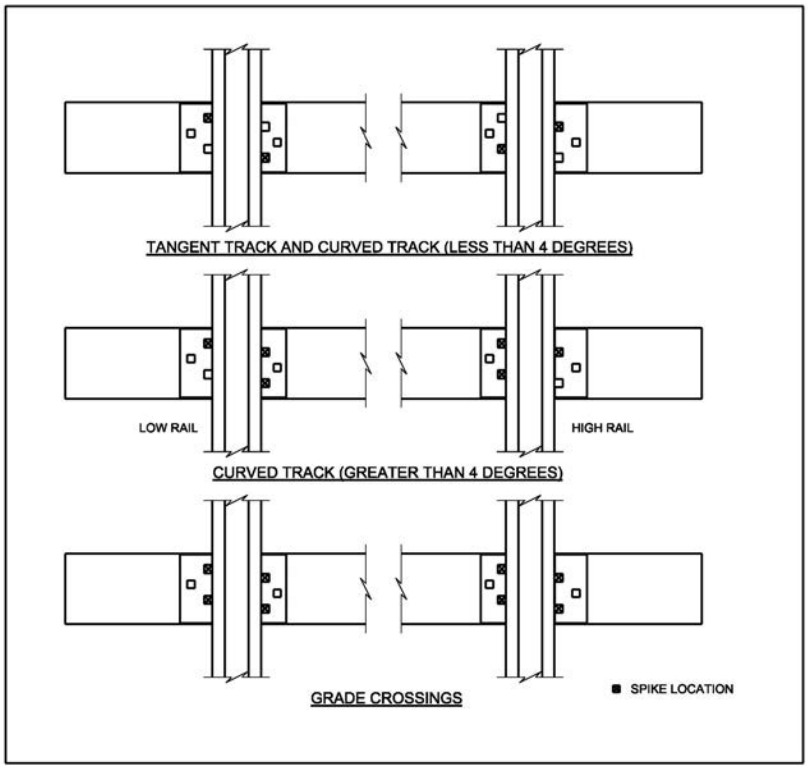


5-16.3 Spikes.

On tangent track and on curves up to 4 degrees, use one spike on the gage and field side of each rail, for a total of four spikes in each tie. On curves greater than 4 degrees, use one spike on the field side and two spikes on the gage side of each rail, for a total of six spikes in each tie. On track within road crossings, use two spikes on the gage

side and two on the field side of each rail, for a total of eight spikes in each tie. Diagrams of these spiking patterns are shown in Figure 5-24.

Figure 5-24 Typical Spiking Plans



5-16.4 Rail Spring Clips.

Rail spring clips are elastic forged steel fasteners that attach the rail base to steel or concrete ties to prevent horizontal and vertical movement of the rail. Rail spring clips can also be used with wood and engineered composite ties with special tie plates. Use rail spring clips with wood and engineered composite ties in situations where difficulty in holding gage is anticipated or encountered, such as curves sharper than 8 degrees. The spring clips come in different configurations. A common type of spring clip on a wood tie is shown in Figure 5-25. The spring clips tightly clamp the base of the rail to the tie and are typically applied and removed with a sledge hammer or special mechanized equipment. Spring clips eliminate the need for rail anchors.

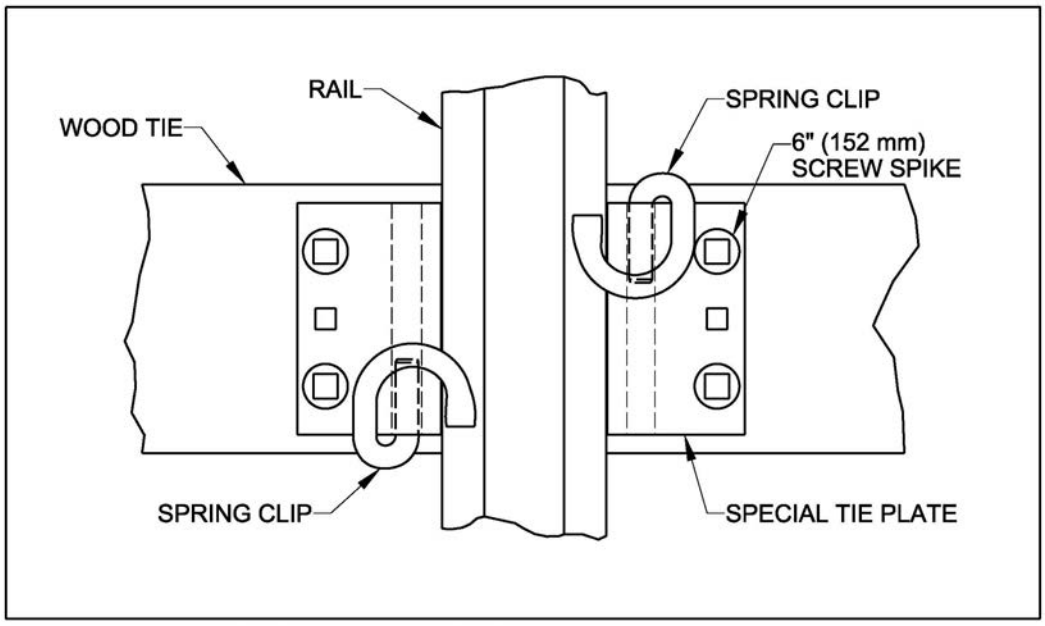
5-16.5 Rail Joints and Joint Bars.

Use either four-hole (24-in. (608 mm)) or six-hole (36-in. (914 mm)) joint bars for rail joints. Standard joint bars are used to join rail of the same section. Compromise joint bars are used to join rail of different section. Ensure both standard and compromise joint bars are properly factory designed and constructed. In addition, ensure the bars are of the size, shape, and punching pattern to fit the rail being joined. Specifications for new joint bars are found in “Specifications for Quenched Carbon Steel Joint Bars

and Forged Compromise Joint Bars" in Chapter 4, Part 3 of the AREMA Manual and joint bar assemblies in Chapter 4, Part 3 of the AREMA manual. Compromise joints will be specified as indicated in AREMA Portfolio of Trackwork Plan 700B.

Use secondhand joint bars on secondhand rail if not bent, cracked, excessively corroded, or otherwise defective. Do not use secondhand joint bars on new rail. Use either field-applied type or prefabricated (glued) type joints for insulated joints required to isolate signal currents for road crossing warning devices. Special insulated tie plates are also required. It is recommended that rail joints be welded where located in paved areas or at any location where access to the joint is restricted.

Figure 5-25 Typical Rail Spring Clip



5-16.6 Track Bolts, Nuts, and Spring Washers.

Track bolts, nuts, and spring washers will conform to the specifications in Chapter 4, Part 3, of the AREMA Manual.

Common bolt diameters for different rail weights are found in Table 5-16.

Table 5-16 Common Joint Bolt Diameters

Bolt Diameter - in. (mm)	Rail Weights - lb/yd (kg/m)
1 (25)	90 to 130 (44.6 to 64.5)
1⅛ (25.4)	131 to 140 (65 to 69.4)

5-16.7 Rail Anchors.

For new construction, as a minimum, use rail anchors on main running tracks with spikes to restrain longitudinal rail movement in the quantity and arrangement diagrammed in Figure 5-26. Use additional anchors on track with grades steeper than 0.5 percent if required, and where maintenance problems indicate a need. Rail anchors are required in track with continuous welded rail. Rail anchors are not necessary in tracks that utilize rail spring clips. When anchors are used, apply four anchors to each tie that is anchored (box anchored), per tie as shown in Figure 5-26.

Use either spring or drive-on type anchors, shown in Figure 5-27. Drive-on anchors have the advantage of being easier to apply and remove manually, and do not require a special anchor wrench, as do spring anchors. Use caution, do not overdrive a drive-on anchor. Overdriving causes the anchor to lose its ability to tightly grip the rail base.

5-16.7.1 Bridges.

Do not use rail anchors across open deck bridges. Instead, box anchor every third tie for two rail lengths off each end of the bridge. Use a similar arrangement at rail crossings, as shown in Figure 5-28. Apply rail anchors at the normal designated pattern across ballast deck bridges.

Figure 5-26 Recommended Minimum Rail Anchor Application

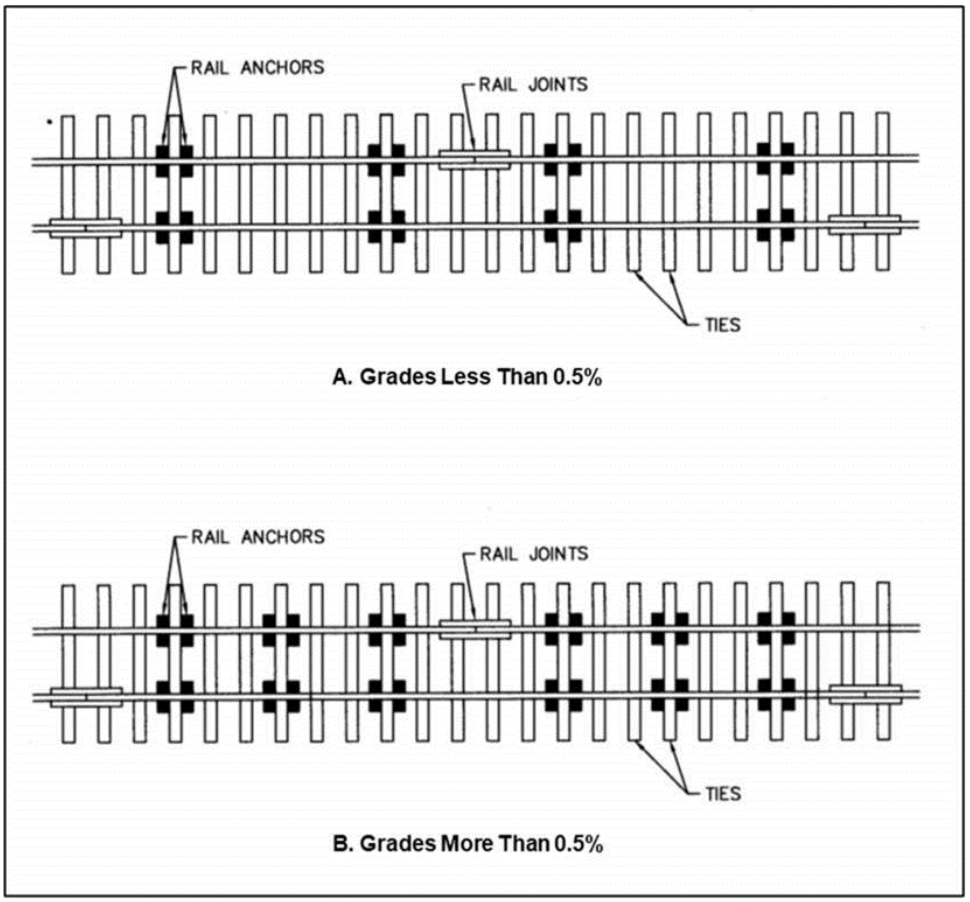


Figure 5-27 Rail Anchors

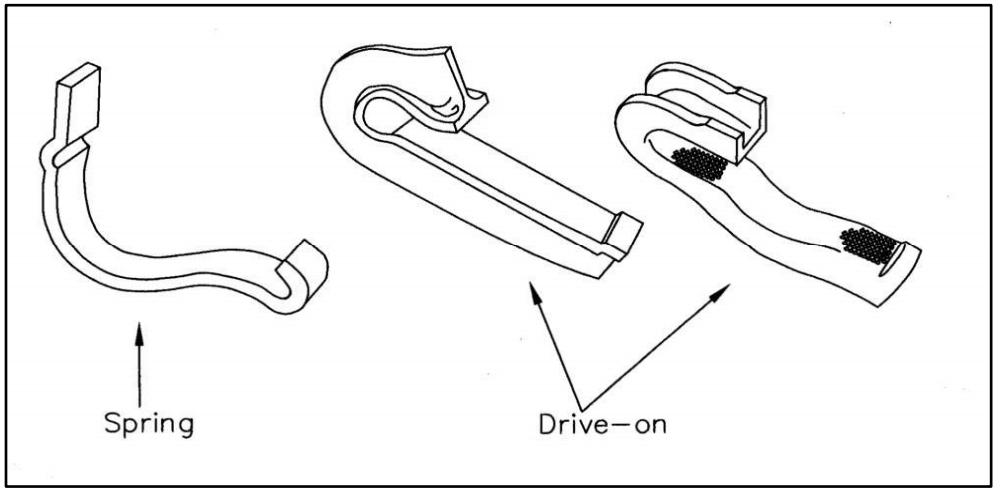
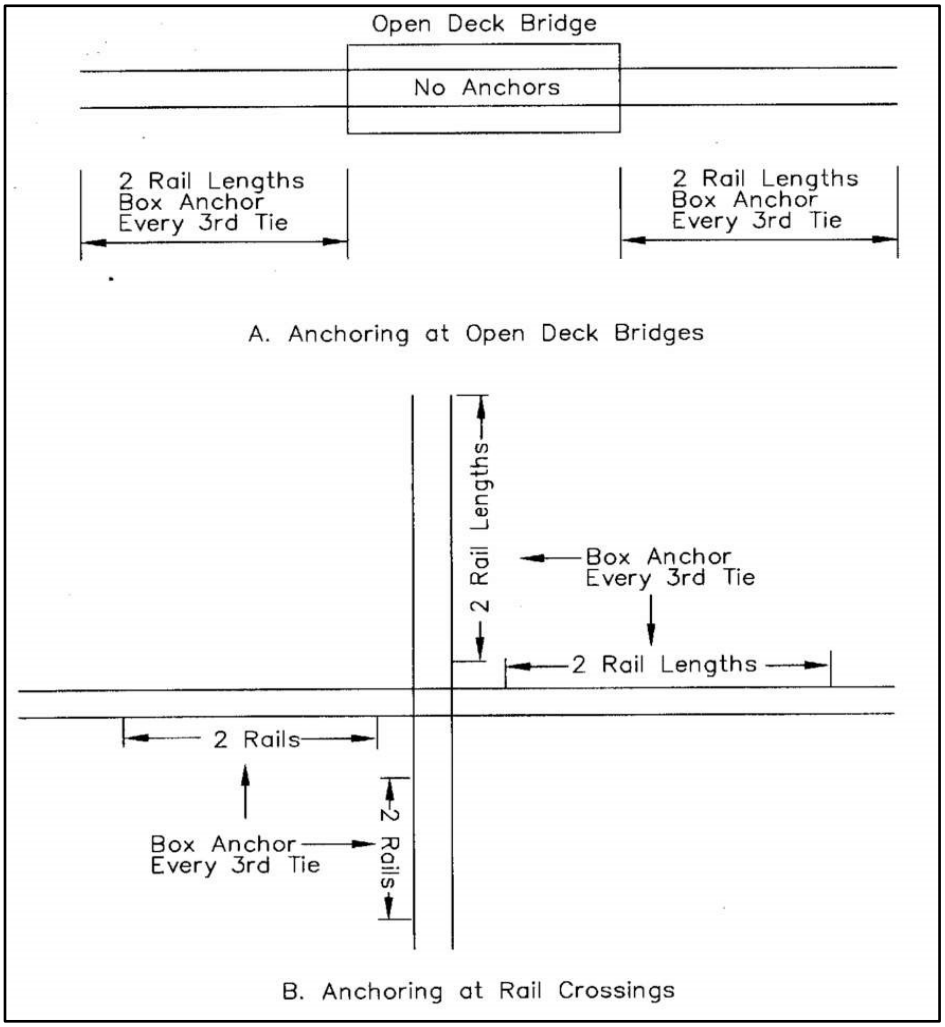


Figure 5-28 Rail Anchor Applications at Open Deck Bridges and Rail Crossings



5-16.8 Gage Rods.

Gage rods are sometimes specified for maintenance purposes on curves over 8 degrees where difficulty in holding gage is encountered. Install two to four rods per rail length when used on sharp curves.

Do not use gage rods for new construction, only use them for maintenance of existing track. In new construction areas where difficulty in holding gage is anticipated, consider the use of wood ties with rail spring clips or steel ties rather than gage rods.

5-17 TURNOUTS AND CROSSOVERS.

Turnouts are designed to divert trains from one track to another. Two turnouts form a crossover when used together to allow the passage of trains between parallel tracks. The general arrangement of turnouts and crossovers is shown in Figure 5-29. The main parts of a turnout are shown in Figure 5-30. For additional switch detail see AREMA Portfolio of Trackwork Plans 190, 220, and 221.

Figure 5-29 General Arrangement of Turnouts and Crossovers

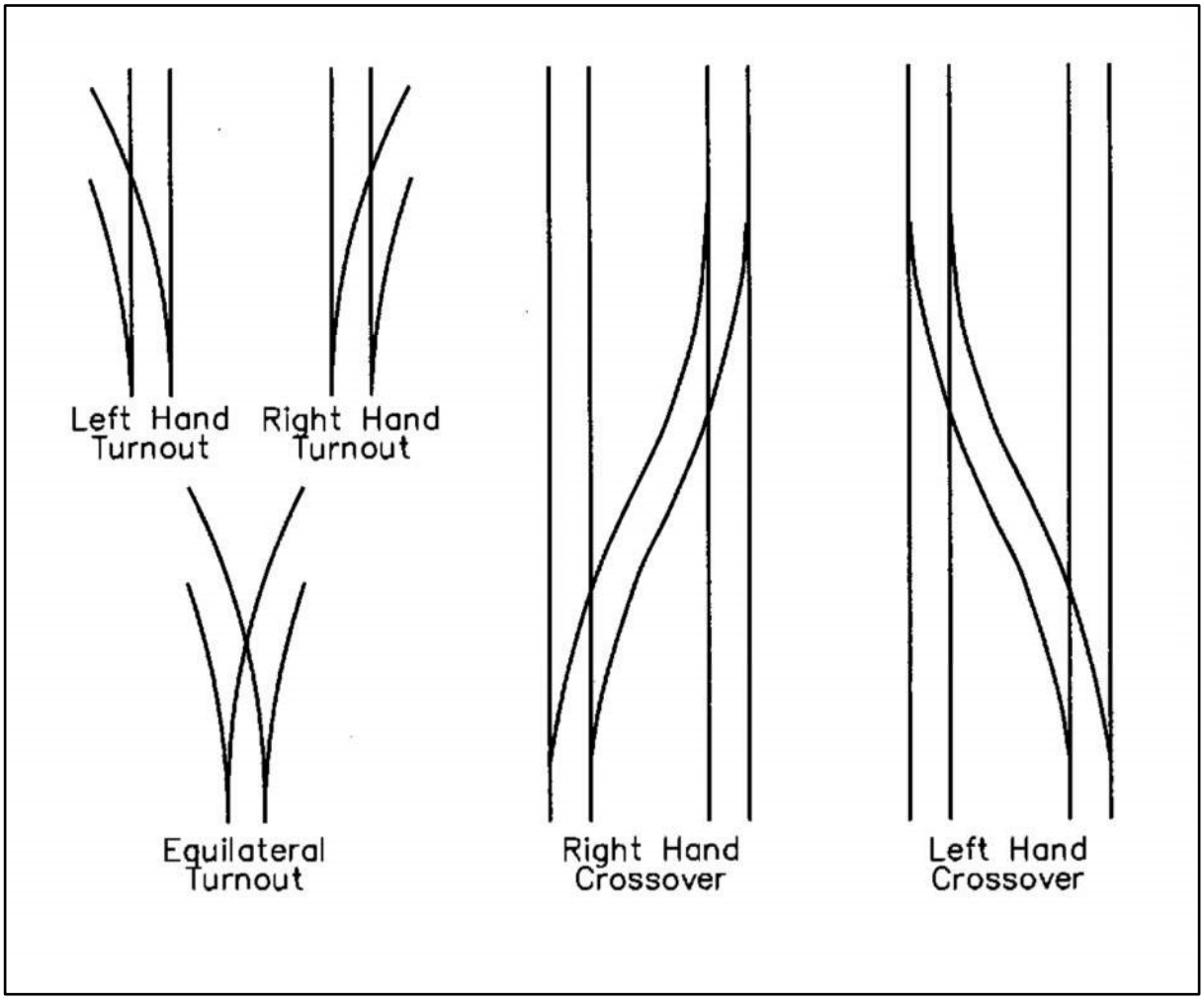
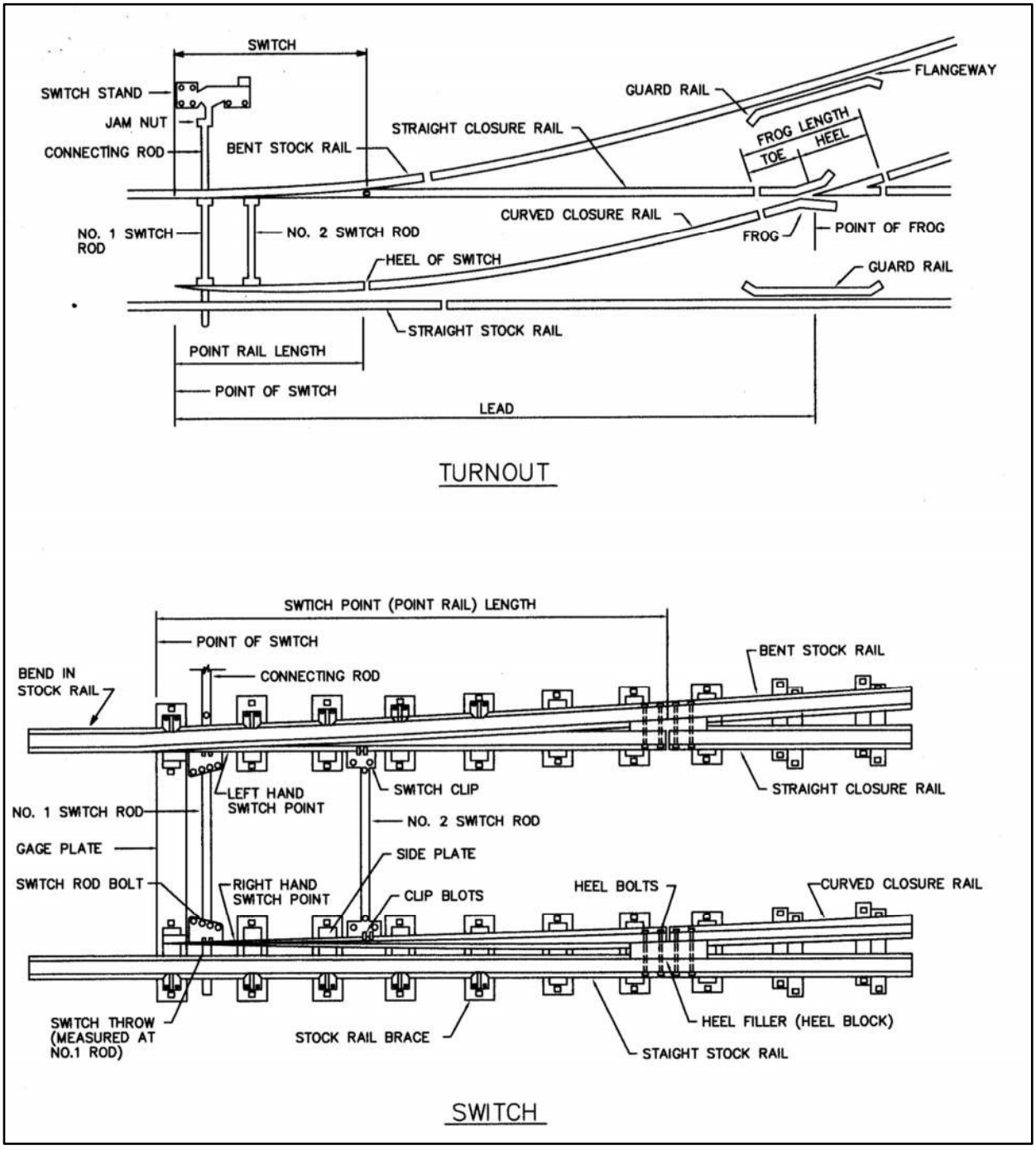


Figure 5-30 Parts of a Turnout



5-17.1 Size.

Turnout size is designated by the size of the frog used in the turnout, as illustrated in Figure 5-31. The size of the frog determines the angle at which the turnout track diverges from the tangent track. Frog size also influences the required degree of curvature within the turnout.

Select standard turnout sizes according to Table 5-17.

Figure 5-31 Determining Frog Number (Turnout Size)

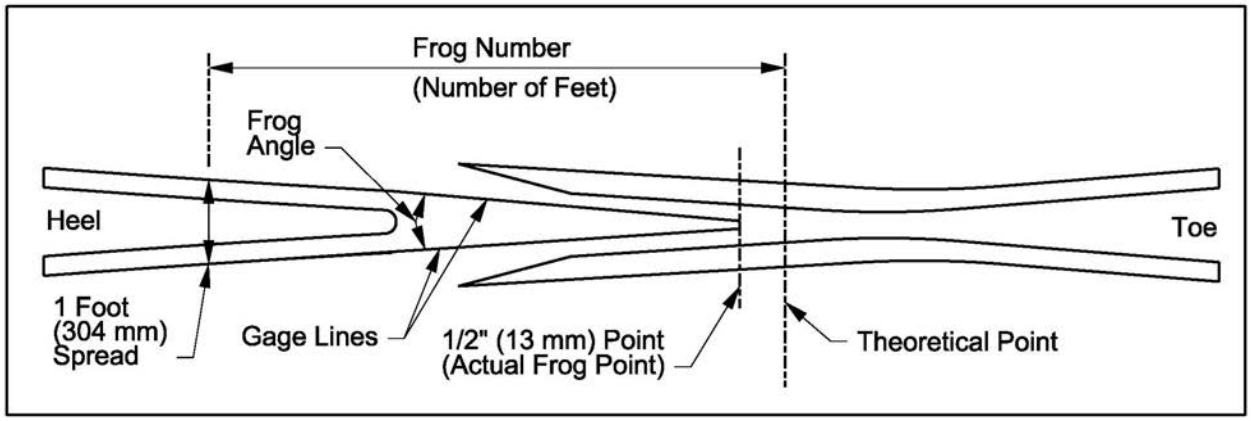


Table 5-17 Turnout Size Selection Criteria

Turnout Size	Turnout Curvature (Degrees)	Selection Criteria
10	7.4	Preferred where space permits, or where long cars (over 75 ft (22.9 m)) or 140-ton (127 MT) flatcars (with 3-axle trucks) are being handled. Use for crossovers.
9	9.3	Smallest size recommended for handling long cars (over 75 ft (22.9 m)) or 140-ton (127 MT) flatcars (with 3-axle trucks). In ladder tracks, saves space compared to a number 10.
8	11.8	Not recommended for handling long cars (over 75 ft (22.9 m)) or 140-ton (127 MT) flatcars (with 3-axle trucks). Smallest size normally permitted.

5-17.2 Design and Selection.

The main design decisions for turnouts are the direction the turnout will diverge, as shown in Figure 5-29, and the angle of the frog (or frog number), which determines how sharply the turnout diverges and also designates the size of the turnout. Recommended choices for different turnout components are covered below, as is layout design for use where nonstandard configurations are required.

Once a standard turnout has been selected from Table 5-17 or the geometry has been otherwise determined, the designer specifies the desired switch, frog, and guard rails if needed, from the appropriate AREMA Portfolio of Trackwork Plans; the turnout or crossover tie set from Table 5-14; and the amount of rail needed to complete the turnout (connect the switch and frog) from AREMA Portfolio of Trackwork Plan 910 or 911. The USACE Omaha District has standard plans available for the turnouts shown in Table 5-14 based on the AREMA Portfolio of Trackwork Plans. Guidance on the selection of these items and other turnout hardware is given below. Ensure all materials used within the limits of a turnout are factory designed and constructed, of the proper type and size, and not flame cut or otherwise altered in the field.

5-17.3 Switch Ties.

A turnout is fastened to a special set of ties called a switch tie set. Generally, switch ties increase in length from the switch point to just past the frog where the turnout ends. From that point, two standard tracks continue. An exception is at the switch point where the switch stand requires two long ties called head blocks to accommodate the stand and operating rods. Determine the make-up of switch tie sets using Table 5-14.

Use 7-in. x 9-in. (178 mm x 229 mm) hardwood ties for turnouts. Use oak switch ties in areas east of the Mississippi River and use oak or Douglas fir in areas west of the Mississippi River. Composite tie and steel tie sets are acceptable in turnouts. Switch tie material and treatment specifications are the same as for standard track ties and are covered in Chapter 5, Paragraph 14.

5-17.4 Switches and Switch Point.

The standard switch for use on military track is the 16 ft., 6-in. (5 m) switch with graduated risers, as shown in AREMA Portfolio of Trackwork Plan 112. The detailed specification for this switch is given in the notes in the upper right corner of the plan. In most cases, the specification will be for a 112A hand throw switch with adjustable braces. Use this specification for switches that are either within or not within a signal circuit (as near crossings with warning lights or gates). Use longer switches as needed when turnouts larger than No. 10 are used.

Specific criteria for switch point design in new turnouts are found in AREMA Portfolio of Trackwork Plan 221, Detail 5100. In locations where traffic conditions cause excessive wear on the tapered ends of the switch point, use manganese steel switch points per AREMA Portfolio of Trackwork Plan 220. The use of spring switches is not recommended on DoD track.

5-17.5 Switch Clips.

Use adjustable ductile iron rocker clips for switch clips as shown in AREMA Portfolio of Trackwork Plan 222, Detail 3117.

5-17.6 Rail Braces.

Use the adjustable type rail braces that support the outside of the stock rails as shown in AREMA Portfolio of Trackwork Plan 224. Leave rigid braces in existing turnouts if they provide adequate support per UFC 4-860-03.

5-17.7 Switch Stands and Lever Latches.

Ergonomic ground throw (low) switch stands are preferred, especially in terminal areas. However, there are situations when the height of the ergonomic stand will conflict with the clearance envelope of an adjacent track. In these situations, use a non-ergonomic stand. Many variations of ergonomic and non-ergonomic stands are available, and most are suitable. Ensure any stand selected has a provision for the throw lever to lock or latch solidly in place. For switches in more remote areas, a switch point lock and/or lever lock is desirable.

5-17.8 Frogs and Guard Rails.

Frogs are secured to ties with universal frog plates as shown in AREMA Portfolio of Trackwork Plan 242 or a set of hook plates. When not using self-guarded frogs, specify guard rails to match the frog size, as listed in Note 2A of AREMA Portfolio of Trackwork Plan 502. Guard rails of the type in AREMA Portfolio of Trackwork Plans 504 or 509 are acceptable.

Do not use spring rail frogs on DoD installations. Bolted rigid frogs that are in existing turnouts and are not defective can stay in place. When new frogs are required, use either solid manganese or rail bound manganese meeting the above specifications.

5-17.8.1 Solid Manganese Self-Guarded.

The solid manganese, self-guarded type frog, as shown in AREMA Portfolio of Trackwork Plans 641 and 691 (Section BB), is preferred for the slower speed operations most common at military installations. Self-guarded frogs simplify turnout construction by not requiring separate guard rails opposite each side of the frog.

5-17.8.2 Railbound Manganese.

Use railbound manganese (RBM) frogs, as shown in AREMA Portfolio of Trackwork Plans 622 - 625, on heavy traffic lines where the traffic is approximately equal on both sides of the frog. This type of frog is most desirable for long turnouts (Size No. 15 or above) since manganese steel is especially suited to the thin long points and requires comparatively little maintenance.

5-17.9 Stock Rails and Closure Rails.

When planning, specify enough rail to make up the straight and curved stock rails and closure rails, as indicated in AREMA Portfolio of Trackwork Plan 910 or 911. This amount will approximately equal twice the actual lead (Column 4) plus the closure distances (Columns 5 and 6). Ensure all rail within the limits of a new or secondhand

turnout is of the same weight and section and match the rails on the main and diverging tracks. Compromise joints are not permitted within the limits of a turnout. Where new switch points are specified with relay closure rail, check to assure that the top and gage side of the points and closure rails match at the heel joint.

When rebuilding turnouts, and new and relay rail are available on the project, it is recommended that new rail be used to reconstruct the turnouts; this will avoid the potential problem of rail contour mismatch at the switch heel joints.

5-17.10 Equilateral Turnouts.

In an equilateral turnout, the diverging angle (frog angle) is divided equally on both sides, thus the turnout has two curved stock rails and two curved closure rails that mirror each other. Likewise, the degree of curve along each closure rail is half that of a standard left or right-hand turnout.

5-17.11 Turnouts in Curves.

Do not place turnouts within the limits of horizontal curves without the approval of the AHJ. If a turnout is placed within the limits of a horizontal curve, preferably place the turnout with the curved side of the turnout in the main route's curve and the straight side of the turnout creating the new track to the outside of the curve. In this situation, the curvature of the turnout must match the curvature of the main route curve.

Avoid turnouts creating a new track to the inside of a main route curve. Curvature through a turnout on the inside of a curve equals the degree of curvature for the curve plus that for a standard turnout. Thus, a number 10 turnout off the inside of a 3 degree curve will have a curvature of 3 + 7.4 = 10.4 degrees. Ensure the total curvature does not exceed design limits.

5-18 TRACK CONNECTIONS AND LADDER TRACKS.

5-18.1 Diverging Routes.

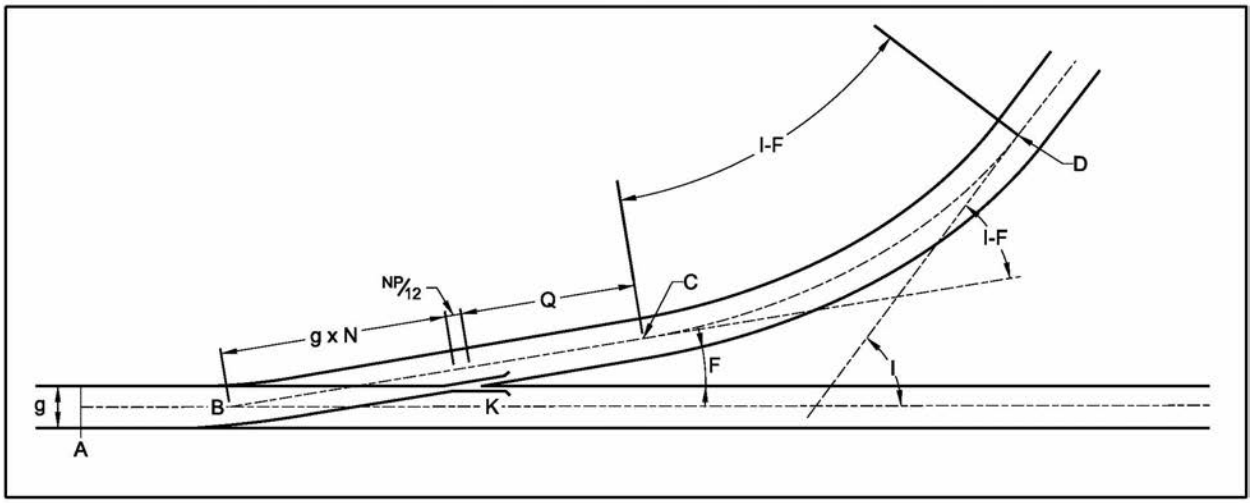
Figure 5-32 shows the layout for a typical diverging route connection. Note that the initial angle that the route diverges is the same as the frog angle for the turnout. If the diverging route needs to be at a different angle, the difference in angle is accomplished with a curve after the turnout and the required tangent distance. The distance from the intersection of track center lines to the location of the frog point is given by Equation 5-13. This distance is critical for determining the location of the turnout.

The layout of a parallel siding connection is a special case of a diverging route. See Figure 5-33. The parallel siding connection is used with sidings and yard ladders.

5-18.2 Crossovers.

Crossovers are a combination of two turnouts used to join two adjacent tracks, as shown in Figure 5-29.

Figure 5-32 Diverging Route Connection

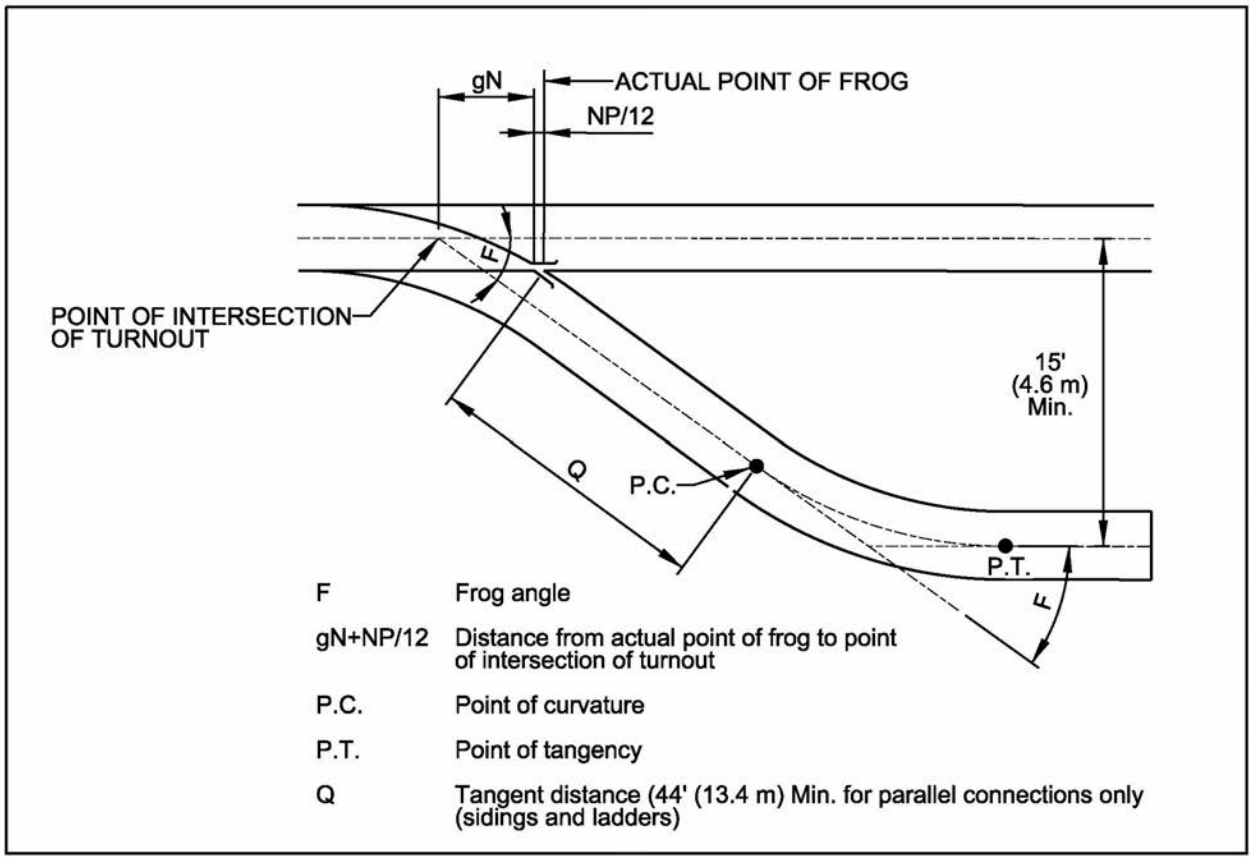


Equation 5-13. Distance from Track Center Lines to Frog Point

$$BK = g(N) + \frac{NP}{12}$$

Where:
A = Point of Switch.
AK = Actual Lead.
B= Point of Intersection of Turnout.
BK = Distance from points B to K, as shown in Figure 5-32 (feet).
C= Point of Curvature.
D = Point of Tangency.
F = Frog Angle.
g = Track gage (feet).
I = Angle between mainline and diverging route.
K = Point of Frog.
N = Frog number.
P= Frog point width = ½ in. (13 mm)
Q= Tangent distance = 60 ft. (18.2 m) minimum for diverging routes.
= 44 ft. (13.4 m) minimum for parallel connections only (sidings & ladders).

Figure 5-33 Parallel Siding Connection



5-18.3 Ladder Tracks.

Figure 5-34 illustrates a typical ladder track, shown between points A and E. This arrangement is commonly used for parallel yard tracks or loading tracks. See Chapter 7 for layout of yard and terminal tracks.

5-19 RAIL CROSSINGS.

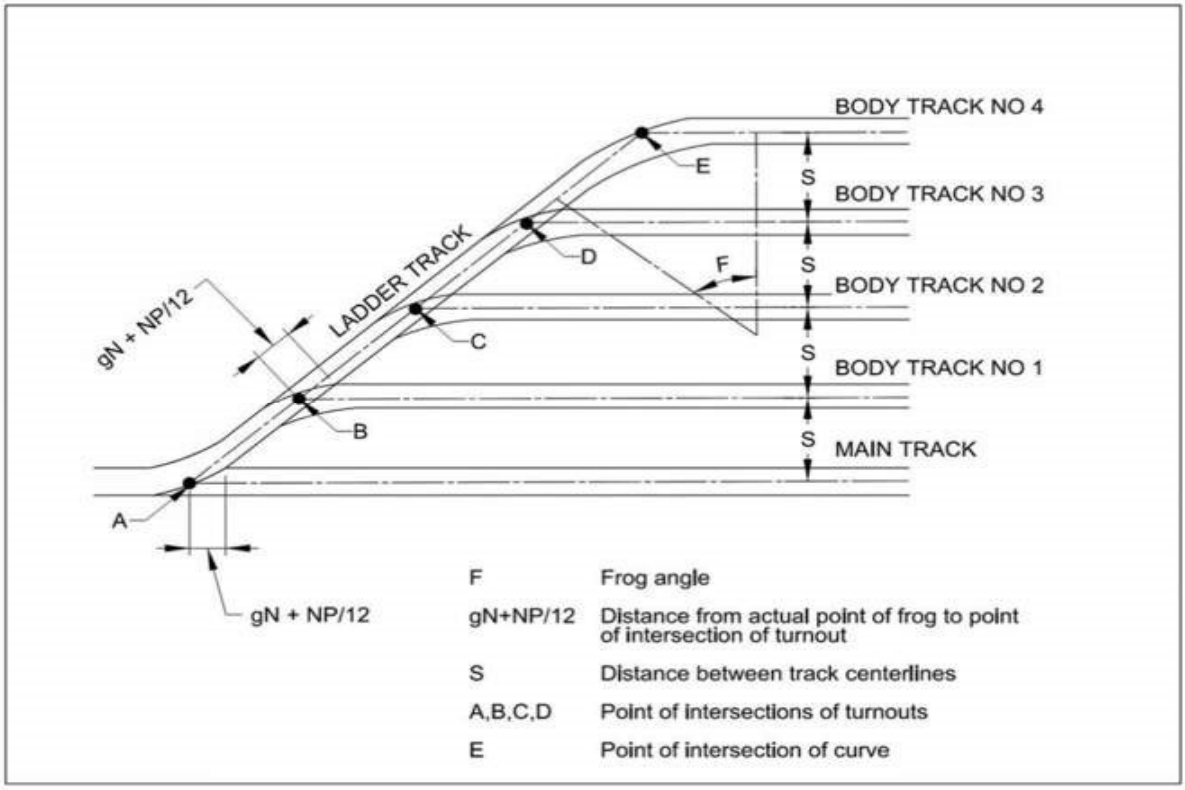
5-19.1 Recommended Types.

Bolted rail crossings, as described in item 1 on AREMA Portfolio of Trackwork Plan 700A, are recommended for use on military track. Tie layouts and plates for various angle crossings are given in AREMA Portfolio of Trackwork Plans 700F through 700J.

5-19.2 Anchoring Approaches.

Where rail anchors are used on the tracks approaching rail crossings, box anchor every third tie (four anchors per tie) for at least two rail lengths in all directions from the crossings.

Figure 5-34 Ladder Track Layout



5-19.3 Application.

As rail crossings are expensive and require more maintenance than standard track, do not design track layouts with crossing tracks unless this is clearly necessary.

5-20 MISCELLANEOUS TRACK APPLIANCES.

5-20.1 Derails.

5-20.1.1 Application and Type.

5-20.1.1.1 Switch Point Derails.

Derails are commonly used on spur tracks or sidings to prevent runaway rail cars or unauthorized entry of rail cars onto the main track. Derails are also used to protect standing equipment stored on a track. Three different types are the switch point derail, permanent hinged or sliding derail, and portable derail.

5-20.1.1.2 Permanent Hinged/Sliding Derails.

Use permanent hinged or sliding derails for permanent installations on military track. Hinged derails are typically more economical, require less maintenance, and are the

most popular. Sliding derails are easier to operate if they are properly maintained. Ensure permanent hinged and sliding derails include a sign or target to indicate when they are in the derailing position and are painted AREMA yellow.

Permanent hinged, sliding, or switch point derails must include locks to secure them in both the derailing and non-derailing position.

5-20.1.1.3 Portable Derails.

Use portable derails for temporary conditions, such as protecting a construction crew that is working on a track. Paint portable derails AREMA yellow (Federal Standard 595-B, color #13538, SCN 470.0004584.1) and include an elevated blue sign with the word "DERAIL" in white lettering to indicate when it is installed.

5-20.1.2 Location.

Locate derails so that after running over the derail, a car would stop before reaching the point requiring protection. To prevent the unauthorized entry of rail cars into a main track, place derails a minimum of 50 ft. (15.2 m) beyond the point where the centerline of the track has separated 13 ft. (4 m) from the main track. Additional distance can be required depending on track gradient or the requirements of the commercial railroad. To protect standing equipment stored on a track or a work area, install the derail a minimum of 150 ft. (45.7 m) from the equipment or work area. Figure 5-35 illustrates derail placement.

5-20.1.3 Size and Designation.

Specify derails for the size of rail on which they are to be installed. The number of the derail usually indicates the distance (in inches) from the top of the rail to the top of the tie (including tie plate thickness). Derails generally come in even 1-in. (25 mm) sizes and can be shimmed up to a height of 0.5 in. (13 mm) (or the ties on which the derail is attached can be added up to 0.5 in. (13 mm) deep) to accommodate height variations.

5-20.1.4 Direction.

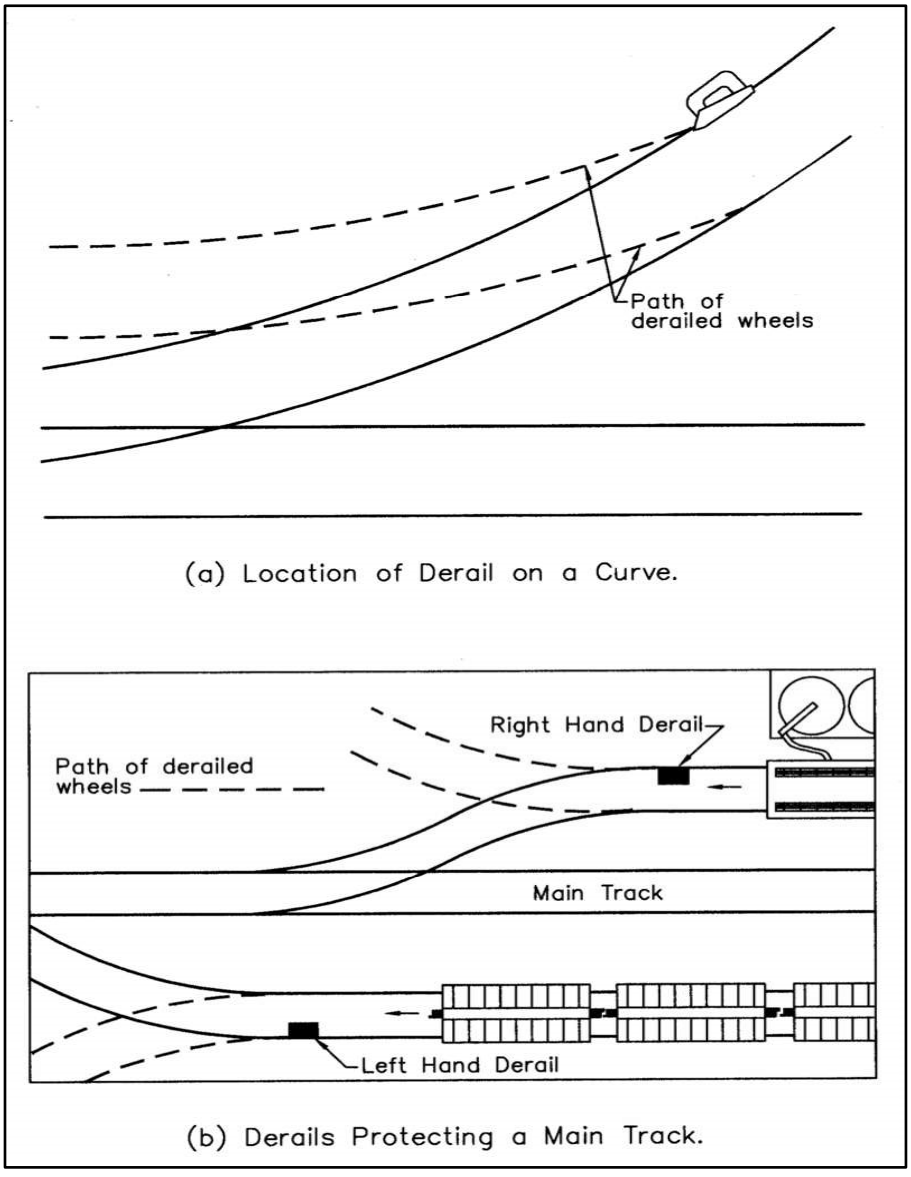
Derails are designed as either left-hand or right-hand. The proper direction is determined by looking in the direction that the rolling stock to be derailed moves. Install a right-hand derail on the right-hand rail to derail the cars off the right side of the track. Install a left-hand derail on the left-hand rail to derail cars to the left.

5-20.2 Bonded and Grounded Track.

Wherever unloading cars carrying fuel, ammunition, or other flammable or explosive materials, or where track is located adjacent to electrical equipment, bond, ground, and insulate the rails and related track materials capable of conducting electrical current from the remaining track. This bonding and grounding help prevent the discharge of static electricity during the loading or unloading of these hazardous materials. General requirements for bonding and grounding are given below; additional details are found in Chapter 33, Part 7 of the AREMA Manual.

When a side track or section of running track is to be bonded and grounded, provide an insulated joint on each rail at the first rail joint beyond the turnout of the adjacent main track at either end of the main track. The rails at all other joints in the track beyond or between the insulated joints are bonded together with bond wires and both rails of the bonded track will be connected by grounding connectors to a single driven ground rod. Remove defective bonds by shear cutting old cables immediately adjacent to the weld or pin. Do not use flames or torches to remove defective or out-of-service bonds.

Figure 5-35 Location of Derails.



5-20.2.1 Grounding Rods.

Grounding rods are 0.75-in. (19 mm) diameter copper clad steel rods or 1-in. (25 mm) diameter zinc coated steel rods. The minimum length of ground rods is 8 ft. (2.44 m).

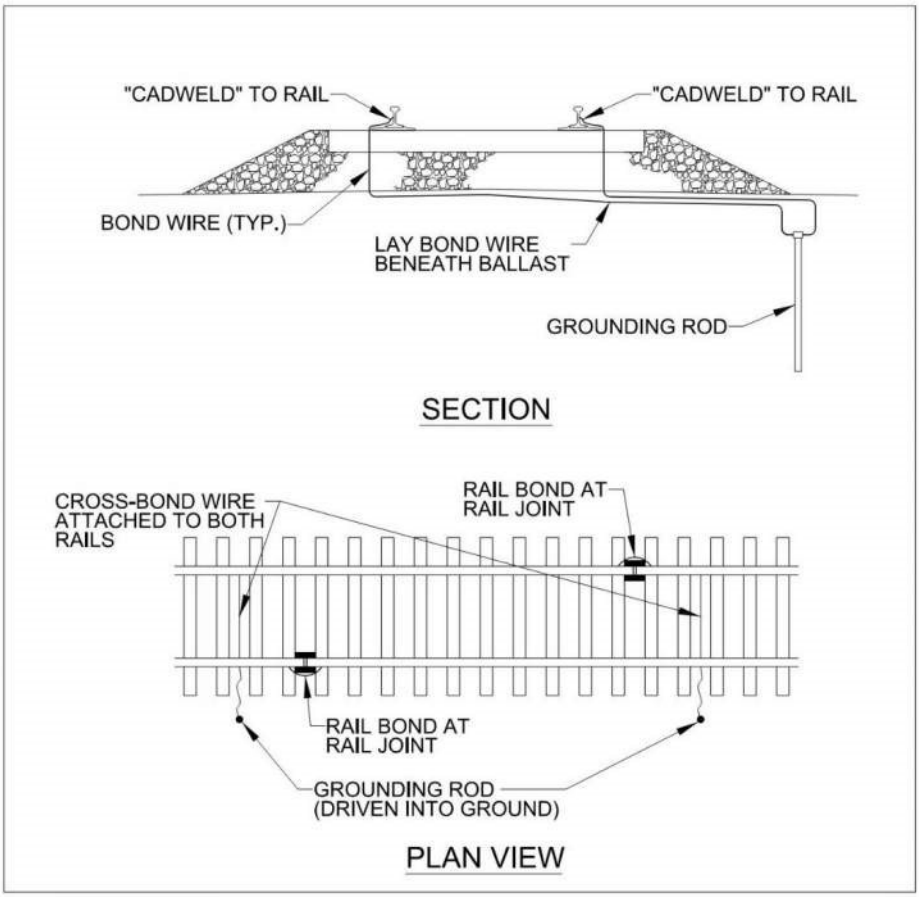
Drive ground rods vertically for their full length and ensure the top of the ground rod is located a minimum of 12 in. (304 mm) below the top of the subgrade at the toe of the ballast slope. The maximum allowable resistance of grounded rail or structures is 25 ohms. If testing indicates the resistance is greater than 25 ohms after all grounding and bonding connections are made, consult the design engineer to determine how to reduce the ground resistance below the minimum requirement.

5-20.2.2 Exothermic Rail Bond.

An exothermic type rail bond is recommended for the application of rail bonds on military track. Ensure bond cables are flexible bare copper stranded 1/0 AWG cables with preformed ends and conform to the applicable requirements.

Rail cross bonds are required to bond the two rails together and to connect the rails to the grounding rods. Install rail cross bonds using exothermic type bonds and 1/0 AWG flexible bare copper stranded cable. Apply the cross bond to the rail head or rail web and install the cable for the cross bonds a minimum of 12 in. (304 mm) below the bottom of the ties. Install cross-bonded ground rods at 100-ft (30.5 m) intervals along tracks designated for the loading and unloading of fuel, ammunition, and other volatile or hazardous materials. Figure 5-36 illustrates bonded and grounded track.

Figure 5-36 Bonded and Grounded Track



5-20.2.3 Overhead Power Lines.

Where overhead power lines in excess of 600 volts cross over the track, make the rails electrically continuous and grounded for a distance of 150 ft. (45.7 m) on each side of the power lines.

5-20.3 Track Scales.

When required, track scales will be designed and installed in accordance with the Scale Handbook, which appears as an appendix in the AREMA Manual.

The design and construction of track scales is best performed by a commercial firm that specializes in design, fabrication, and construction of railroad track scales.

5-20.4 Bumping Posts and Wheel Stops.

Use bumping posts, wheel stops, or earth mounds at the end of all stub tracks to prevent cars from rolling off the end of the track.

Where it is not critical that railroad cars be absolutely stopped at track ends to protect personnel, facilities, or parked vehicles and equipment, and where no other hazards are present, 4 ft. (1.2m) high earth mounds should be used at the end of the tracks rather than coupler-height bumping posts, wheel stops, or other obstructions. Earth mounds are economical, stop cars with minimal damage to the cars or the earth mound, are easy to repair, and are recommended by commercial railroads. An example application for earth mounds is at the ends of storage tracks. However, earth mounds must not be used with end ramps, which require the use of coupler-height bumping posts.

5-20.5 Security Fencing.

The character of the land use of property adjacent to the railroad and security requirements will govern the need for fencing along the right-of-way lines. Consult the installation Physical Security Officer to ensure that security fencing requirements are incorporated in the design. UFC 4-022-03 provides guidance on security fencing and gates. All gates are equipped with locking hardware.

5-20.5.1 Terminal Fencing.

Security fencing can be required to surround facilities within a terminal, or even a complete terminal area. These fences are typically standard chain-link construction, such as 6-ft (1.8 m) FE5 per USACE STD 872-90-02 Omaha District. When required, the following standard provides a more secure fence: FE6 USACE STD 872-90-03 or FE7 USACE STD 872-90-04 Omaha District .

5-20.5.2 Track Gates.

When designing a track gate, ensure the following:

- The gate prevents unauthorized entry by both pedestrians and vehicles.

- The gate opens a minimum width of 18-ft (5.5 m) or wider to meet the clearances in Paragraph 5-4 to allow cars to pass through.
- Culverts draining the track through a fence or gate have security bars in them.
- It is recommended that a drainage ditch security barrier be constructed using concrete. This will provide both a headwall for the culvert and a foundation to mount rollers for the sliding gate.

5-20.6 Snow Fences.

Chapter 1, Part 6 of the AREMA Manual provides guidance on the application and construction of snow fences and other measures to minimize snow drifting on the track.

5-20.7 Cattle Guards.

In areas where livestock or other large animals could enter the railroad right-of-way at road crossings, install cattle guards.

5-20.8 Utility Pipe Crossings.

Encase utility pipelines that carry liquids under pressure under or over railroad tracks within a protective steel casing pipe. Encase utility pipelines that carry gases under railroad tracks within a protective steel casing pipe or protect them using other means. Chapter 1, Part 5 of the AREMA Manual provides requirements for pressurized liquid and gas pipelines that cross railroad tracks.

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CHAPTER 6 ROAD CROSSINGS AND BRIDGES

6-1 ROAD CROSSINGS.

6-1.1 Establishing Crossing Requirements.

Verify the need for a new crossing and its appropriate location with the installation master plan. As road crossings increase maintenance costs and safety risk, limit their quantity to a minimum.

Conduct a study to assess traffic and site conditions for a newly planned crossing or one intended for upgrading or rehabilitation. These findings help establish crossing and protection design requirements. This study should include:

- Amount and character of vehicle and train traffic.
- Train and vehicle operating speeds.
- Crossing angle and horizontal and vertical approaches of road and track.
- Available sight distances, from all directions, for vehicles approaching the track and from trains approaching the crossing.
- Previous accident or incident history.

6-1.2 Design Steps.

The main steps in designing a road crossing are:

- Determining the geometric layout.
- Selecting the crossing surface and flangeway design.
- Designing the drainage.
- Designing the track section.
- Determining the appropriate crossing protection.

6-1.3 Geometric Layout.

The ideal crossing geometry is a 90-degree intersection of the track and road (for best sight angles) with slight ascending grades on the road approaches. Drainage should be away from the track to reduce the flow of surface water toward the crossing.

Avoid locating crossings near road intersections. Avoid locating crossings within either a road or railroad curve. These sites typically result in poor sight distances and in conflicting super-elevations that often lead to long-term maintenance problems and poor performance of the crossing. Where the road and railroad cannot cross at right angles, the angle should be kept to 60 degrees or greater whenever practical. For angles less than 60 degrees additional warning or crossing protection should be considered.

6-1.4 Crossing Surfaces and Flangeways.

6-1.4.1 Standard Crossing Types.

Table 6-1 lists 5 standard crossing types. Figures 6-1, -2, -3, -4, and -6 show cross sections and design details for the 5 standard crossing types. These designs are described below along with recommendations for their application and their limitations. It should be noted that, even for the most expensive crossing surfaces, the cost of rebuilding the track, especially when new rail is installed, and the road approaches is usually more than the purchase and installation cost of the crossing surface itself. Thus, especially where road traffic volume is significant, where significant numbers of heavy trucks pass over the crossing, or where vehicle speeds exceed 25 mph (40.2 km/hr), the main cost variable will probably be the expected durability of the crossing.

Table 6-1 is a starting point for matching a crossing surface with traffic requirements. The descriptions of the crossing surfaces below will help focus on the most appropriate choices.

Table 6-1 Recommended Crossing Surfaces

Crossing Type	Vehicular Traffic Use Summary
Gravel Crossing with Timber Flangeway Header.	Very low or intermittent non-public traffic volume. For use within rail yards for maintenance access.
Timber Crossing.	Low traffic volume, low truck volume.
Asphalt Crossing with Rubber Interface.	Low to medium traffic volume. For use with steel ties. Not to be used for tracked vehicle crossing.
Prefabricated Concrete Panel Crossing.	High traffic volume, high truck volume, vehicle speeds exceed 25 mph (40.2 km/hr).
Sectional Monolithic Concrete (No Ties).	Crossing designed for heavy loading. For use by tracked vehicle.

6-1.4.2 Constructed Surfaces.

Gravel and asphalt crossings are constructed crossings. With this classification, the road or street extends across the track to form a crossing. Separate flangeway headers or rubber interfaces are recommended, but the crossing is generally made from available road and track materials and fabricated on-site. This arrangement provides site-specific versatility to fit a crossing in-place at the time of construction. These crossings are readily adaptable to any track curvature, superelevation, or gradient.

These crossings are not readily removed and replaced for track or road maintenance. Construct these crossings at least 2-ft (.61 m) on each side beyond the typical pavement width for the road. Taper the crossing material at each end of the crossing forming a beveled end ramp down to the track surfacing. Note that track constructed with steel ties requires a constructed crossing surface.

6-1.4.3 Prefabricated Surfaces.

Timber, prefabricated concrete panel, and sectional monolithic concrete crossings are categorized as prefabricated. These crossings are generally ordered from a manufacturer and are assembled at the site from surface panels using special panel attachment or track fastening hardware. Prefabricated crossings often require longer ties than standard. They are ordered specifically for the size of rail, tie plates, and anchors (if used) at the crossing. This ensures the panel height will match the rail height and that sufficient clear space is available under the panels for the tie plates and rail fastenings. Also, order prefabricated crossings to match any track curvature and for crossing angles that vary significantly from 90 degrees. It is suggested that prefabricated crossings be ordered to extend at least 2-ft (.61 m) on each side beyond the widest part of the road through the crossing, allowing for crossing angle as needed. Taper the crossing at each end of the crossing forming a beveled end ramp down to the track surfacing. A fabricated metal end ramp or deflector plate fastened to the ties and crossing panel can be used in-place of a beveled crossing surface.

Prefabricated crossings are typically installed more quickly than constructed crossings and are usable as soon as installation is complete. When considering prefabricated crossings, it is suggested that drawings and instructions be obtained from a sampling of manufacturers to help determine an exact list of materials and hardware required, as well as available options and track construction and preparation requirements.

6-1.4.4 Selecting a Road Crossing Surface.

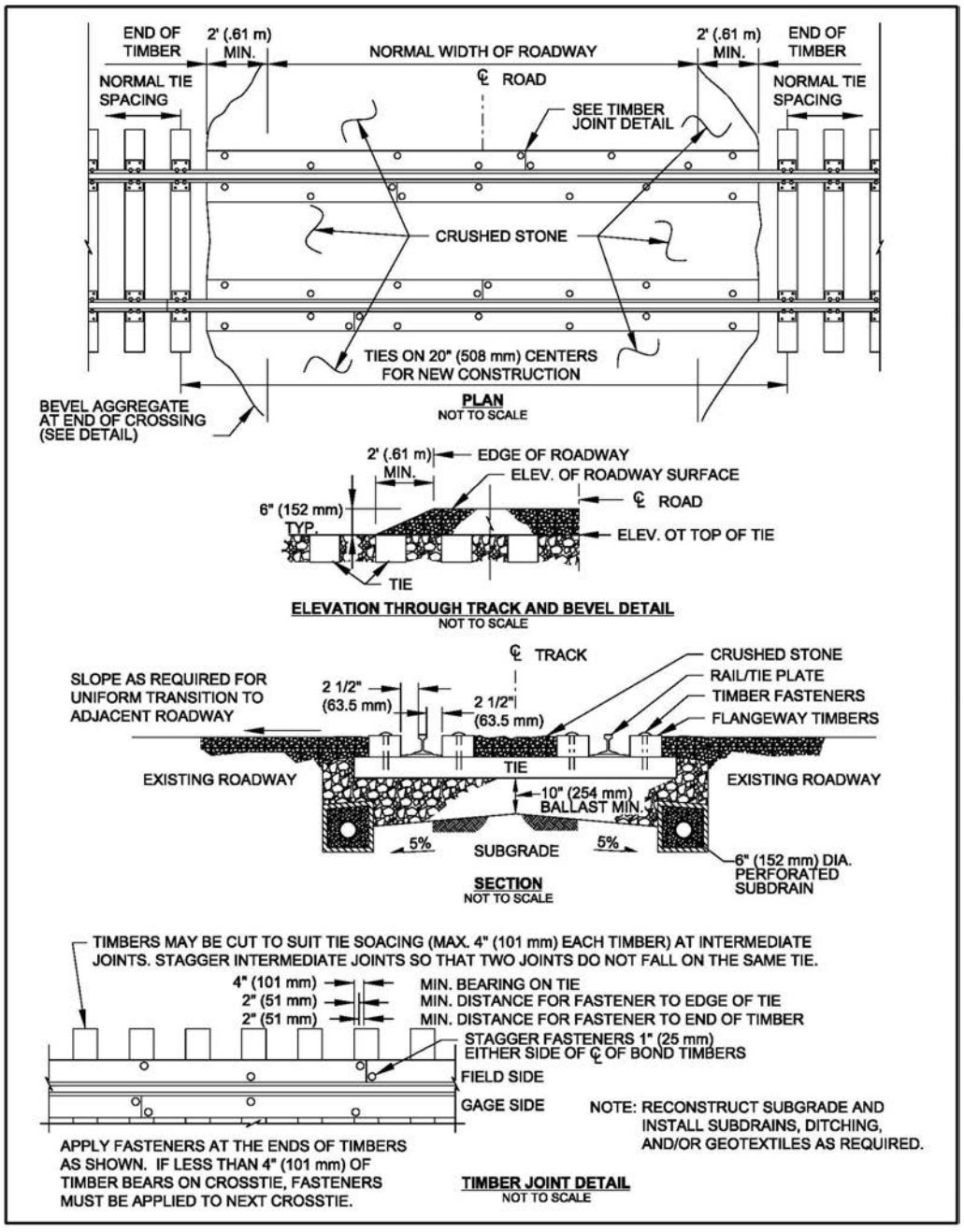
Consider the following in selecting an appropriate road crossing surface:

- Vehicle traffic – volume, type, and speed.
- Road classification – local road, collector, arterial, or highway.
- Use by industrial traffic, special vehicles, tracked vehicles.
- Railroad traffic – volume, type, and speed.
- Accident history for existing crossings where the crossing surface contributed to the accident.
- Cost – initial construction cost, replacement cost, and maintenance cost.
- Expected service life.

6-1.4.5 Gravel Crossing with Timber Flangeway Header.

These crossings are appropriate in locations with very low traffic volumes and where a crossing is infrequently used by large trucks or tracked vehicles.

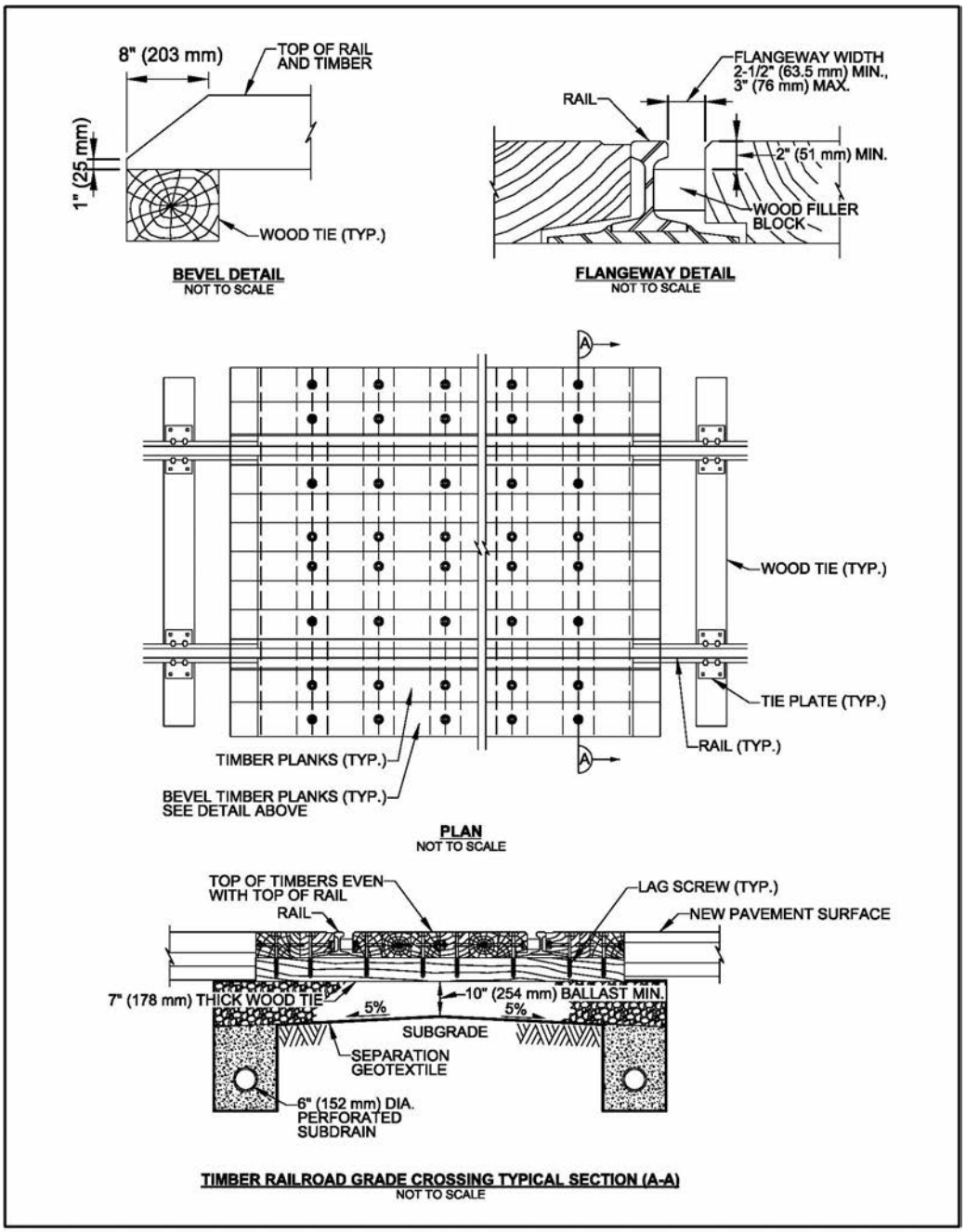
Figure 6-1 Typical Gravel Crossing with Timber Flangeway Header



6-1.4.6 Timber Crossing.

These crossings generally have a medium life span of about 10 to 15 years. They are often chosen due to long familiarity and experience with their design. If removed for track or road maintenance, however, the warping stresses that commonly build up in wood long exposed to weathering elements can make replacement difficult and produce a rougher riding surface. Timber is subject to wear that gradually exposes fastenings to vehicle tires. Timber is also subject to damage by plow blades during snow removal.

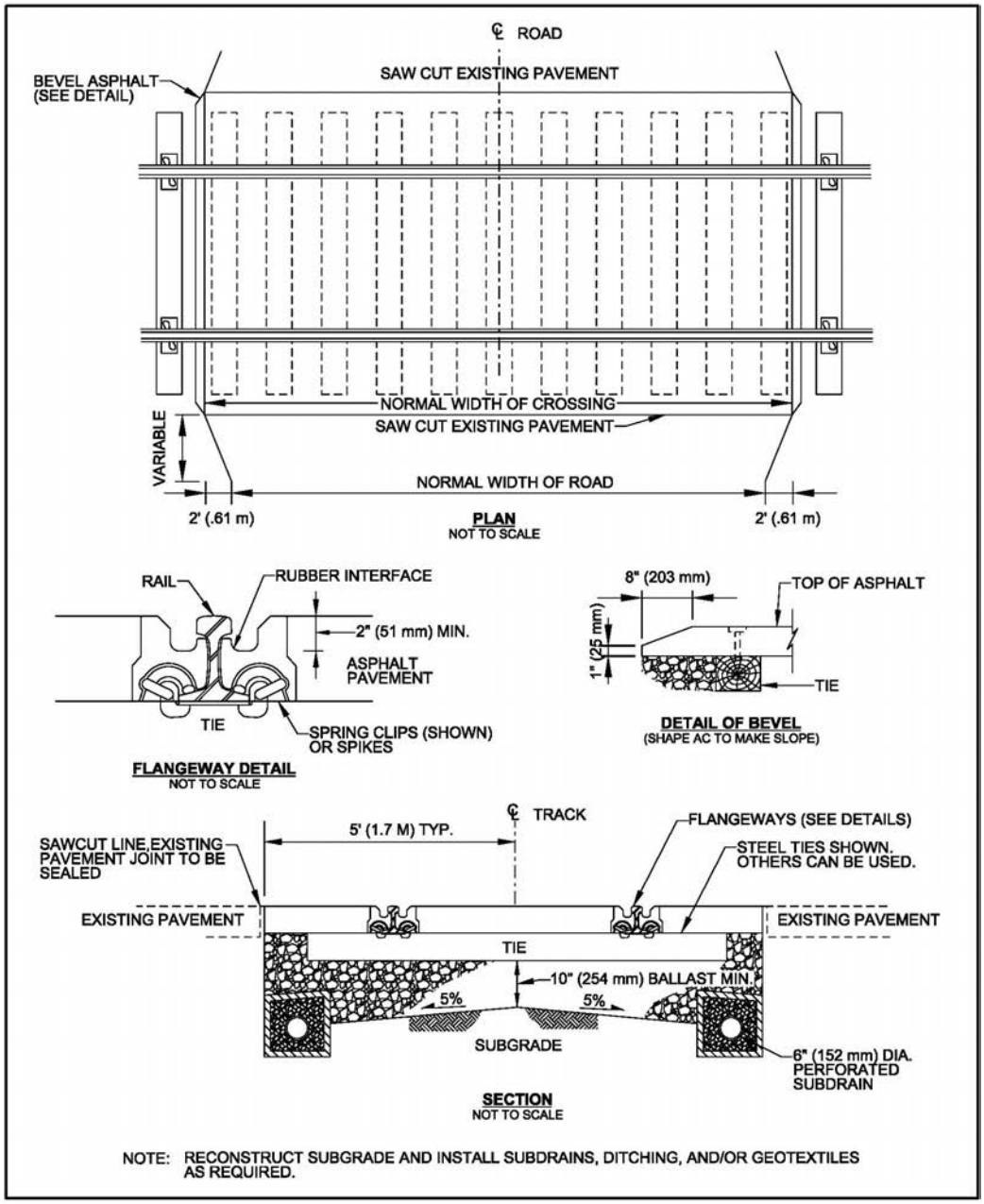
Figure 6-2 Typical Timber Crossing



6-1.4.7 Asphalt Crossing with Rubber Interface.

These are expediently and inexpensively constructed. The presence of a rubber interface providing a flangeway and separating the asphalt from the rail, typically results in reduced flangeway maintenance and less pavement breakage near the flangeway. Expected life averages 8 to 10 years under moderate traffic and where freeze-thaw cycles are common.

Figure 6-3 Typical Asphalt Crossing with Rubber Interface



6-1.4.8 Prefabricated Concrete Panel Crossing.

6-1.4.8.1 General Characteristics.

These are now being produced by a number of manufacturers and are being widely adopted due to their relative strength and expected durability, ease of installation and removal for track maintenance, and moderate cost. These crossings are not subject to decay as are standard timber crossings and are much less subject to damage from plow blades during snow removal operations, compared to timber or gravel crossings. In addition, they are the most suitable to accommodate traffic from tracked vehicles. When either track or adjacent road maintenance is required, these crossings can be removed relatively easily, in part or whole, and replaced without damage to the crossing material or track, and without loss of original evenness of surface. Like other crossings, though, these require solid support to prevent panel breakage or loss of crossing surface evenness. Due to the stiffness of the panels, these crossings are not recommended for locations where there is a pronounced vertical curve in the track.

6-1.4.8.2 Specifications.

Design of these crossings varies with manufacturer. It is suggested that a type be chosen with a minimum concrete strength of 5,000 psi (34.5 MPa), with guaranteed panel thickness variation within +/- 1/8 in. (3.2 mm), with a waterproof and chemical resistant seal on panels, and with the option of epoxy coated rebar. A warranty of crossing performance should also be obtained.

6-1.4.8.3 Installation Options.

In a standard or lagged installation, the panels are “lagged” (attached) to wood ties with lag bolts, with no fastening between adjacent panels - similar to the way a conventional timber crossing is installed. With a lagless installation, the field panels and gage panels are fastened lengthwise to form three monolithic panels for the length of the crossing, with no fastening into the ties. Different methods are used for panel-to-panel fastening. Use end angles or other end restraint devices to secure the crossing longitudinally. Vertical and lateral movement is prevented by the weight of the fastened panels combined with confinement between the adjacent roadway and the rail for field panels, and confinement between the rails for gage panels. With a lagless installation, use flangeway fillers to keep gage panels secured away from the running rails. For most military applications, lagless installation is suggested. Figure 6-5 shows a lagless concrete panel crossing in which adjacent panels are fastened by a series of short welds.

Figure 6-4 Typical Prefabricated Concrete Panel Crossing

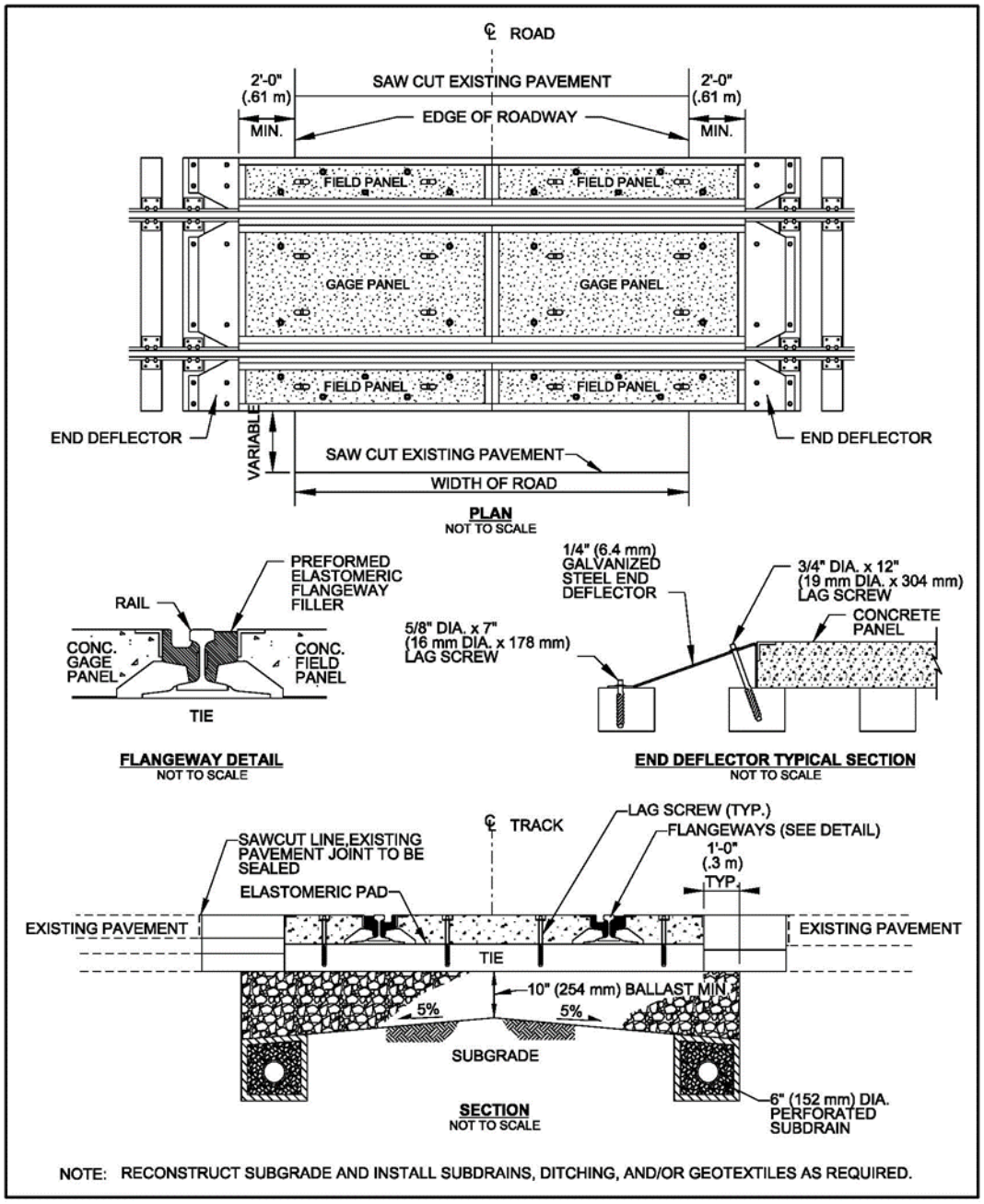
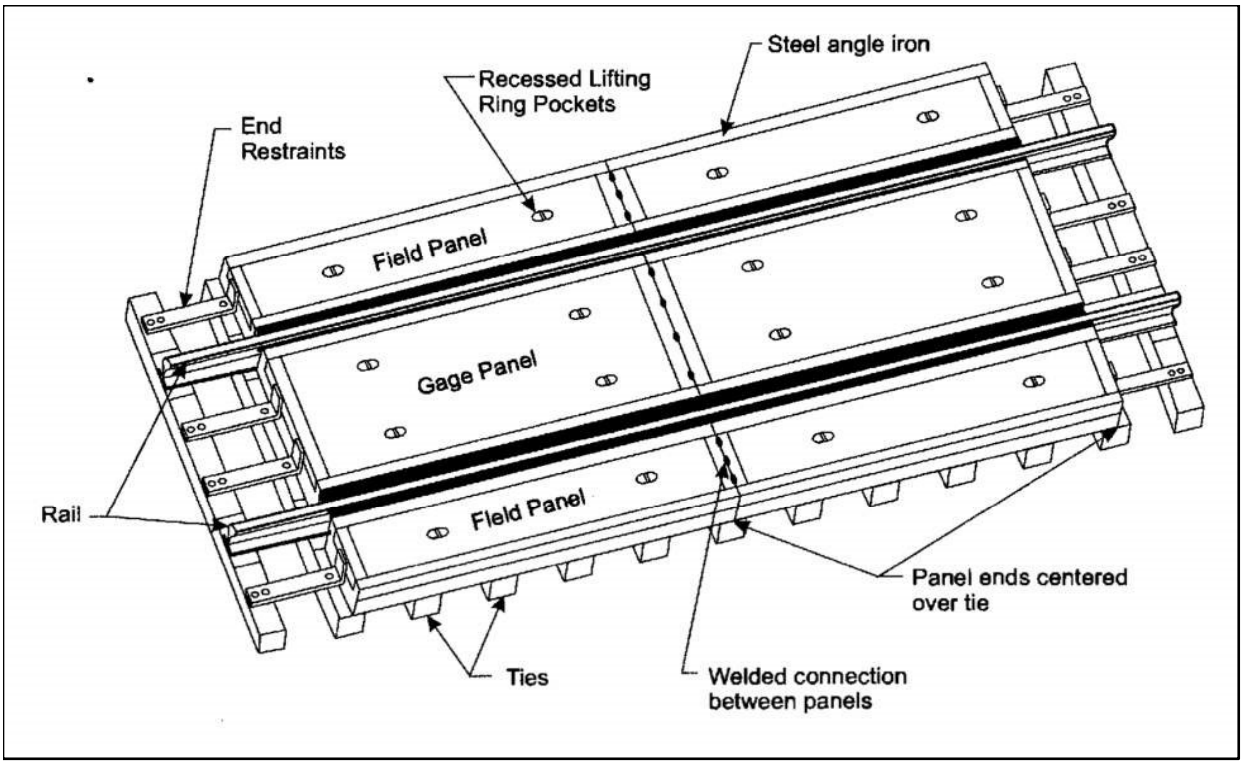


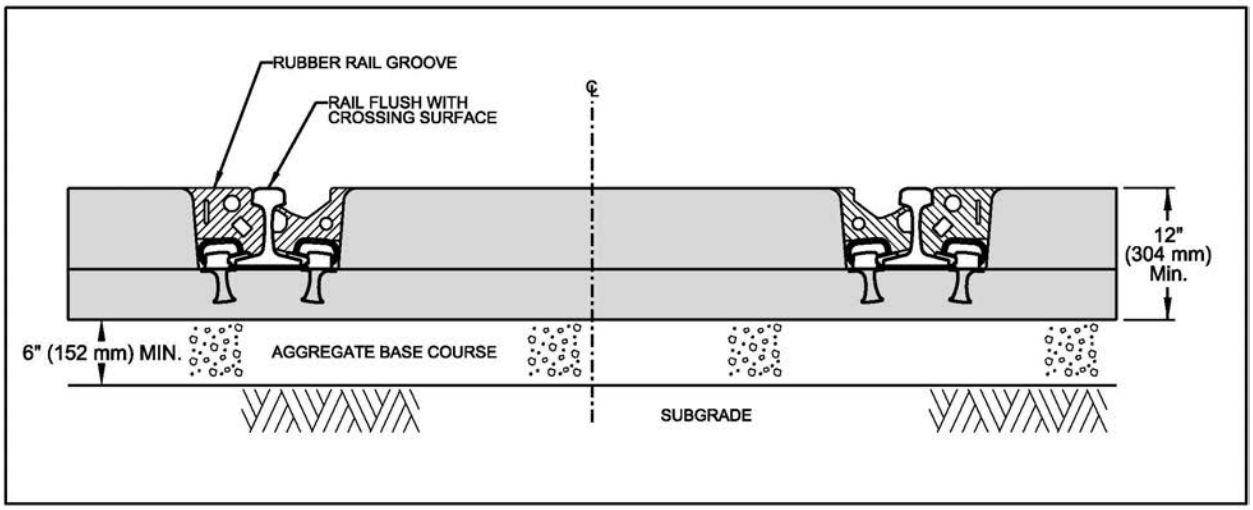
Figure 6-5 Lagless Concrete Panel Crossing



6-1.4.9 Sectional Monolithic Precast Concrete (No Ties).

These crossings essentially form a concrete roadbed and crossing surface all in one complete unit. The rails rest on rubber pads in precast concrete sections that form a solid bed. The concrete bed rests on a layer of crushed rock over a prepared subgrade. These crossings are well suited for rail service through an active container handling area or for tracks running through a concrete paved area. They are suitable for frequent heavy truck traffic and where other crossing types have not withstood the traffic and loadings. With these crossings, the rail is accessible by unbolting and removing the upper gage panels; however, since the bed is solid, the track cannot be surfaced (tamped or raised) by conventional methods. Conduct surface correction or a track raise by either completely removing the crossing sections and altering the subgrade, or for small corrections, by pressure injection of grout beneath the sections. A subgrade and base material with adequate strength and drainage are essential for good long-term performance of these crossings. These are the most expensive of the 5 crossing types – generally about twice the cost of a prefabricated concrete panel crossing.

Figure 6-6 Typical Sectional Monolithic Precast Concrete (No Ties)



6-1.4.10 Flangeways.

6-1.4.10.1 General.

These are often the most maintenance-intensive parts of a crossing. In all crossings, provide a clear flangeway space to allow unimpeded passage of the flange on railroad wheels.

6-1.4.10.2 Open or Closed Flangeways.

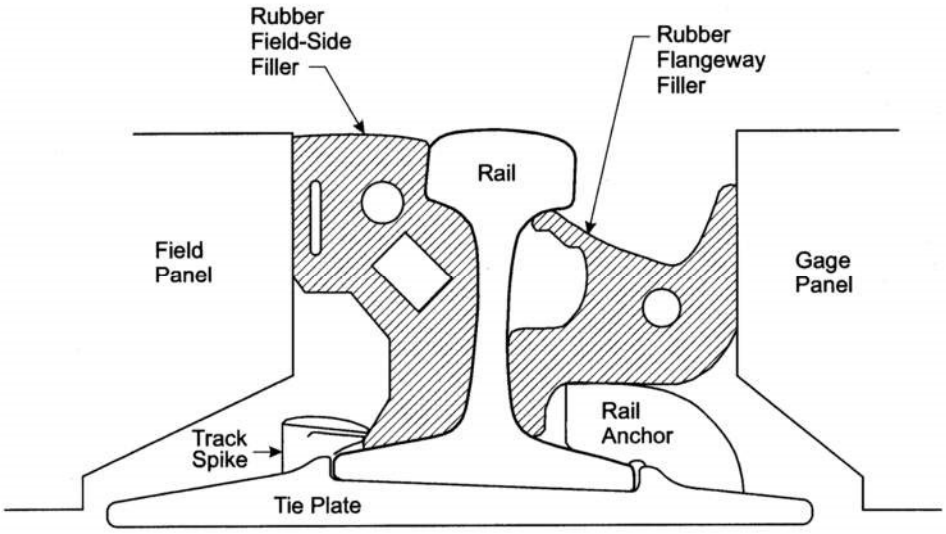
Depending on the location, opinions vary on whether the benefits of filling a flangeway exceed its costs and disadvantages. Open flangeways allow water to enter the crossing and track below, and that is highly undesirable; however, if the drainage is good, the water quickly runs off and causes little harm. Over time, dirt and debris entering an open flangeway impedes drainage. Filled flangeways are often subject to rapid build-up of dirt and debris or snow and ice. If left uncleaned, these foreign materials are typically packed in by the passage of wheel flanges and can build up to the point of blocking the flangeway and causing a derailment. Ice in a flangeway has a high probability of causing a derailment.

In summary, an open flangeway readily allows water to enter the track structure, and a filled flangeway must typically be cleaned more frequently. In areas with low annual rainfall, or where track and road gradients naturally direct water away from the crossing, an open flangeway design is preferred. In most other cases, a filled flangeway provides long term benefits by reducing the amount of water entering the track through the flangeway. A closed flangeway may also be desirable in an indoors/interior track or anywhere you would want to reduce a tripping hazard.

6-1.4.10.3 Filler Material.

The least desirable filler is asphalt. While inexpensive, it tends to crack in a short time, losing its ability to seal against water entry, and ultimately requiring time-consuming removal and replacement. Preformed or pourable rubber products are available for some crossings. Concrete panel crossings are often supplied with rubber flangeway fillers, sometimes pre-attached to the panels. Rubber fillers can have a high initial cost, but they offer a reasonably good seal against water entry, are generally long lasting, and have a flexibility that reduces the tendency of a debris-packed flangeway to cause a derailment. Rubber flangeway fillers are especially useful where: (1) crossing geometry and low relative elevation naturally direct rainwater to the crossing flangeways, (2) where crossing drainage is naturally difficult, or (3) where crossing heave from freeze-thaw cycles is a common problem from rainwater or snowmelt entering unsealed flangeways. Rubber fillers are also an alternative where asphalt filler has not held up well in the past. Figure 6-7 shows rubber flangeway fillers installed in a concrete panel crossing.

Figure 6-7 Rubber Flangeway Fillers



6-1.5 Drainage.

Ensure all prefabricated concrete crossings have a subdrainage system similar to that shown in Figures 6-8 and 6-9. Subdrainage systems are recommended for asphalt and timber crossings. Geotextile surrounding the pipe filter is optional but recommended in fine-particle soils where filter clogging is likely.

Figure 6-8 Typical Geotextile/Subdrain installation for Vehicle Road Crossings

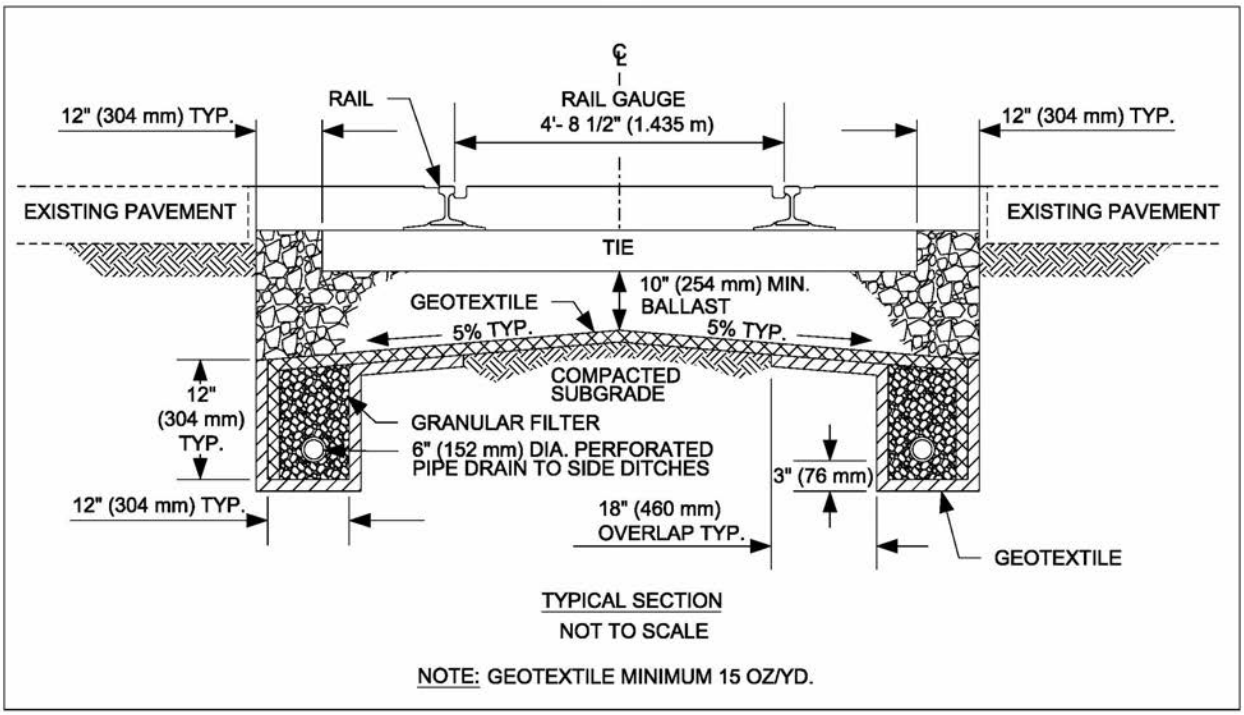
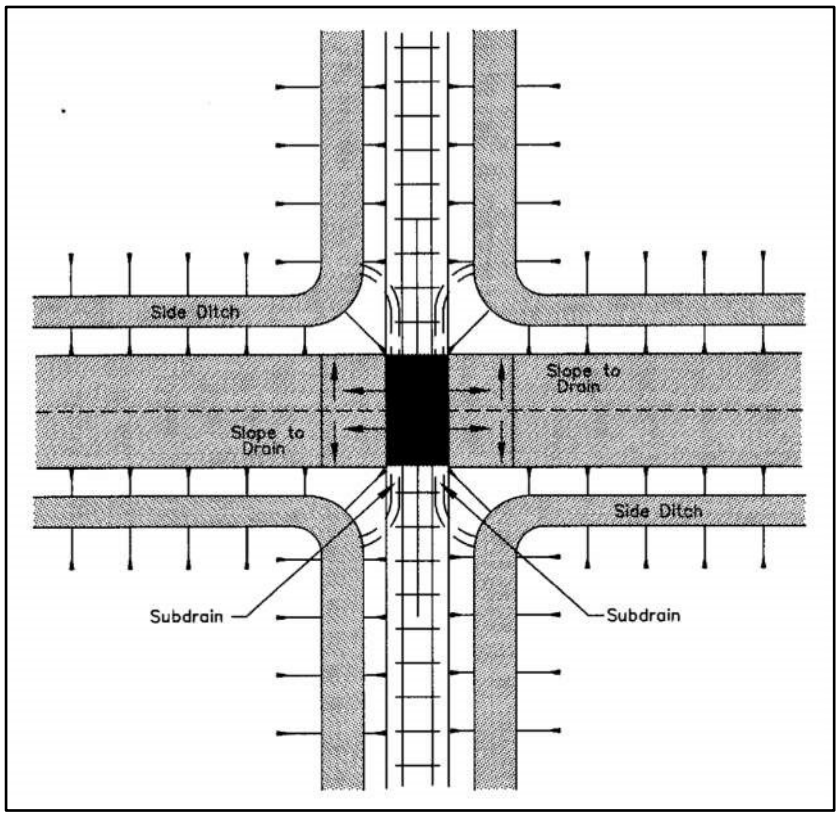


Figure 6-9 Typical Drainage at Road Crossings



6-1.6 Track Design.

Crossings do not act alone – their performance depends on adequate support from the ballast and subgrade. Unless recently constructed or repaired, rebuild the track, ballast section, and drainage system on a well-prepared subgrade before installing the crossing. Ensure the drainage system effectively transmits water outside the crossing limits.

6-1.6.1 Ties.

When crossings are built or rebuilt, replace all the ties in the crossing itself and for at least 20-ft (6 m) beyond each end of the crossing. Use 7-in x 9-in (178 mm x 229 mm) hardwood or polymer composite ties with minimum length of 9-ft. (2.75 m). Use longer tie lengths if required by the crossing manufacturer. To increase the life of the crossing, consider the use of composite ties that are 7-in x 9-in (178 mm x 229 mm) rather than wood ties. When prefabricated road crossings are installed, ensure tie length and spacing comply with the installation requirements provided by the crossing manufacturer.

If the track approaching the crossing is anchored, it is required that each tie in the crossing be box anchored and that the normal anchoring pattern be maintained throughout the remainder of the crossing area (20-ft (6 m) beyond each end).

6-1.6.2 Rail.

In crossings on main running tracks, rail of 115 lb per yd (57 kg/m) or greater is required.

As bolted rail joints in road crossings are often a maintenance problem, it is required that all joints through the crossing and for 20-ft (6 m) from either end of the crossing be welded. As an alternative, use 80-ft (24.4 m) rails to eliminate joints in the crossing area.

6-1.6.3 Geometry.

Ensure the track geometry (gage, surface and alignment) are correctly in position before covering the track with a conventional crossing surface. Failure to do so will result in a costly repair. Ensure the ballast in and around all the ties is well compacted to prevent settlement and movement of the crossing.

6-1.6.4 Flangeways.

Crossing flangeways are a minimum width of 2.5-in. (63.5 mm) with a maximum width of 3-in. (76 mm) and be at least 2-in. (51 mm) deep.

6-1.7 Road Approaches.

To reduce the amount of runoff water directed toward the crossing, road approaches are best sloped away from the crossing.

To achieve smooth riding characteristics, road approach slopes should be designed per AASHTO Policy on Geometric Design of Highways and Streets, 2018, Part 9.12.2, Figure 9-66 or subsequent latest edition. This criterion prevents low-clearance vehicles from being caught on the tracks. However, the difference in elevation between the railroad and the adjacent roadway can require steeper approaches. In these situations, verify ascending road approaches are not so steep that low-clearance truck trailers contact them. On descending road approaches, ensure gradients do not excessively lengthen stopping distances for vehicles approaching the crossing – including an allowance for wet or icy pavement. Use appropriate vertical curves to transition from the roadway grade to a level plane at the elevation of the rails. Tracks that are superelevated or a roadway approach section that is not level require a site-specific analysis.

6-1.8 Crossing Protection: Signs and Signals.

6-1.8.1 Specifications and Minimum Requirements.

Specifications for the basic design and appearance of passive crossing warning devices, such as signs and pavement markings, is given in Part 8 of the Manual of Uniform Traffic Control Devices (MUTCD). All road crossings are required to have the passive warning devices shown in the MUTCD, at a minimum. The need for additional signs or active warning devices, such as flashing lights and gates, includes consideration of the following:

- Crossing visibility or sight distance.
- Volume and speed of vehicular traffic.
- Volume and speed of railroad traffic.
- Volume of pedestrian traffic.
- Crossing geometry.
- Accident and incident history.

Further guidance on providing crossing warnings and protection can be found in the FHWA Railroad-Highway Grade Crossing Handbook.

6-1.8.2 Visibility.

Minimum clear visibility or sight distance criteria is provided for crossings without active warning devices in the AASHTO Policy on Geometric Design of Highways and Street, 2018, Part 9.12.4 or subsequent latest edition. Crossings that do not meet this clear visibility criteria require additional protection.

6-1.8.3 Traffic Character and Volume.

Consider additional protection at crossings that experience two or more train movements per day and the product of train movements and average daily vehicle traffic exceeds 3,000. This traffic threshold drops to 1,000 for crossings that are

considered visually obstructed, as defined above. In addition, consider active warning devices for crossings that experience several daily train movements, have heavy truck traffic, high usage by school buses, or frequent hazardous material traffic, and where clear visibility criteria are not met.

6-1.8.4 Crossing Geometry.

Consider additional protection for crossings with a road to track angle of less than 45 degrees, or where the road approaches the track at a steep grade.

6-1.8.5 Accident and Incident History.

Consider adding flashing lights to crossings with a history of at least one serious accident, some close-call incidents, and/or where incidents of motorists not obeying existing warnings are common. If flashing lights are already present, consider adding gates.

6-1.9 Whistle Posts.

6-1.9.1 General.

Whistle posts are signs located adjacent to the track to indicate to the train crew that a road crossing is ahead. They mark the point at which the standard train horn signal for crossing approach must begin. Whistle posts commonly show just a large letter “W” on their face, but various designs are used. The installation’s operating rules can designate the sign requirements.

6-1.9.2 Location.

Whistle posts are usually located on the right side of the track (when viewed facing the crossing) at a distance that allows sufficient time to warn motorists that an engine, train, or track machine is approaching the crossing. Consult the State Department of Transportation and the installation for requirements on whistle post location. The appropriate location will depend on factors that include the speed of railroad traffic, speed of vehicle traffic, and the visibility at the crossing. A commonly used guideline is that the crossing warning signal must begin sounding at least 20 seconds before an engine, car, or track machine reaches the nearest end of the crossing.

6-2 BRIDGES.

6-2.1 Deck Types.

Classify railroad bridges by deck type: open deck or ballast deck. In a typical open deck bridge, every second or fourth tie is bolted directly to the structure; thus in effect, the track becomes part of the bridge. In a ballast deck bridge, a standard track and ballast section are supported on a solid floor. The ballast deck has the advantage of allowing the track across the bridge to be lined and surfaced in the same fashion as standard track.

6-2.2 Design Procedures.

When a bridge is required, the bridge structure is designed by a practicing railroad bridge engineer in accordance with the AREMA Manual: Chapter 7 for timber structures, Chapter 8 for concrete structures, or Chapter 15 for steel structures. Part 9 of AREMA Chapter 15 provides background and commentary on railroad bridge design practices.

6-2.3 Basis for Design.

The design of railroad bridges is based on two main factors: the magnitude of loads applied to the bridge and the expected level of traffic (or number of stress cycles) over the design life of the bridge. One stress (or load) cycle is defined by one application and release of loading on a bridge member.

6-2.4 Live Load.

Use Cooper E-80 live load as shown in Figure 6-10 for the design of railroad bridges. If the bridge will be a steel structure, consider the Alternate Live Load shown in Figure 6-11. Use the live load that produces the greater stress for the design. Consider both Cooper E-80 and the Alternative Live Load for the design of each element in a steel structure. Use only Cooper E-80 live load for the design of timber and concrete bridges.

Figure 6-10 Cooper E-80 Live Load Configuration for Bridges

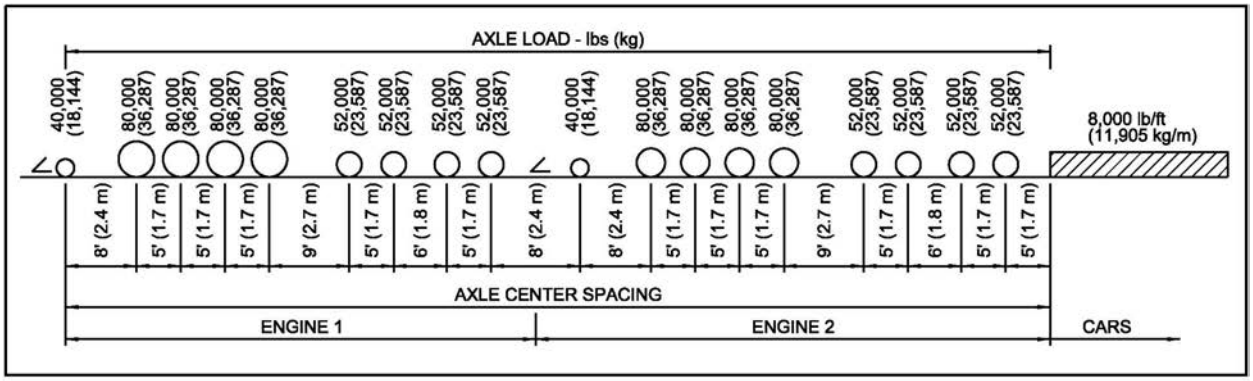
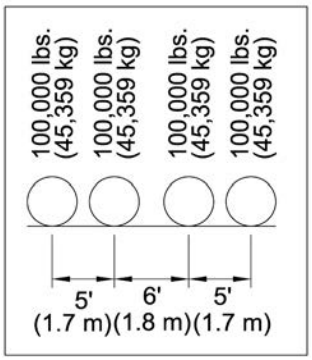


Figure 6-11 Alternative Live Load for Steel Structures



6-2.5 Walkways.

When bridges are located in areas where switching movements are made and at other locations where it is either useful or necessary for people to walk alongside a train (or cut of cars), provide walkways on at least one side of a bridge. Where people require access to both sides of the track when a bridge is occupied, provide walkways on both sides. Workers are never allowed or expected to cross the track by going under cars, crossing over couplers, or climbing over cars.

6-2.6 Tie Pads.

On open deck bridges, installation of rubber tie pads between the tie and tie plate is recommended.

6-2.7 Bridges Spanning over Railroads.

Design bridges spanning over railroads to have adequate horizontal and vertical clearance from the railroad tracks. Locate piers so they provide more than 25 ft. (7.6 m) of horizontal clearance from the centerline of existing tracks and possible future tracks. If less than 25 ft. (7.6 m) of horizontal clearance is provided, install crash wall pier protection.

Design crash wall pier protection per AREMA Chapter 8, Article 2.1.5.1. Crash walls for piers 12 to 25 ft. (3.6 to 7.6 m) clear from the centerline of track require a minimum height of 6 ft. above the top of rail. Crash walls for piers less than 12 ft. (3.6 m) clear of the centerline of track require a minimum height of 12 ft. (3.6 m) above the top of rail. If crash walls are used, the minimum required horizontal clearance for piers is as specified in Chapter 5, Paragraph 4. The minimum vertical clearance for bridges spanning over railroads is also specified in Chapter 5, Paragraph 4. Survey the profile of existing tracks for 1000 ft. (304.8 m) each side of a proposed overhead bridge. If the profile indicates a sag at the proposed bridge location, increase the vertical clearance sufficiently to permit raising of the track to remove the sag.

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CHAPTER 7 TERMINALS

7-1 INTRODUCTION.

This chapter addresses the design of railroad terminal and support facilities that are primarily intended to support unit mobilization. Obtain design and planning information for terminals at supply depots or ammunition plants from the Construction Branch of the Army Material Command.

Terminals contain track and facilities for:

- Loading and unloading: tracked and wheeled vehicles, containers, equipment, ammunition, fuel, and general supplies.
- Holding: empty cars waiting to be loaded or loaded cars waiting to be unloaded, or cars that require repair or adjustment of the load or tiedowns.
- Switching: maneuvering cars around the terminal, re-ordering or turning a line of cars, or allowing an engine to get on either side of a cut of cars.
- Interchange: holding loaded or empty cars waiting to be picked up by the connecting commercial railroad, or cars delivered to the installation by the commercial railroad.
- Storage: for cars infrequently used or moved.
- Fueling and housing engines.

7-2 SITING AND GENERAL LAYOUT.

In the siting and layout of terminals, consider space requirements, logistics, security, safety, the presence and use of existing facilities, character of the terrain and natural drainage, as well as mission requirements. When locating a terminal area, select a site that has the correct size, shape, and orientation so that it provides convenient access for both vehicles and railroad service.

Where space is limited, consider two or more separate terminals to provide sufficient capacity. This option can generate better traffic flow and less congestion than at a single site but can complicate command and control of loading operations and security arrangements.

7-3 TRACK DESIGN.

7-3.1 Design Wheel Loads.

For through running tracks in terminal areas, use Table 2-2, “10 MPH (16 km/hr) or Less.” For tracks where cars are simply placed and removed (as distinguished from those where general running or back and forth switching movements frequently occur) such as warehouse sidings and spur tracks (dead end tracks), including loading and storage tracks, use Table 2-2, “Light Use.” For run-around tracks, passing sidings, yard tracks, wyes, balloon tracks, or other tracks where switching movements commonly occur, use Table 2-2, “10 MPH (16 km/hr) or Less.”

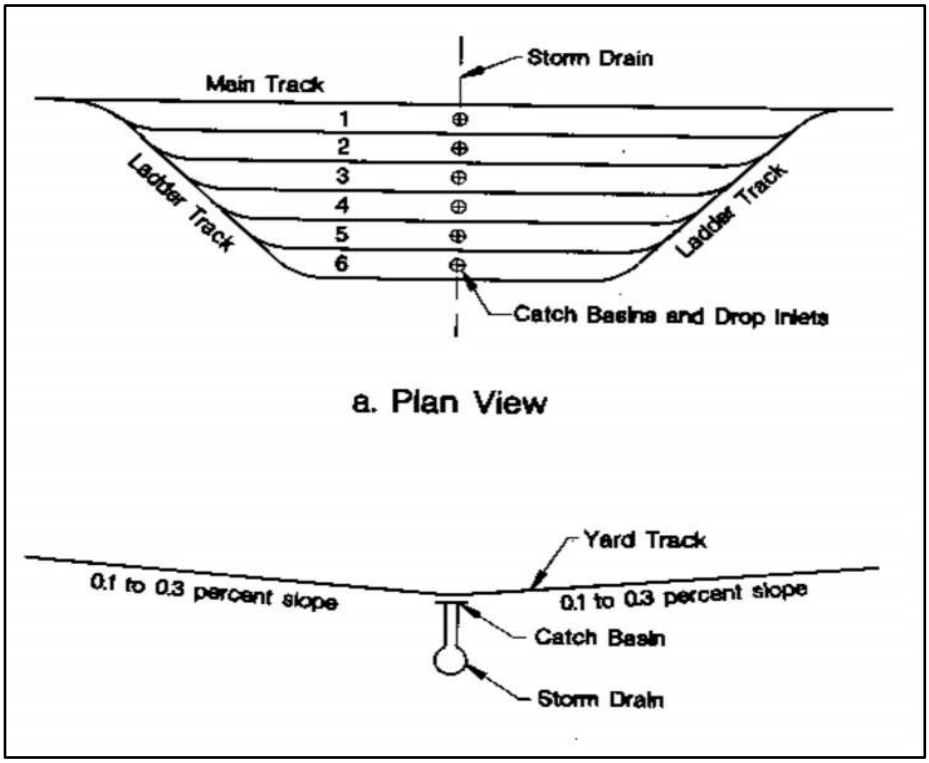
7-3.2 Gradients.

Do not allow gradients on running tracks through a terminal to exceed 1.0 percent. On auxiliary tracks where cars are temporarily left standing during switching, gradients cannot exceed 0.3 percent. Gradients on tracks where cars will be left standing for 1 or more days, such as loading, yard, and storage tracks, preferably do not exceed 0.2 percent, with a maximum allowable of 0.3 percent. It is desirable to have these tracks slope away from the main track or connecting track. Thus, if hand brakes do not properly hold on cars, they would not roll toward the main track.

7-3.2.1 Double-End Yards.

Double-end yards are best graded as shown Figure 7-1, with tracks sloping toward the center, where storm drainage is provided. This grading arrangement prevents cars from accidentally rolling toward either ladder track and will also facilitate drainage by collecting runoff at the center of the yard.

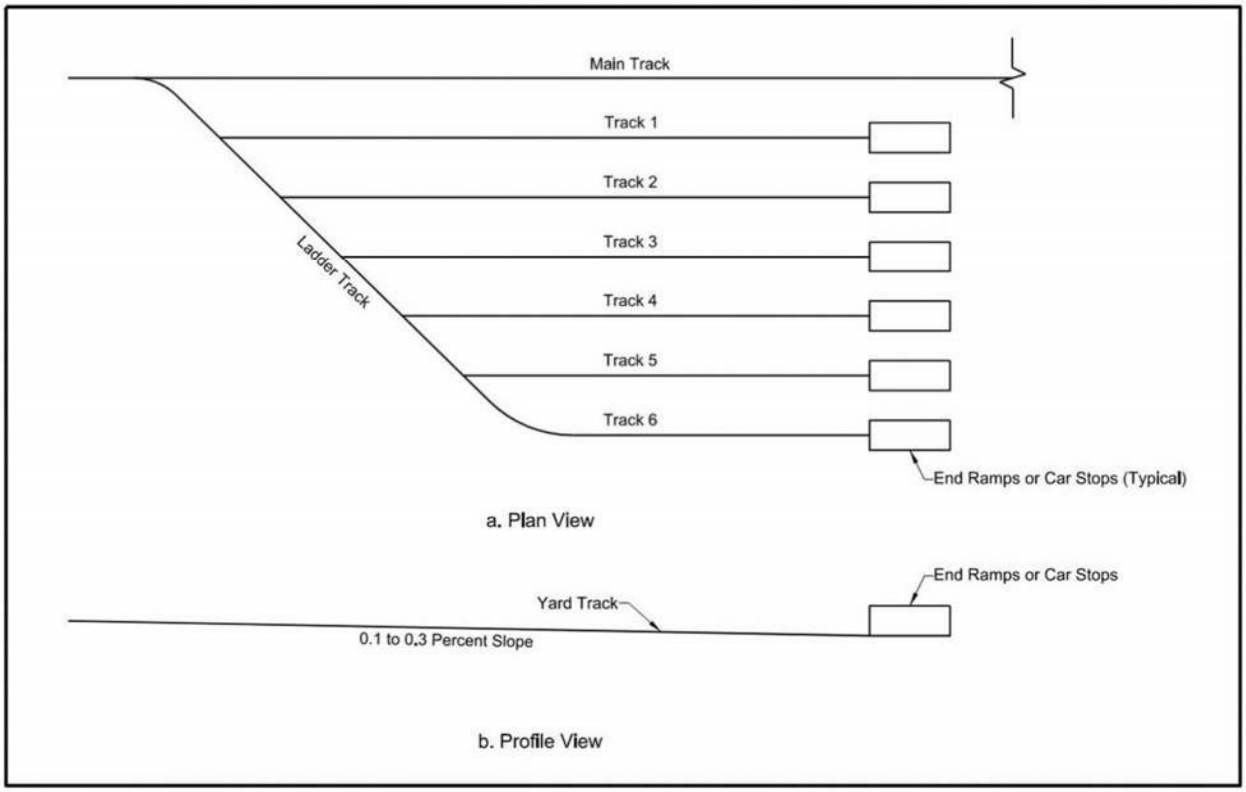
Figure 7-1 Typical Double-End Small Yard with Storm Drainage



7-3.2.2 Single-End Yards.

Grade single-end (also known as dead-end) yards as shown in Figure 7-2, with tracks sloping toward the end ramps or car stops.

Figure 7-2 Typical Single-End (Dead End) Small Yard



7-3.3 Vertical Curves.

Design guidance for vertical curves in terminals is provided in Table 5-1.

Do not locate turnouts in vertical curves. Turnouts in vertical curves result in problems with point fit and operation.

7-3.4 Horizontal Curves.

Design guidance for horizontal curves in terminals is provided in Table 3-3.

7-3.5 Track Layout.

Design guidance for the layout of turnouts, curves, ladder tracks, and track connections is covered in Chapter 5.

7-4 CLEARANCES AND USABLE TRACK LENGTH.

As terminal track is typically closely spaced near loading docks, buildings, access roads, parking and staging areas, parallel tracks, etc., awareness of clearance requirements is especially important. Clearance requirements are covered in Paragraph 5-4.

The maximum usable track length for positioning cars extends from the end of track (for spur tracks) to the clearance point, or (for sidings) between two clearance points, as indicated in Figure 5-9.

7-5 VEHICLE TERMINALS.

7-5.1 Purpose and Facility Requirements.

A vehicle loading terminal is generally designed for transferring tracked or wheeled vehicles on or off flatcars or, in the case of smaller wheeled vehicles, bi-level auto racks. A vehicle terminal will contain the following:

- Loading tracks to position the flatcars.
- Staging area to hold the vehicles.
- End ramps or multilevel ramps for transferring the vehicles to and from the railroad cars.
- Railyard operations building.
- Storage building for tie-down, blocking, and bracing material.
- Lighting for terminals and staging areas with operations after dark.

7-5.2 Track Spacing.

When the loading tracks in a vehicle terminal are laid out parallel to each other (as is often the case), the tracks are typically paired as shown in Figure 7-3. The minimum track spacing between tracks in a pair is 22.5-ft. (6.9 m). The minimum track spacing between track pairs is 50-ft. (15.2 m). 22.5-ft. (6.9 m) is the minimum track spacing for small utility terrain service vehicles to drive between the tracks. Bridge plate storage racks can be located in the 50-ft. (15.2 m) space between track pairs.

7-5.3 Track Length and Number of Tracks.

For vehicle loading, strings of between 10 and 20 cars are most effectively handled at a time: the lower limit of 10 to minimize switching requirements and the upper limit of 20 to limit the length needed to drive vehicles down the string of rail cars for efficient loading. As a result, each loading track has a tangent length extending from 10 to 20 car lengths from the loading ramp, as shown in Figure 7-4. For multi-level ramps, only handle a maximum string of 6 rail cars at a time.

The number of tracks required can be determined from the traffic and mission information covered in Chapter 2, the space available in the terminal area, and the criteria for track length above.

Figure 7-3 Vehicle Terminal

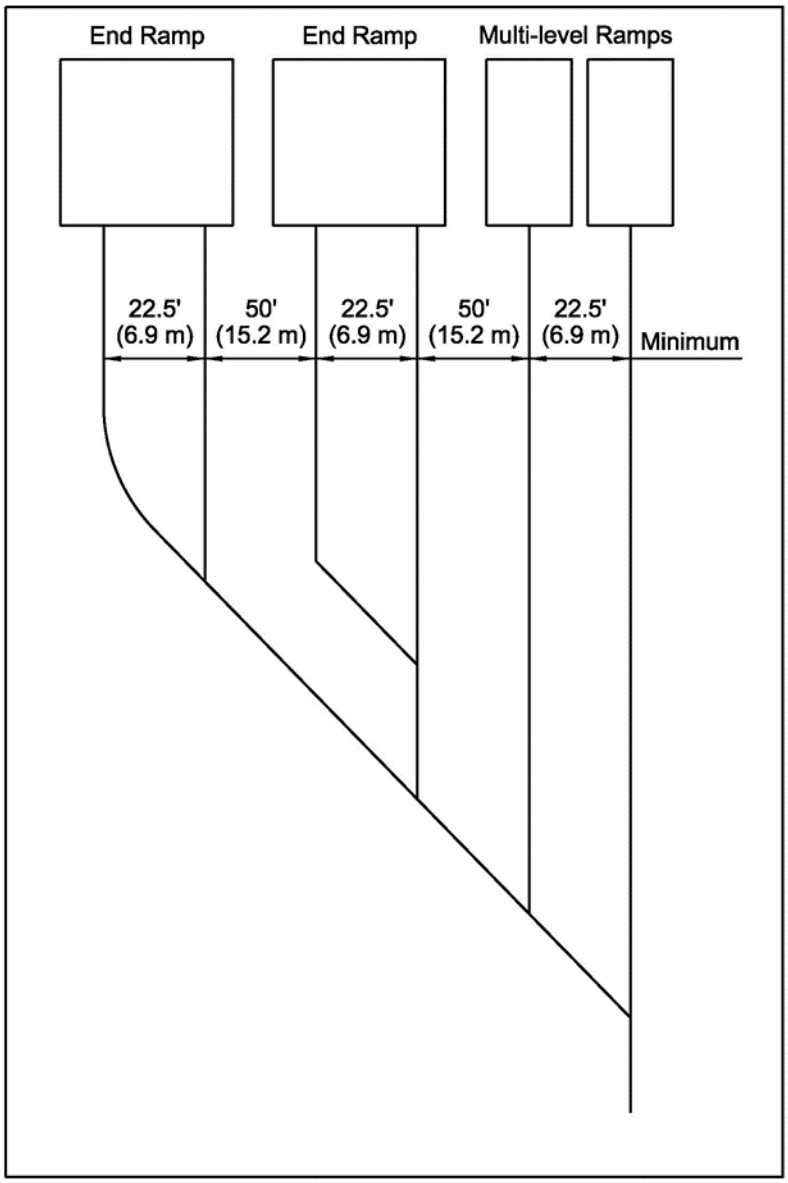
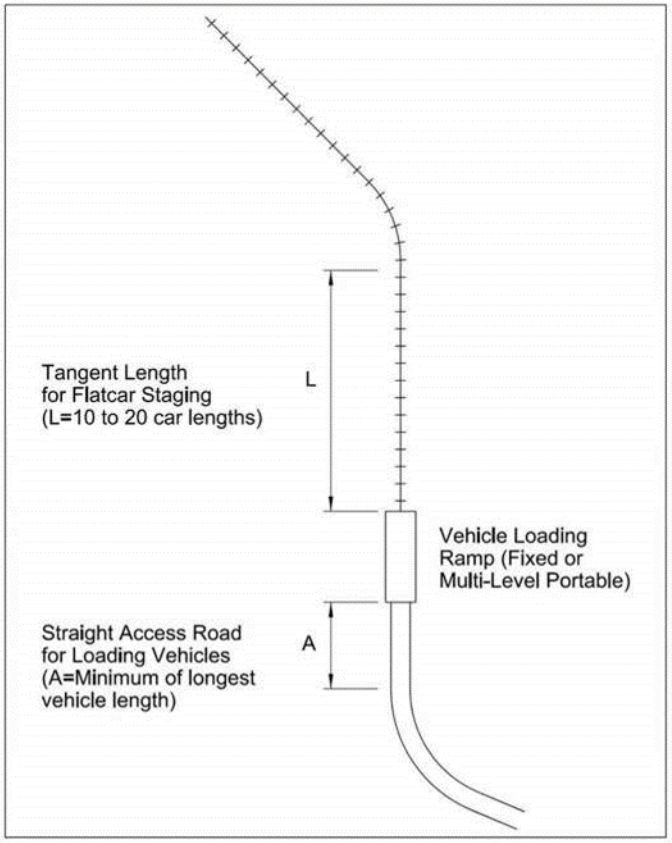


Figure 7-4 Track and Approach Road Lengths for Vehicle Loading



7-5.4 Staging Area.

The size and location of a vehicle staging area depends on terrain characteristics and availability of space. Locate the staging area as close to the loading area as possible to facilitate better command and control. Ensure the staging area is large enough to stage one full loading cycle of vehicular cargo, thus a loading terminal with a capacity of 50 flatcars would require a staging area with a capacity of 50 carloads of vehicles.

The staging area requires an access road or approach leading up to the loading ramp, which is straight and in line with the ramp for at least the full length of the longest vehicle to be loaded. If practical, the in-line approach is twice the length of the longest vehicle to ensure that a vehicle can always be positioned ready to load as the first vehicle is driven up the ramp. It is also preferable that this road is not directly adjacent to any track to avoid a dust cloud from the approaching vehicles reducing the view of loading operations.

For operation after dark, staging areas need to be lighted with “parking lot” type lighting. Fencing is required if the cargo is security sensitive. (See Chapter 5, Paragraph 20.5).

7-5.5 End Ramps for Tracked and Larger Wheeled Vehicles.

Rapid loading of larger vehicles onto flatcars is best accomplished with permanent end ramps constructed at the end of the loading tracks. While end ramps can be constructed with concrete, wood, steel or retained earth, they must support the largest and heaviest vehicles mobilized: typically a main battle tank. A general reinforced concrete ramp design is shown in Figure 7-5. Obtain more detailed guidance from the Army Transportation Systems Center (CENWO-ED-TX, or at website: https://transportation.erdc.dren.mil/tsmcx/). A well-designed end ramp will:

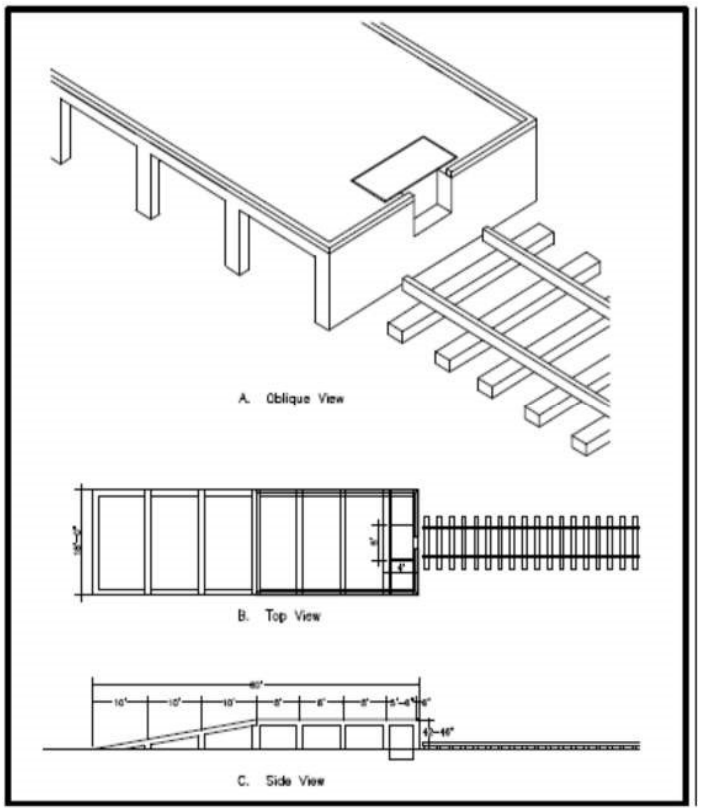
a. Allow an M-1 Abrams tank to be driven onto a flatcar having the lowest platform height used in commercial railroad service. Note: It is safer and easier to drive a vehicle from a lower ramp level to a higher flatcar level than vice-versa.

b. Provide ample width to enable guides to walk on both sides of an M-1 tank.

c. Provide sufficient level platform length to allow a tank to be in a completely horizontal position prior to proceeding onto the railcar.

d. Have the proper transition between the incline and the level platform so that a tank will not “high center” itself while negotiating the ramp.

Figure 7-5 Concrete End Ramp



To make vehicle loading easy, it is desirable to have the end of the rail car close to the ramp platform. It is also necessary to protect both the rail car and the ramp from impact damage when rail cars are being positioned at the ramp. As rail car designs vary (draft gear length, amount of end overhang, position of uncoupling lever, etc.), this protection cannot be reliably provided by fastening wheel stops to the track. The design in Figure 7-5 incorporates a cut-out at the front of the ramp at the height of the car coupler. Behind the cut-out is a concrete block separated from the remaining ramp structure with cushioning (expansion joint) material. This concrete bumper block reduces the likelihood of impact damage to the ramp. Other shock absorbing designs and devices can be used as well, including commercial railcar buffers. Select the method best suited for the particular application. While the concrete bumper block could easily be incorporated into new construction, it might prove impractical during rehabilitation if the existing ramp platform will not be extensively modified.

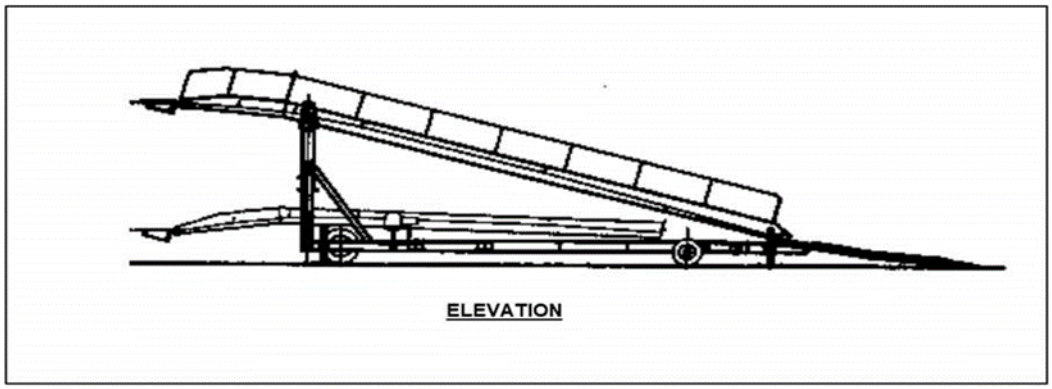
7-5.5.1 Spanners.

To permit wheeled vehicles to cross the gap between the ramp and the flatcar, spanner boards are necessary; tracked vehicles do not require spanner boards. Thus, if fixed spanners are used, ensure they are detachable so that they will not interfere with the loading and unloading of tracked vehicles.

7-5.6 Multilevel Ramps for Smaller Wheeled Vehicles.

If an installation has a requirement to mobilize large quantities of small-wheeled vehicles, it is recommended that multilevel ramps be used to load bi-level railcars. These ramps are portable pieces of equipment that can either be purchased and maintained by the installation or leased from a commercial railroad when needed. Like end ramps, multilevel ramps are positioned at the end of a track spur. A typical multilevel ramp is shown in Figure 7-6.

Figure 7-6 Portable Multilevel Ramp05



It is important that the ground underneath a multilevel ramp be level and capable of bearing the weight of the ramp plus the heaviest vehicle being loaded. A Portland cement concrete pad is recommended to ensure good ramp stability.

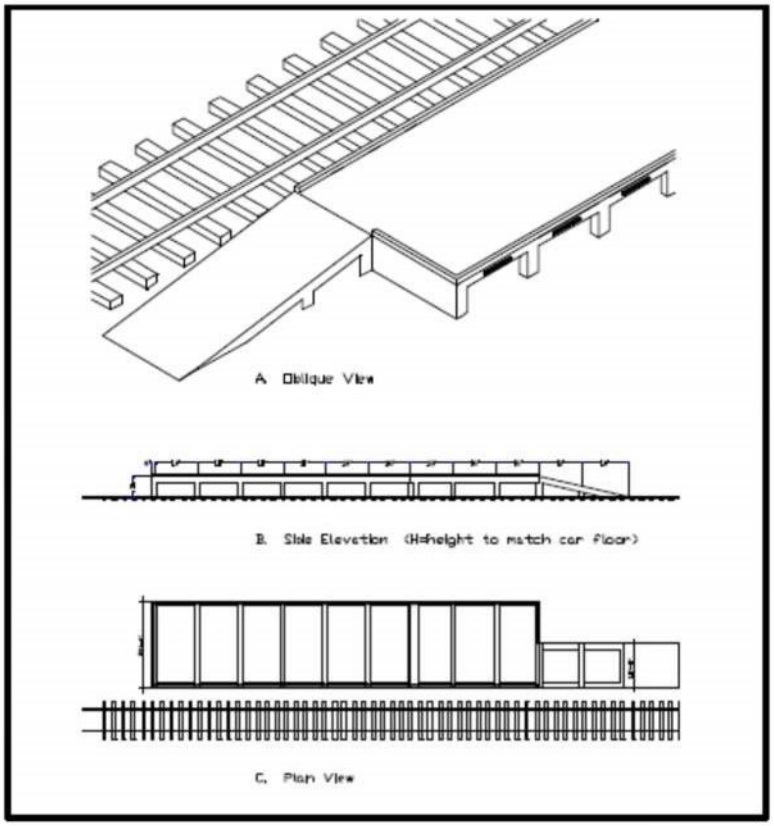
7-6 BREAK BULK (SMALL CARGO) TERMINALS.

Permanent side ramps, parallel to the track, are recommended for loading break bulk cargo into boxcars. For staging cargo, large open areas are needed surrounding the ramps. Thus, where several parallel tracks run through a terminal, construct the ramps along the outermost tracks. Figure 7-7 shows a diagram of a reinforced concrete side-loading ramp.

Side ramps are required to meet the following design criteria:

- Capable of supporting the weight of a fully loaded 4,000-lb (1815 kg) forklift.
- Allow sufficient area for a forklift to maneuver.
- A height convenient for a forklift to drive into a boxcar on the adjacent track as well as into a truck docked at the ramp.
- Incline angle small enough for a forklift to easily negotiate it.

Figure 7-7 Side Loading Ramp



7-7 CONTAINER TERMINALS.

A container loading area includes at least one track spur with sufficient space on one or both sides of the track for a container handler to operate. The required size of a

container terminal is related primarily to the largest volume of cargo required to be handled in the shortest time period. General plans and additional design guidance for container terminals can be found in Chapter 14, Part 4 of the AREMA manual.

Use the following design criteria for a container terminal:

- Include at least one straight spur track long enough to hold a minimum of five flatcars.
- Have one entrance and one exit to the yard area located to establish a one-way circular traffic flow.
- Have sufficient open area for a Rough Terrain Container Handler (RTCH) to efficiently operate.
- Have a surface that will support the weight of a RTCH carrying a loaded 40-ft container.
- For night operations, have “Parking Lot” type lighting positioned so that the light poles will not interfere with the operation of the RTCH or truck-trailers operating inside the yard.
- If a secured area is required, have a perimeter fence with a gate across each track entry and exit (see Chapter 5, Paragraph 20.5).

7-8 AMMUNITION TERMINALS.

Design ammunition terminals to meet the required shipping volume at the installation. Set up the terminal as either a break bulk terminal (Chapter 7, Paragraph 6) or a container terminal (Chapter 7, Paragraph 7). In addition to the usual terminal requirements, incorporate the following Explosives Safety standards into the design:

- Refer to service specific Explosives Safety guidance to determine the minimum Explosive Safety Quantity Distances (ESQD).
- Generally, yards will be laid out on a unit car-group basis with each car-group separated by the applicable above-ground magazine distance.
- If the yard is formed by two parallel ladder tracks connected by diagonal spurs, the parallel tracks and the diagonal spurs will be separated by the applicable above-ground magazine distance for the unit group quantities of high explosive.
- If the yard is a tree arrangement, consisting of a center ladder track with diagonal dead-end spurs projecting from each side at alternate intervals, separate the spurs by the applicable above-ground distance for the net quantity of high explosives in the cars on the spurs.
- Separate railroad yards from other facilities by the applicable Quantity-Distance standards.

The following recommendations also apply to ammunition loading areas:

- If loaded ammunition cars will stay in a terminal area for sufficient time, fence the areas completely, with gates across all tracks entering the area, and have locking pedestrian and vehicular gates. See Chapter 5, Paragraph 20.5.
- Lighted with “parking lot” type lighting.
- If guard towers are required, position them to allow observation of the entire ammunition loading area.

7-9 PETROLEUM, OIL AND LUBRICANT (POL) TERMINALS.

The design of POL handling and storage areas is regulated by Federal, State, and local environmental protection agencies as well as State and local fire marshals. Contact these agencies when designing POL facilities and incorporate appropriate design standards.

POL handling and storage areas are required to be completely fenced, with gates across all tracks entering the area and have locking pedestrian and vehicular gates (see Chapter 5, Paragraph 20.5). Light these areas with “parking lot” type lighting.

7-10 CAR INTERCHANGE.

7-10.1 Purpose.

The interchange area or yard consists of one or more tracks used for the transfer of cars between the installation’s railroad and the connecting commercial railroad. These tracks are usually located at or near the junction of the two railroads.

7-10.2 Arrangement.

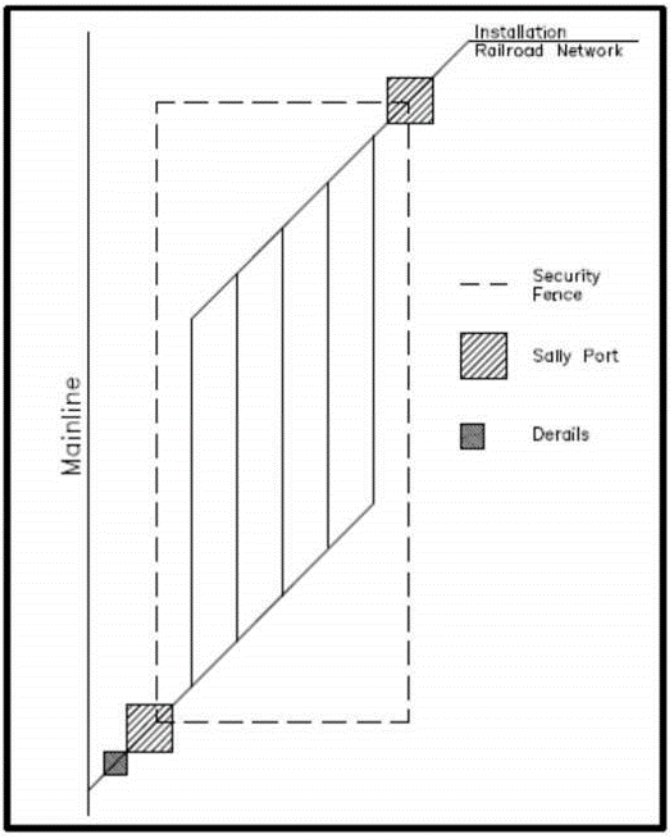
Figure 7-8 shows an example car interchange yard. In this arrangement, one or both of the outer two tracks would normally be designated as a running track and left clear of cars. The other tracks would be of sufficient combined length to handle the largest expected number of cars to come in or go out at any one time.

7-10.3 Running Track.

An open running track through the interchange yard will allow the installation’s or commercial railroad’s engine access to either end of each interchange track, and otherwise leaves an unblocked connection between the two railroads. The running track can also be used temporarily for switching. This makes it easier to rearrange the cars, if needed, or to pull out selected cars from any track.

At installations with frequent grade crossings or where at least one heavily traveled road crosses the tracks at grade, especially if the crossing angle is less than 45 degrees, access to either end of a cut of cars is usually required. This will permit the engine to always be at the front of a train, pulling the cars rather than pushing, in either direction of travel, providing much better visibility and safety at road crossings.

Figure 7-8 Interchange Yard



7-10.4 Set Out Track.

Consider including an additional track (or perhaps a short spur) at an interchange yard for special over-size loads, for cars needing repair, or for other special movements that need separate handling.

7-10.5 Derails.

In addition to being good practice, the connecting railroad will usually require that a derail be placed on the track leading to its line, along with a sufficient safe length of track between the derail and the junction. The derail is intended to prevent cars from accidentally rolling onto or blocking the connecting railroad's track. In some instances, derails are desirable at the installation end of the interchange tracks.

While derails themselves are not a design issue, their location is. Without a sufficient length of track between a derail and the clearance point of the track being protected, a derail will be nearly useless. During design, allow for this safe track length as an addition to the length of track required for car holding and switching space. The safe track length needed past a derail will vary with the grade of the yard tracks and the configuration of the junction area. Consult the connecting commercial railroad's engineering department for guidance on placing a derail to protect their track.

7-10.6 Security.

If the interchange yard is outside the main installation area or otherwise not located within constant view, it is recommended that the area be completely enclosed with a security fence, including lockable gates across the tracks (see Chapter 5, Paragraph 20.5). Consider lighting and guard towers if security-sensitive cargo is regularly handled.

7-11 YARD, STORAGE, AND OTHER AUXILIARY TRACKS.

7-11.1 Purpose.

Yard and storage tracks are intended for, respectively, the short and long-term holding of cars. Yard capacity is needed at least equal to the maximum number of cars that the installation is expected to handle at one time. Ensure the storage capacity, at a minimum, accommodates the number of cars to be kept at the installation over a longer term. Loading tracks are not considered available for storage unless cars are pre-positioned on them for loading.

Auxiliary tracks include sidings, wyes, balloon tracks, crossovers, tail tracks, and other tracks used for switching and maneuvering cars, allowing engines and cars to clear the main track for other movements (as in a second engine switching or delivering cars), or to allow an engine to get around the other side of a string of cars.

7-11.2 Yard Tracks.

Especially where the interchange with the commercial railroad is several miles from the loading sites, or where loading sites are within a separate secure area, a yard can be required. A yard is typically several parallel tracks, as in Figure 7-1, serving as a holding area for cars waiting to be loaded or delivered to the interchange area.

An example is an installation with a mobilization plan calling for 60 loaded cars to be picked up each day and 60 empties to be delivered by the commercial railroad, and with loading sites 12 miles (19.3 km) from the interchange point that can accommodate 30 cars at one time. This installation will likely need a yard that will hold at least the second 30 cars waiting to be loaded, and subsequently, the first 30 after they are loaded — to make room for the second 30 at the loading sites.

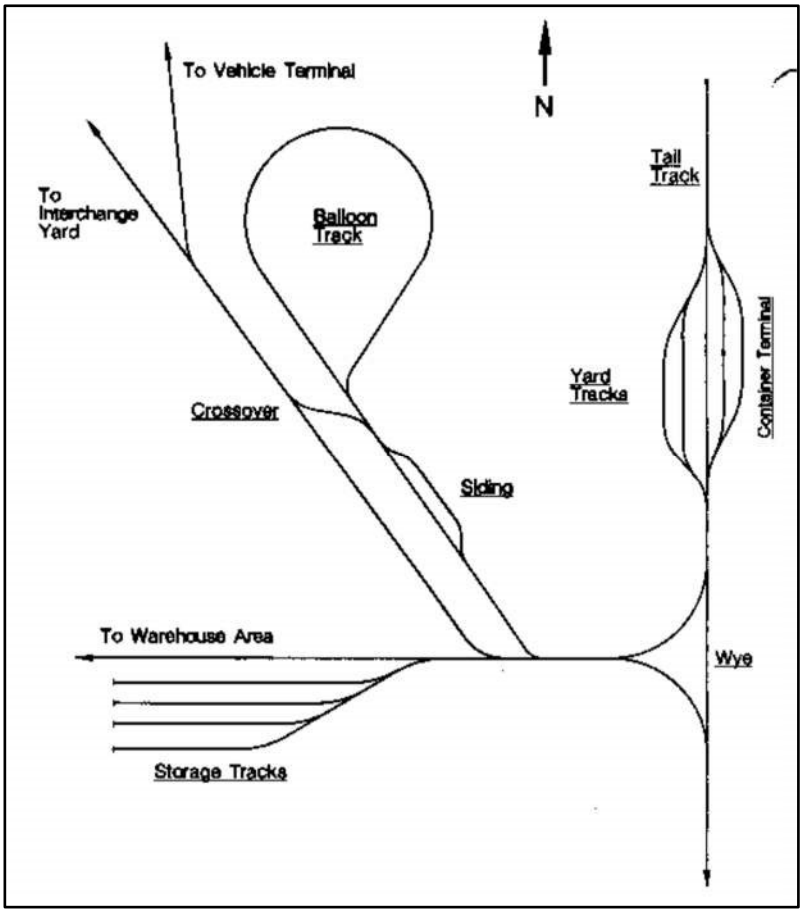
7-11.3 Storage Tracks.

Storage tracks or a storage yard can appear as shown in Figure 7-1 but are often designed as spur (dead end) tracks off a single ladder, as indicated in Figure 7-2 and the lower left corner of Figure 7-9. It is usually not essential to have access to either end of cars in storage, thus saving the cost and maintenance of turnouts at one end of storage tracks.

7-11.4 Auxiliary Tracks.

Figure 7-9 shows common auxiliary tracks. Their application is explained below.

Figure 7-9 Auxiliary Tracks



7-11.4.1 Sidings.

Sidings temporarily hold extra cars or part of a string of cars while the remainder are switched or allow an engine to bypass a string of cars.

7-11.4.2 Crossovers.

Crossovers can be used as a shortcut between routes or to allow an engine to get around a string of cars. In Figure 7-9, the crossover, for example, allows trains from the interchange yard access to the siding without having to go south to the warehouse track and then back north again, thus the crossover allows the siding to be conveniently used from either track. In addition, when handling a string of cars longer than the capacity of the siding, the cars can remain south of the crossover on either track, with the engine then using the crossover to get to the other track and then around to the opposite end of the cars.

7-11.4.3 Wye or Balloon Track.

At least one wye or balloon track is almost always needed at military installations. These tracks allow engines and cars to be turned around. This capability is required for most effective use of vehicle terminals. If cars are delivered to the installation such that the vehicles on them would be facing away (backward) from the loading ramps, the cars need to be turned so the vehicles can be driven in a forward direction off the cars. Of the two types of turning tracks, wyes are most common, as they require far less space than balloon tracks. Balloon tracks are typically used if space allows them to conveniently encircle other facilities, thus not requiring a large land area just for the balloon track. Balloon tracks have the advantages over wyes of requiring only one turnout and a single movement to accomplish the turn. Wyes require a backward movement to complete a turn, as well as throwing more switches. Wyes are often created by installing the third leg where a junction already exists (or is required). In Figure 7-9, for example, the wye also allows convenient access to the warehouse track from either north or south directions.

7-11.4.4 Yard or Siding.

When a yard or siding is located near the end of a route, a tail track is often added to allow switching from the far end of the yard or siding. A tail track is most useful if it is at least three car lengths longer than the siding or the longest track in the yard. Figure 7-9 shows a tail track north of the container terminal.

7-12 MISCELLANEOUS BUILDINGS.

7-12.1 Purpose.

Evaluate if buildings are needed for storage, shelter, and for other purposes in each terminal area. At vehicle terminals, a railyard operations building is needed for blocking and bracing storage.

7-12.2 Railyard Operations Building.

Consider the following when designing a railyard operations building:

- Locate as close to the loading area as possible without interfering with the flow of vehicles between the staging areas and the loading ramps.
- Sufficient space to accommodate the billeting of a rail loading crew.
- A communication system for enhanced command and control.

7-12.3 Blocking and Bracing Storage Facility.

Consider the following when designing a blocking and bracing storage facility:

- Locate as close to the loading tracks as possible. Determine if co-location with the railyard operations building is desirable.

- Sufficient size to accommodate blocking and bracing material required for one cycle of rail loading, that is, enough material for the maximum car capacity of the terminal.

APPENDIX A BEST PRACTICES

A-1 ROUTE SELECTION.

A-1.1 Introduction.

This chapter describes the process of selecting the route for the track connecting the terminal facilities with the commercial railroad serving the installation.

The location process begins by roughly defining potential routes or areas through which a railroad might practically run. Additional and more detailed information is then collected, and the route alternatives are gradually reduced until the final route is chosen. Before this process begins, complete the initial location and orientation of terminal facilities as described in Chapter 7.

The ideal route is usually the one that:

- Is shortest in length.
- Has the lowest grades.
- Has the least curvature.
- Costs the least to build.
- Most conveniently serves the installation and all terminal areas, as well as connecting railroads.
- Causes the least interference with other activities and modes of transportation.
- Is environmentally compatible with adjacent land use.
- Provides reliability for use in all weather conditions.

Since the above-listed objectives often conflict, the engineer’s job is to determine the appropriate compromises that will produce the best route under the circumstances – the one that best meets all objectives.

If initial line locations prove unsatisfactory in some important aspect, look for a different terminal location or re-orient a terminal so that the line serves it from a different direction.

Throughout the route selection process, it is essential to have good maps, including contour maps, of the area for the potential railroad line. These are often available from online sources.

A-1.2 Establishing Control Points and Potential Corridors.

Control points serve to limit location alternatives. They represent places through which the railroad must pass or would ideally pass. The most obvious control points are end points: the terminals and the connections with the commercial railroad. Establish intermediate control points, which can include facilities or geographic features that must

be avoided, such as firing ranges, poorly drained areas, or environmentally sensitive areas. Place control points that also offer significant construction and operating advantages, such as narrow or shallow river crossings and areas with naturally good drainage. After control points are marked on contour or aerial maps, sketch approximate boundaries of potential route corridors. Identify more control points, and other information needed to define a specific route, during the next stage (reconnaissance).

A-1.3 Reconnaissance.

The reconnaissance is a quick examination of a wide strip of land between control points – the strip representing rough boundaries of a potential line location. If appropriate, examine several potential routes or alternatives for portions of a route.

The purpose of a reconnaissance is to identify routes that might allow the easiest construction effort consistent with the purpose and requirements of the railroad.

Contour maps, available geographic information system (GIS) information from county, state, and installation sources, aerial photographs from online sources, and previous survey information are good sources to use during the reconnaissance. A small set of maps and diagrams, with control points and potential routes identified, is convenient for field use. The information gathered during the reconnaissance can then be transferred to larger maps and computer files back in the office.

Perform reconnaissance by any means appropriate for the terrain and distances to be covered: review of online maps and photography, walking, driving, or from the air. Generally, take note of terrain features and anything that might affect route location and construction. Look especially for:

- Landmarks for referencing the location.
- Additional control points.
- Areas of potentially easy or difficult construction.
- Roads and utility lines to be crossed.
- Waterways or ravines to be crossed. Estimate length and height of bridges.
- Drainage paths.
- Soil conditions and geological features.
- Vegetation type and density.
- Potential for future additions to the railroad, as per the installation master plan.
- Wetlands and other environmentally sensitive areas.
- Snowfall and exposure to drifting snow.

Observe snow conditions along the proposed routes for at least one winter to identify locations where drifts form. Winter aerial photographs are potentially helpful for this

purpose. Avoid sites downwind of frozen lakes unless there is adequate room between the shore and the roadway to install snow fences.

After the reconnaissance has been completed, prepare maps showing all control points and potential alternative routes. Then, make general comparisons between the routes with respect to length, grades, curvature, relative amount of earthwork and drainage work required, bridge work, special construction requirements, and potential operating advantages and disadvantages.

If sufficient information is available at this point, recommend the best route; otherwise, prioritize the routes. Also note any special requirements for the initial survey.

A-1.4 Initial Survey.

The objective of the initial survey is to obtain sufficient information to allow preparation of initial earthwork and construction estimates and to establish a location for the track and drainage paths on maps back at the office. When the route choice is clear from the reconnaissance, the initial and final surveys are often combined.

The initial survey is done by approximating the routes as a series of tangents, taking elevations and cross section data at selected intervals, perhaps every 100 to 250 ft. (30.5 to 76.2 m) along the route. Generally, where terrain is fairly uniform, the longer survey intervals can be used. Take elevations and cross section data at points representing a rapid change in terrain or at other points of special interest that aid construction estimating. Incorporate all useful landmarks into the survey. Stakes need to be driven in sufficient number to clearly show the survey centerline - about every 200 to 400 ft. (61 to 121.9 m).

For cross sections (nearby elevations at right angles to the route), simply take elevations at points that will show the shape of the adjacent terrain - local peaks, low points, and other points of special interest. The width of the required cross section will be dictated by the character of the terrain, right-of-way ownership, and distance needed to show local drainage and topographical features. It is not necessary for cross sections to be of equal distance on each side of the route centerline or of equal width at each station along the route.

Where terrain is open and easily accessible, cross section data is often taken from 300 to 500 ft (91.4 to 152.4 m) on each side of the route centerline. In areas where the route location is fairly well defined, cross sections are much narrower; sometimes only a 50-ft (15.2 m) wide strip is needed. The situation governs the choice of width.

When approaching points where a change in direction will occur, it will often prove useful to take an extra wide cross section on the inside of the angle, as a curve must eventually connect the two tangents through this area.

During the initial survey, be sure to take sufficient information to establish drainage paths on both sides of the track. Also note paths that drain runoff into the right-of-way as well as outlets where water can exit the right-of-way to nearby streams, drop inlets, or other runoff channels.

A-1.5 Trial Location.

Trial location is the process of determining potentially practical routes (trial routes) through a particular area. The objective of trial location is to produce the best combination of tangents, curves, and grades for the routes surveyed. This is done by combining survey information with design and economic guidelines, operating requirements, and engineering judgment. During this process, many factors must be weighed and prioritized, and conflicting objectives must be balanced.

After the first trial routes are located, construction estimates are made. Then, the location of the track or drainage path is usually modified in an attempt to reduce construction cost, while still maintaining satisfactory operating characteristics, or to improve operating characteristics while keeping construction costs at a reasonable level. Adjustments are made to each route until the most satisfactory set of compromises has been produced.

For track through an installation or in a terminal area, this process can usually be simplified and done with fewer iterations. Likewise, the construction estimates might be done only once.

Trial location begins by lightly sketching the boundaries of the initial survey on a contour map. The first trial route drawn through this strip is often done by minimizing grades, or in flatter territory, by minimizing the number of curves needed. As with the initial survey, the route begins as a series of connected tangents, with curves chosen and drawn in later.

After the route is sketched, a profile is drawn. The elevations of the railroad come from the elevations of end and intermediate points and the different grades chosen between these points. The elevations of existing ground level are obtained by approximating the point where the route would pass through each cross section taken in the initial survey. When an initial survey is not done, the ground elevations are taken from the points where the route crosses map contours.

With the trial routes drawn, earthwork and construction estimates are made using standard procedures. At this stage, estimate embankment and cut widths and slope angles using the typical roadway cross sections in Chapter 5, Paragraph 1. If one route does not yet appear clearly superior, generate an additional iteration of modifications and analysis to produce the final location.

A-1.6 Final Location.

To finalize the route selection, modify the trial routes, if necessary, to even cut and fill amounts in adjacent areas or to reduce the total earthwork and grading required.

Where grades or curvature exceed the most desirable limits, the routes should be modified, if feasible, to reduce these. Also review the criteria listed in Paragraph A-1.1, for each trial route.

APPENDIX B RULING GRADE – EXAMPLE PROBLEM

This example of determining a trial ruling grade for a new railroad line follows the material presented in Chapter 3, Paragraphs 4, 5, and 6.

A railroad line is to be built from the terminal serving the new training area at Fort Example to the nearest commercial railroad, about 15 miles away. The most critical traffic, and heaviest loads, will be M-1 tanks on flatcars. Each car is 70 feet long and has a maximum loaded weight of 187 tons riding on 6 axles. The installation has one 1,500 HP, 100-ton locomotive.

To handle movements during larger training exercises and mobilization, the installation wants to use an engine from the connecting railroad which will be capable of hauling 25 loaded flats over the line at 15 MPH minimum speed. The connecting railroad expects to have a 3,000 HP, 170 ton (340,000 pound) locomotive available when needed. Tractive effort curves are not available for either locomotive. For simplicity, let locomotive length equal car length.

The designer must now determine the maximum effective gradient and grade length on the new line to accommodate these train movements. The first step is to determine how much traction force is available using Chapter 3, Paragraph 5.4. Available traction force will be the lesser of locomotive tractive effort or traction at the wheel-rail adhesion limit, for the commercial locomotive:

1. Locomotive Tractive Effort at 15 MPH = 300 x 3,000 / 15 = 60,000 lbs.
   Wheel-Rail Traction Limit = 340,000 / 4 = 85,000 lbs.
2. Locomotive traction capability governs usable tractive effort.
3. Ruling Grade from Equation 3-3:

   TE =60,000 lbs

   W_{eng} = 170 tons

   W_{car} = 187 tons

   N_{car} = 25

   G = 60,000 / 20(170 + 25 x 187) - 0.15

   = 0.47%

   Grade length = 26 (engine and cars) x 70 = 1820 Feet (or longer)

Thus, grades of 1820 feet or longer would have to be limited to an effective gradient of 0.47%. After a brief review of contour maps of the proposed route, the designer believes the route requires grades much steeper than 0.47% to keep construction costs at an acceptable level.

One way to accommodate the desire to move single trains of 25 loaded flats at a minimum speed of 15 MPH and allow for a steeper ruling grade is to use the installation's engine and commercial engine together. Dropping the travel speed up the ruling grade to 10 mph further increases the tractive effort available. To offset the loss in speed up the ruling grade, other portions of the route might be constructed to accommodate higher speeds perhaps – 25 to 30 mph. A check of this possibility shows the following:

For the commercial locomotive:

1. Traction at the Adhesion Limit = 340,000 / 4 = 85,000 lbs.
2. Locomotive Tractive Effort at 10 MPH = 300 x 3,000 / 10 = 90,000 lbs.
    a. Wheel-rail adhesion governs usable tractive effort.

For the installation's locomotive:

1. Traction at the Adhesion Limit = 200,000 / 4 = 50,000 lbs.
2. Locomotive Tractive Effort at 10 MPH = 300 x 1,500 / 10 = 45,000 lbs.
    a. Engine power governs usable tractive effort.
3. Ruling Grade (from Equation 3-3):

    TE =85,000 + 45,000 = 130,000 lbs.

    W_{eng} = 170 + 100 = 270 tons

    W_{car} = 187 tons

    N_{car} = 25

    G = 130,000 / 20(270 + 25 x 187) - 0.15

    = 1.16%

4. 2 engines and 25 cars = 27 total

    Grade length = 27 x 70 = 1890 Feet (or longer)

Thus, if this revised arrangement is acceptable, grades of 1890 feet or longer could have an effective gradient as high as 1.16%. Table B-1 shows the curve compensation for curves on this grade.

Table B-1 Curve Compensation for a 1.16% Grade

Degree of Curve	Uncompensated Grade		Compensated Grade	
	Actual	Effective	Actual	Effective
1	1.16	1.20	1.12	1.16
2	1.16	1.24	1.08	1.16
3	1.16	1.28	1.04	1.16
4	1.16	1.32	1.00	1.16
5	1.16	1.36	0.96	1.16
6	1.16	1.40	0.92	1.16

From the table, if a 5 degree curve was located within the ruling grade, the constructed (actual) gradient through that curve must be limited to 0.96% to keep the effective gradient within 1.16%.

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APPENDIX C SAMPLE TRACK REHABILITATION REPORT

This sample report illustrates the type of information and level of detail suggested for an analysis of a military railroad network in preparation for rehabilitation work. The material that explains how the work is normally conducted is included for the benefit of the reader and would not be necessary in an actual rehabilitation plan.

Included in this example report are:

1. A description of track and roadway condition.
2. A problem/defect analysis.
3. A sequential work plan to correct the defects.
4. Cost estimates for each item of the work plan.

The material in Appendix C covers the structural evaluation that is normally required in a rehabilitation plan. Follow the guidance in Chapter 4, Paragraph 5 for the operational evaluation, which is not detailed here. Please note, do not use costs shown in the sample report as they are out-of-date.

RAILROAD TRACK REHABILITATION REPORT FOR FORT EXAMPLE

SUMMARY

Examination of the railroad network at Fort Example showed the following major deficiencies:

1. Inadequate lateral and longitudinal track stability.
2. Deteriorated track through road crossings.
3. Turnout defects.
4. Washouts under track.
5. Defective and/or skewed ties in certain areas.
6. Loose or missing track fastenings.
7. Thick vegetation growing in some portions of track.

The work plan was divided into 2 phases, with a total project cost of approximately $970,000.

Phase 1, to be accomplished first, covers the rehabilitation of the primary route and sidings extending from the connection with the commercial railroad to the end of the East Line. This work is estimated to cost approximately $550,000.

Phase 2 covers rehabilitation of most of the remainder of the track network: the south half of the Main Line, the West Line, and the North Line. This work is estimated to cost approximately $420,000.

The remedial work described in this report would restore the railroad network to a fully functional level, in a cost-effective manner. Remedial work has been specified only for those sections of track where the work is most needed. Tracks with no current use are not included in the plan.

The work plan has been designed so that when completed, the railroad network would require only normal routine maintenance to keep it fully functional for the foreseeable future.

C-1 INTRODUCTION.

C-1.1 Background.

This rehabilitation plan was prompted by reports that portions of the Fort Example railroad network were in a general deteriorated condition and that results of the structural evaluation program indicated structural deficiencies in several stretches of track. These conditions were confirmed by the team performing the track assessment contained in this report.

C-1.2 Objectives.

The objectives of this report are to:

1. Document the track and roadway deficiencies found during the recent field inspection, both by type and extent.
2. Propose corrective measures.
3. Provide cost estimates for budget planning.

The corrective work included in the plan is intended to restore the railroad network in a cost-effective manner. Thus, not all sections of track in the network are included in the plan, and each type of remedial work is specified only for those sections most in need. Further, corrective work is specified only to the extent that will restore the long-term function of the track. Tie replacement estimates are based on improving tie condition to the point where installation trackage can function well for 5 years before the next tie replacement program is needed.

C-1.3 Approach.

A three-person team visited the installation to examine the railroad network. During this visit, all track (except the short piece leading to the old coal/gravel chute) was examined by walking inspection, and all primary routes were traveled with the installation's 120-ton locomotive. In addition, those who were familiar with the track were interviewed about deficiencies they had observed and about track work performed in recent years.

C-1.4 Scope.

This report is intended to assist in the preparation of contract specifications for remedial track work. Neither the field investigation nor this report is intended to cover every detail required for proper restoration of the railroad network, nor is this report intended to be a substitute for a complete statement of work and specifications. There are, in fact, several items noted that will require additional examination and decisions before a complete and final remedial work plan can be established.

Accompanying this report are both general and detailed track maps and photographs, with notes, showing portions of the railroad network and representative defects.

C-2 OPERATIONAL EVALUATION.

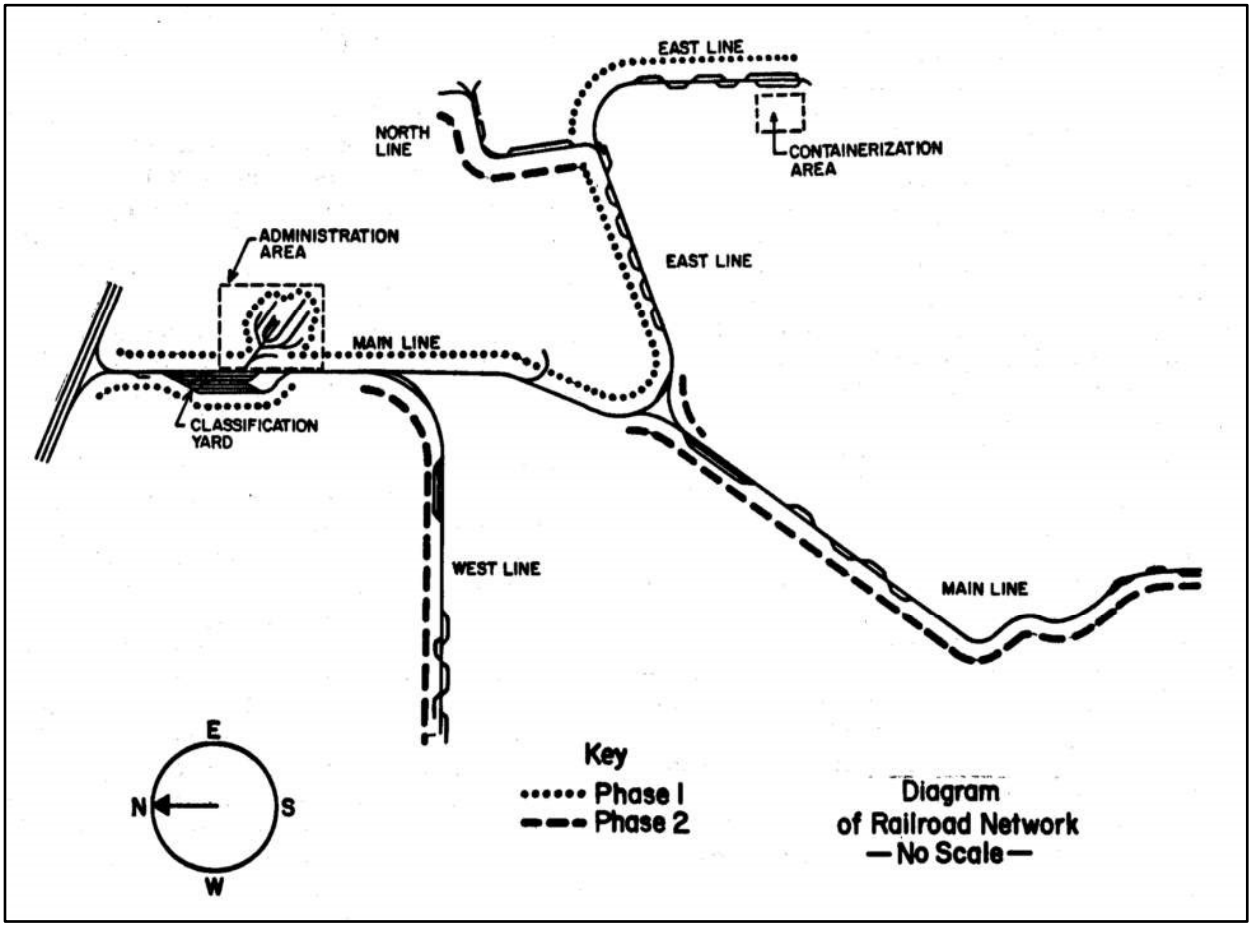
Operational evaluations are covered according to the guidance in Chapter 4, Paragraph 5.

C-3 DESCRIPTION OF NETWORK AND TRACK CONDITION.

C-3.1 Introduction.

The railroad network connects with the [_____] Railway about 10 miles east of (City), (State). Of the 19.95 miles of track, 9.62 miles are primary routes, 3.43 miles are in the classification yard, and 6.90 miles are loading and storage sidings and auxiliary tracks. A track diagram is shown in Figure C-1, with a key to track designations in Table C-1.

Figure C-1 Track Diagram for Fort Example



Incoming cars are generally brought to the classification yard by the commercial railroad. There, one of the two installation locomotives will pick up the cars and deliver them to the appropriate area for loading or unloading. These cars are then brought back to the yard for pick up by the commercial railroad.

Table C-1 Key to Track Names and Station Locations

Letter Prefix	Track Type or Area
M	Main Line
E	East Line
W	West Line
N	North Line
A	Administration Area
P	Sidings serving loading ramps
S	Sidings serving buildings A through L
X	Miscellaneous spurs or sidings
Y	Wye tracks
2-14	Tracks in the Classification Yard

Below is a description of the railroad network, by component, reflecting conditions found during the investigation.

C-3.2 Rail.

C-3.2.1 Description.

80 percent of the rail is 90 lb (weight per yard of length) and manufactured between 1909 and 1924. The remaining 20 percent is 85 lb. The 85 lb. rail is primarily in Tracks 4 through 14 of the classification yard, the end of the North Line, and on Track A5 in the Administration Area, leading to the engine house. All rail was manufactured before the control cooling process was in use. The control cooling process, now standard practice, greatly reduces the formation of internal defects.

C-3.2.2 General Condition.

The rail is generally in good condition, neither excessively nor unevenly worn. Very few pieces show serious end batter or surface bending. Likewise, obvious external defects, serious corrosion (except, perhaps in crossings - where the whole rail is not visible), and breaks are rare. Testing for internal rail defects was not done.

C-3.3 Plates/Fastening.

C-3.3.1 Plates.

Almost all track has single shoulder tie plates. These are in adequate condition, with relatively few missing or defective.

C-3.3.2 Joints.

Joint bars are in good condition, with few excessively worn, cracked, or broken. However, many bolts are missing, loose, or not fully tightened. Of those that are not fully tightened, many appear to be rusted solid with the nut.

C-3.3.3 Spikes.

Spikes are in good condition; however some are not fully driven or have worked their way up in the last few years. Also, spikes have been frequently driven through angle bar base slots, which is no longer considered to be good practice.

C-3.4 Ties.

C-3.4.1 Description.

Most older ties are 6 x 8-in. in cross section. Most of the ties installed during the tie replacement 8 years ago are 7 x 8-in.

C-3.4.2 General Condition.

Tie condition is generally fair to good. Areas that did not receive ties during the last tie replacement program are generally in the worst condition. On the Main Line, approximately between stations 200+00 and 250+00, there are many skewed, bunched, or otherwise improperly spaced ties.

C-3.5 Ballast.

C-3.5.1 Description.

Most track in the primary routes has ballast composed of a low density, finely crushed volcanic material or slag, or cinders mixed with earth. Some stretches of track appear to have no real ballast section, leaving the track essentially sitting directly on the subgrade.

During recent track work, some new ballast was applied. This ballast is crushed rock of about AREMA 3 or 4 gradation and appears to be good, hard material. However, in most cases, this ballast is only a surface treatment, helping to fill in cribs (the spaces between the ties) and fill out the shoulders (at the ends of the ties).

C-3.5.2 General Condition.

The cinder/volcanic/earth material seems to drain adequately, but apparently provides insufficient lateral or longitudinal stability to the track. See Track Geometry section below. Additionally, this material is not sufficiently dense and stable to resist washout from heavy rains. See Drainage/Subgrade section below.

C-3.6 Drainage/Subgrade.

C-3.6.1 Description.

While the rainfall in this area of the country is not high, much of the rain comes in short, heavy periods, resulting in flash floods and washouts. Culverts at the installation are generally large, as big as 72 in., and often of double pipe arrangement, not only to accommodate sudden heavy flows, but also the debris that is swept along by the water.

The track is built on a sandy subgrade and is generally elevated above surrounding ground level. There are, however, clay layers near the surface in some locations. The large, flat areas containing tracks in the classification yard and in the Administration Area do not have a subdrainage system.

C-3.6.2 General Condition.

Drainage is generally good, both from the track and through culverts. However, there are a few problem areas. After a heavy rain, water commonly stands in the Administration Area and in some loading sidings for quite some time. Also, due to the large amount of debris present in the storm runoff, some culverts are partially or fully blocked.

Heavy rains have also caused several small washouts on the Main Line, especially along a roughly 800-ft stretch between stations 162+00 and 170+00 and at the south end of the line. In some places, shallow clay seams block vertical drainage, but water can usually escape adequately in lateral directions. And despite the numerous loose joint bars, the number of low joints is quite small, indicating good vertical ballast and subgrade support.

C-3.7 Vegetation.

C-3.7.1 Description.

Thick brush and low vegetation grow close to the track in many stretches of track, especially in loading sidings and near the ends of the primary routes.

C-3.7.2 General Condition.

Some vegetation is very tough, and where dense growth occurs, it scrapes the sides of trains. Because of this growth, it is difficult for a person to walk next to the track in several loading sidings and at the end of the Main Line.

C-3.8 Turnouts.

C-3.8.1 Description.

Turnouts are either 85 or 90 lb, matching the rail in the adjacent track. All but a few are Number 8 (in size) and have bolted frogs and either 11-ft or 16 ft, 6-in. switch points.

C-3.8.2 General Condition.

Overall, turnout condition, line, and surface are adequate. However, many switches are difficult to operate and badly need cleaning, lubrication, and adjustment. At many switches, the heel bolts are loose and the nuts and bolts often appear solidly rusted together, which would prevent re-tightening. Some switch points are also badly chipped or broken, and other miscellaneous parts need replacement. About half the turnouts had most or all of their ties replaced during the last tie replacement program. A few turnouts that did not get new ties do need some new ones.

C-3.9 Road Crossings.

C-3.9.1 Description.

Most crossings are all asphalt, with a few gravel/dirt type. There are two rubber crossings through the Main Highway near the connection with the commercial railroad.

C-3.9.2 General Condition.

About 25 percent of the asphalt crossings are in fair to poor condition. Likewise, the track in those crossings appears to be in fair to poor condition, typically showing loose joints and wide gage. Through a few crossings, only the slow and careful operation by the installation train crews has prevented derailments from occurring.

C-3.10 Track Geometry.

C-3.10.1 Description.

Track geometry describes the relative position of the two rails and track in the vertical and horizontal planes. The three primary measurements are:

- Alignment - a measure of lateral track deviations.
- Surface/Cross level - measures of vertical track deviations.
- Gage - the spacing between the two rails. Standard Gage is 56-1/2 in.

C-3.10.2 General Condition.

C-3.10.2.1 Alignment.

Track alignment is generally fair, with some poor sections.

C-3.10.2.2 Surface/Cross Level.

Track surface is generally adequate, although poor in places on the east half of the East Line, west half of the West Line, and spots on the Main Line. Track surface is also poor in some loading sidings. A few curves have excessive superelevation.

C-3.10.2.3 Gage.

Track gage is generally good, with the exception of some of the road crossings, where wide gage is common, and spots where skewed ties have caused tight gage.

C-3.11 Bridges.

C-3.11.1 Description.

There are three all timber bridges:

Table C-1 Timber Bridges

Line	Location	Length	Deck Type
Main	19+13	64 ft	Open
West	9+02	85 ft	Ballast
	40+00	122 ft	Open

C-3.11.2 General Condition.

These bridges were thoroughly inspected about 2 years previously and found to be in good condition. During this visit, the bridges were given a brief inspection, and no obvious defects were apparent.

C-4 STRUCTURAL ANALYSIS.

Explain any computer program or structural evaluations here.

C-5 ANALYSIS OF MAJOR DEFICIENCIES.

Below is a description of the major track deficiencies, along with contributing factors, where appropriate. In addition, these deficiencies refer to the remedial actions, as described in Paragraph C-6, designed to correct them.

C-5.1 Inadequate Lateral and Longitudinal Track Stability.

The track at the installation has at best, a surface layer of crushed rock ballast. Most stretches have a low density mix of fine crushed volcanic material and earth filling in the spaces between and around the ties. This material does not provide adequate lateral or longitudinal track support. And as a result, track alignment is generally fair or poor, and many ties have shifted position and become skewed (not perpendicular to the rails).

To both restore and keep proper track line and surface and maintain proper tie position, a sufficient amount of good quality ballast material must be added to the track. In addition, anchors must be correctly re-applied and added where needed. Remedial Actions 2, 6, 8, 9, 12, and 13 (as listed in Table C-2) are designed to establish adequate lateral and longitudinal track stability.

C-5.2 Deteriorated Track Through Road Crossings.

About 25 percent of the asphalt crossings are in poor condition, and likewise, so is the track in them; ties have deteriorated, track support is mushy, and joints have loosened - in some cases allowing track gage to widen to an unsafe distance. Remedial Action 5 includes complete crossing/track rebuild, as required.

C-5.3 Turnout Defects.

The portion of the track covered by this rehabilitation plan includes 48 turnouts. Many of these are difficult to operate, out of adjustment, and have loose or defective parts. Remedial Action 9, Restore Turnouts, includes allowances for general turnout rehabilitation.

C-5.4 Washouts under the Track.

Heavy rain runoff occasionally washes out ballast and subgrade beneath the track in three areas along the Main Line. Nine small washes have occurred in the last 3 years in the Main Line between Sta. 162+80 and 169+70. One small washout occurred near Sta. 253+40, and a deeper washout just past that point. This is one area in which further study will be required to determine the most cost effective way to either eliminate the probability of future washouts, or at least minimize possible track damage. Remedial Action 2 includes a general plan for correcting drainage problems at these washout areas.

C-5.5 Skewed Ties.

Some areas of the Main Line (mostly between stations 200+00 and 250+00) have skewed (crooked), bunched, and misspaced ties. This situation is caused by the following:

- Low density ballast that cannot resist tie movement.
- Cribs (space between the ties) not fully filled with ballast, further reducing resistance to tie movement.
- Anchors not replaced after tie installation or applied to only one rail (one side of the tie).
- Track on grades. Portions of the track are on grades steep enough to encourage longitudinal rail movement, and thus also, tie movement.
- Spikes driven in the slots in angle bar type joint bars. This is no longer considered good practice. As joints are usually staggered, rarely does a tie ever have a joint on both rails. Driving spikes into the joint bar base slots will then have the same effect as anchoring only one side of a tie.
- Ties with incorrect spiking pattern, present in some of the older ties. While this incorrect pattern does not actually cause tie skewing, it does encourage it.

- Some ties appeared to have been installed crooked.

Remedial Action 7 provides for repositioning skewed and misspaced ties, and Remedial Action 10 will help prevent future tie movement.

C-5.6 Loose or Missing Track Fastenings.

Numerous rail joints have loose or missing bolts, and at least 12 joints noted during the inspection have both bolts in one rail missing. Remedial Action 8 calls for tightening all joints and replacing defective bolts and joint bars.

C-5.7 Vegetation In or Near the Track.

Scattered locations along primary routes and loading sidings have thick brush growing close to the track, and in some cases, in the ballast section. This vegetation must be removed before any track work can be performed. In addition, sufficient herbicide needs to be applied soon after completion of track work to prevent future brush growth. Remedial Actions 1 and 13 cover the removal and future prevention of brush growth.

C-6 RECOMMENDATIONS AND COST ESTIMATES FOR REMEDIAL WORK.

C-6.1 General.

This section presents a general plan for correcting the majority of track deficiencies. The plan is organized as a list of 14 remedial actions, numbered in general work sequence order. The cost estimates for each remedial action are broken down between Phase 1, to be done this year, and Phase 2, to be done next year. Table C-2 shows a cost estimate summary.

Table C-2 Cost Estimate Summary

REMEDIAL ACTION				
No.	**Description**	**PHASE 1**	**PHASE 2**	**TOTAL**
1.	Remove Vegetation	$ 1,200	$2,400	$3,600
2.	Restore Drainage	15,000	35,000	50,000
3.	Rail Defect Inspection	5,000	---	5,000
4.	Replace Defective Rail	13,600	13,600	27,200
5.	Rebuild Crossings	29,950	33,470	63,420
6.	Tie Replacement	140,000	100,000	240,000
7.	Respace Ties	3,250	8,125	11,375
8.	Tighten Bolts/Spikes	18,700	18,700	37,400
9.	Restore Turnouts	19,800	12,150	31,950
10.	Rail Anchors	33,580	25,200	58,780
11.	Unload Ballast	147,640	86,060	233,700
12.	Surface Track	55,200	32,175	87,375
13.	Herbicide Application	3,200	2,600	5,800
14.	On-Site Inspection	12,000	12,000	24,000
	Subtotal	$498,100	$381,500	$879,600
	10% Contingency	49,810	38,150	87,960
	TOTAL	$547,910	$419,650	$967,560

NOTES:

PHASE 1 covers the primary route from connection with the commercial railroad to the end of the East Line, Admin. Area, and Tracks 2-5 of the Classification Yard.

PHASE 2 covers the remainder of the Main Line (East Jct. to End), West Line, and North Line.

Phase 1 and Phase 2 include the following trackage:

a. Phase 1: Main Line from connection with the commercial railroad (Sta. 0+00) to East Junction (Sta. 119+81).
    - Track Y1 and Classification Yard tracks 2 – 5.
    - Administration Area tracks A1 – A8.
    - East Line and sidings from Origin (Sta. 0+00) to End (Sta. 120+56).

b. Phase 2: Main Line and sidings from East Junction (Sta. 119+81) to End (Sta. 263+97), and track Y2.

- West Line and sidings from Origin (Sta. 0+00) to End (Sta. 75+06).
- North Line and sidings from Origin (Sta. 0+00) to End (Sta. 47+96).

The work plan and estimates are for restoration of the majority of the railroad network. However, not all remedial actions are intended to be carried out on all trackage. Within the description of each remedial action, the intended work limits are listed, where appropriate.

Generally not included in the work plan are Classification Yard tracks 6-14 (the far west tracks), tracks X1 through X5, Administration Area track A9 (to the old coal/gravel chute), and track P5 (at the end of the West Line). These tracks, while required for mobilization, are not in regular use.

C-6.2 Remedial Actions.

A cost estimate summary of the remedial actions is shown in Table C-2.

C-6.2.1 Remove Vegetation.

The first step to ensure that the track is fully accessible for other track work and that large amounts of vegetation will not be buried in the track during ballast unloading is vegetation removal. Use a plow and brooms of a ballast regulator, supplemented by laborers with brush cutters to remove vegetation.

Phase	Mileage	$ Estimate
1	1.2	1,200
2	2.4	2,400
Total	3.6 mi	$3,600

Note: Unit Cost = $1,000/Mile

C-6.2.2 Restore Drainage.

It is essential that proper drainage be provided and maintained to prevent roadbed deterioration and track washouts. While drainage of the track network is mostly satisfactory, some general maintenance is needed, with a few areas that require serious attention. This section provides a rough allowance for the following drainage work:

- Excavator, dump trucks, backhoe, and laborers reshaping ditches and cleaning culverts.

- Grading in the Administration Area to keep water from standing within the roadbed.
- Installation of culverts and related earthwork in washout areas on the Main Line.

Due to the nature of the drainage in the Administration Area and in the washout areas, it is not practical to implement a solution that will entirely correct the problems. A plan that greatly improves the situation is recommended.

Especially after heavy rains (such as were experienced last summer), water stands in the track in the Administration Area. Apparently, a drainage system was never installed here, and providing one now is quite expensive.

It is recommended that consideration be given to at least providing some grading so that water will tend to flow away from the track into adjacent lowered areas. While this solution will not eliminate the standing water in this area, it could at least prevent it from standing in the track, where it would do the most damage.

In selected areas along the Main Line, especially between Sta. 162+80 and 169+70, ballast and subgrade have been washed out from beneath the track on several occasions. These areas are located in the natural drainage path of heavy rain runoff. While preventing all runoff from reaching the track is not be affordable, it is recommended that remedial work be considered that will at least prevent the water that does reach the track from causing any roadbed damage. Such work might include:

- Install a culvert, perhaps double pipe, beneath the track, at the center of the washout area. Grade adjacent area to channel water through the culvert. Place large rock near the culvert approach to prevent erosion.
- Construct an interceptor berm, or other obstacle, in the drainage path to break the force of a heavy runoff.
- Increase the ballast shoulder in the washout areas to 12 in. This provides additional resistance against damage by water that does reach the track.

Accomplish any drainage work that directly disturbs the track before track work begins.

Phase	$ Estimate
1	15,000
2	35,000
Total	$50,000

C-6.2.3 Internal Rail Defect Inspection.

Since no record of internal rail defect inspection exists, and all rail was manufactured before the use of controlled cooling (1933), an inspection for the presence of internal rail defects should be made over the entire railroad network.

Phase	Mileage	$ Estimate
1	17	5,000
2	---	---
Total	17 mi	$5,000

Note: Rail defect testing is priced per day plus travel costs, rather than by mileage. Phase 1 includes inspection of all track in the rehabilitation plan. In addition to cost effectiveness, inspection of all rail as soon as practical will permit an accurate determination of the quantity of rail that requires replacement.

C-6.2.4 Replace Defective Rail.

This estimate is an allowance for replacing the defective rails that may be found during an internal defect inspection.

Phase	Number of Rails	$ Estimate
1	34	13,600
2	34	13,600
Total	68	$27,200

Note: Unit Cost = $400/rail. Estimate based on 33-ft sections of 90 lb. rail, and allowance of four defective rails/mile.

C-6.2.5 Rebuild Road Crossings.

In road crossings that require replacement, the track often needs to be completely rebuilt. In addition, conventional rail joints are often replaced with welded joints to eliminate the need for future joint maintenance (which usually requires tearing out at least part of the crossing surface). Welding joints in a crossing is especially recommended in areas with heavy truck traffic and in crossings in main running tracks.

The rebuilding of crossings can start any time before the ballast and surfacing operations. These estimates cover crossing replacements, as listed in Table C-3. Three types are specified: complete track rebuild with timber/asphalt surface, timber/asphalt surface replacement, and timber/gravel surface replacement.

Table C-3 Road Crossing Repair/Rebuilding

Phase	Centerline Line	Crossing Location	Rebuild Length (ft)	Type
1	Main	24+53	24	CA
		77+55	42	CA
		113+65	87	CA
	East	10+94	33	A
		46+46	31	A
		65+81	30	CA
2	Main	173+20	25	A
		193+31	22	A
		204+20	15	G
		258+09	30	A
	West	4+45	18	G
		37+56	21	A
		45+49	19	A
	North	5+75	85	CA
		35+63	30	A
		44+95	67	CA

SUMMARY Phase	Rebuild Type	Number of Xings	Footage	Number of Welds
1	CA	4	183	7
A		2	64	4
2	CA	2	152	8
A		6	126	11
G		2	33	2

Rebuild Type Key

CA – Timber/Asphalt crossing surface with complete track rebuild.

A – Timber/Asphalt crossing surface replacement.

G – Timber/Gravel crossing surface replacement.

The timber portion of the crossing surface refers to timber head boards installed along the gage side (or both sides) of the of the rail. Timber head boards help keep the flangeways clear, reduce intrusion of road material into the track, and lessen the lateral rail impact from vehicle traffic.

Phase	$ Estimate
1	29,950
2	33,470
Total	$63,420

Note: The following are the unit costs used for crossing work:
Timber/Asphalt crossing with complete track rebuild, $125/foot.
Timber/Asphalt crossing surface replacement, $50/foot.
Timber/Gravel crossing surface replacement, $25/foot.
Joint welds, $350 each.

C-6.2.6 Tie Replacement.

This estimate provides for ties primarily in the areas that were not covered in the previous tie replacement program. Generally, the limits are the same as specified for ballast and surfacing. The number of ties estimated is intended to allow the installation track to maintain sufficient tie condition for 5 more years before another tie program is required. (Although during the next 5 years, some spot tie replacement will probably be needed).

Included in the estimate for each phase is an allowance for 400 ties in the loading tracks (and the containerization terminal on the East Line to be done in Phase 1) and for 100 ties that drop during surfacing and are in too poor a condition to be re-spiked.

Exact tie counts should be made when preparing the final plans.

Phase	Number of Rails	$ Estimate
1	3500	140,000
2	2500	100,000
Total	6000	$240,000

Note: Unit Cost = $40/tie.

The tie spacing at the installation averages 20 in., which equals 3,168 ties/mi.

C-6.2.7 Respace Ties.

During this remedial action, properly reposition all skewed and misspaced ties. This work also includes raising ties that dropped during the track raise and replacing occasional defective ties that cannot be re-spiked.

This estimate covers labor and machine costs for tie respacing.

Phase	Mileage	$ Estimate
1	2.5	3,250
2	6.25	8,125
Total	8.75 mi	$11,375

Note: Unit Cost = $1300/mi.

For Phase 2, tie respacing not required on Main Line from Sta. 154+00 to Sta. 200+00. This work is also only needed over approximately half of the North Line.

C-6.2.8 Tighten and Replace Track Bolts/Drive High Spikes.

Due to numerous loose rail joints, use a bolt tightening machine to tighten all track bolts. During this operation, replace all defective bolts and joint bars. Along with bolt tightening, drive down all high spikes and replace all defective spikes. This will minimize the number of ties that drop down when the track is raised during surfacing.

However, it is not recommended to either pull any spikes driven in the slots of angle bar type joint bars, or pull or add any spikes in ties with an incorrect spiking pattern. The combination of tie straightening/respacing, additional ballast, and application of rail anchors included in this rehabilitation plan will prevent future tie movement due to incorrect spiking. Further, there would be significant potential for long term tie damage due to pulling spikes (even if old holes are plugged).

Both operations (for bolts and spikes) should be performed prior to any ballast unloading or surfacing.

Phase	Mileage	$ Estimate
1	8.5	18,700
2	8.5	18,700
Total	17.0 mi	$37,400

Note: Unit Cost estimate of $2,200/Mile based on:

1. Bolt tightening, $1,500/mi.
2. Allowance for extra bolts, $2.50 each, 120 per mi, or $300/mi.
3. Allowance for extra spikes and miscellaneous work, spikes @ $1.00 each, total allowance @ $400/mi.

C-6.2.9 Restore Turnouts.

Table C-4 provides a detailed listing of turnouts included in Phases 1 and 2, along with a rough approximation of switch tie requirements and switch point replacements. (Determine exact requirements for inclusion in contract work statement).

Phase	Number of Turnouts	$ Estimate
1	10	19,800
2	12	12,150
Total	22	$31,950

Notes:

1. Unit Cost varies with work required. Estimates based on:

   a. $1050/turnout for surfacing, miscellaneous parts, and cleaning and adjustment.

   b. $50/switch tie, installed.

2. Estimate allows for 74 switch ties in Phase 1 and 126 in Phase 2. (See Table C-4).

3. Estimate allows for seven switch points to be replaced in Phase 1 and 6 in Phase 2. Cost per point (installed) is estimated to be about $800 for a 16 ft, 6-in. point.

Table C-4 Turnout Rehabilitation

Phase	Line	I.D. Number	Location	Direction	Switch Tie Requirement	(1) Point Replacement
1	MAIN	M03	24+67	RIGHT	8	L R
		M04	39+88	LEFT	--	R
		M05	40+21	LEFT	--	L R
		M07	44+84	LEFT	12	--
	EAST	E03	3+64	LEFT	10	--
		E04	14+49	LEFT	8	--
		E08	36+15	RIGHT	20	--
		E10	42+77	LEFT	8	--
		E12	49+60	RIGHT	8	--
		E17	117+95	LEFT	--	L R
					74	7
2	MAIN	M13	134+51	RIGHT	15	--
		M15	155+02	LEFT	5	--
		M16	162+11	LEFT	5	--
		M17	170+55	RIGHT	9	L R
	WEST	W09	69+23	RIGHT	8	L
		W11	70+89	LEFT	8	--
		W12	71+54	RIGHT	8	R
	NORTH	NO1	8+78	RIGHT	12	--
		NO4	23+03	LEFT	22	L
		NO5	25+80	RIGHT	11	L
		NO6 (1)	32+47	LEFT	9	--
		NO7 (2)	32+87	RIGHT	14	--
Notes:					126	6

L = Left Point, R = Right Point

1. One switch rod missing
2. Cracked frog

C-6.2.10 Apply Rail Anchors.

After new ties have been installed and skewed and misspaced ties properly repositioned, apply rail anchors.

This estimate calls for every fifth tie to be box anchored (have four anchors applied), with anchoring of primary routes only (no sidings). See Notes 2 and 3 below for intended anchoring limits.

Phase	Mileage	$ Estimate
1	4.77	33,580
2	3.58	25,200
Total	8.35 mi	$58,780

Notes:

1. Unit Cost estimate of $7,040/Mile, based on:
   a. Purchase cost of $2.00/anchor.
   b. Installation cost of $1.25/anchor.
   c. 2,560 anchors/mi.
   d. Assumption that 25 percent of required anchors can be salvaged from existing material.
2. For Phase 1, anchors are to be applied along the Main Line from Railroad connection (Sta. 0+00) to East Junction (Sta. 119+81); East Line from Origin (Sta. 0+00) to End (Sta. 120+56); and along Y1.
3. For Phase 2, anchors are to be applied along the Main Line from East Junction (Sta. 119+81) through Sta. 194+00; West Line from Origin (Sta. 0+00) through Sta. 70+89; and North Line from Origin (Sta. 0+00) through Sta. 43+63.
4. Recommended anchoring near the two open deck bridges (M 19+13 and W 40+00) is: no anchors on the bridge; box anchor every third tie for two rail lengths (about 66 ft) off either end of the bridge.

C-6.2.11 Unload Ballast.

Once the track is clear of excess vegetation, all bolts in place and tight, high spikes driven, and track in crossings rebuilt, the track is ready for new ballast to be applied. Ballast and surfacing locations are shown in Table C-5.

This estimate is for sufficient ballast to give the track a 3-in. raise, fill in shoulders and cribs, and pull up any track sags. It includes the costs of purchasing the ballast material, delivery to the work site, and distribution along the track.

Table C-5 Ballast and Surfacing Locations

Location	Footage
PHASE 1	
Main	
3+87 (S. end Rt. 40 Xing) to 19+13 (N. end bridge)	1,526
24+65 (S. end new Xing) to 45+50 (N. end scale track)	2,085
47+51 (S. end scale track) to 119+81 (East Junction)	7,230
	10,841
East	
0+00 (East Junction) to 120+56 (End)	12,056
Sidings (except X3, X4)	6,586
	18,642
Yard	
Tracks 2-5	5,823
Admin	
Track A1 - up to 5+61 (Building 9)	561
Track A5 - up to 14+40 (to engine house)	1,440
Track A6 - up to 9+52 (End)	952
Track A8 - up to 6+00 (to scrap bin)	600
	3,553
Total Phase 1 Footage (7.36 mi.)	38,859
PHASE 2	
Main	
119+81 (East Junction) to 194+01	7,420
257+79 to 263+97 (End)	618
	8,038
West	
0+00 to 75+06 (End)	7,506
North	
0+00 to 48+73	4,873
Tracks SA-SE	2,237
	7,110
Total Phase 2 Footage (4.29 mi.) 22,654	

The mileages indicated correspond to the surfacing footages, as shown in Table C-5.

Phase	Quantity (tons)	Mileage	$ Estimate
1	10,100	7.36	147,600
2	5,900	4.29	86,060
Total	16,000	11.65 mi	$233,700

Notes:

1. Unit Cost estimate of $20,060/mile based on:

   a. Ballast quantity of 0.2 cu yd per track ft (1,056 cu yd/mi.) @ $10.00/cu yd. delivered to site, or

   b. Unloading operation @ $9,500/mile.

2. Locations for ballast unloading are the same as for surfacing (Remedial Action 12).
3. 1 cubic yard of ballast weighs approximately 1.3 tons. 4) Ballast needed for rebuilding track in crossings is included in the estimate for rebuilding road crossings.
4. Estimate includes AREMA standard 15 percent allowance for ballast waste and loss.

C-6.2.12 Surface Track/Reshape Ballast Section.

The main surfacing and tamping operation includes:

- Lifting the track 3 in.
- Restoring proper track line and surface.
- Reshaping the ballast section.

The limits for this work are as shown in Table C-5.

During the final design process, check the sidings serving the loading docks and magazine standards to ensure that there is proper horizontal and vertical clearance between the track and the loading platform. Make any required corrections during track surfacing.

Phase	Mileage	$ Estimate
1	7.36	55,200
2	4.29	32,175
Total	11.65 mi	$87,375

Notes:

1. The Unit Cost estimate for surfacing is $10,560/Mile. Included in the cost is the following work:
   a. Raising the track 3 in.
   b. Plowing new ballast back into the track to fill in up to the tops of the ties.
   c. Reshaping the ballast section.
   d. Sweeping the track.

For Phase 1, estimate assumes no track raise through the track scale, and also assumes that track will be raised to level of existing crossings in the sidings along the East Line (Buildings A - F).

For Phase 2, provide a 12-in. shoulder in the track washout areas along the Main Line.

C-6.2.13 Herbicide Application.

Once the track work is complete, treat all track to prevent the growth of weeds in the ballast section.

While vegetation spraying at least once per year is recommended, this estimate is for one initial heavy application over a 16-ft wide path (8 ft from the center line of track on both sides).

Phase	Mileage	$ Estimate
1	10.7	3,200
2	8.5	2,600
Total	19.2 mi	$5,800

Note: Contract herbicide application is priced per day. As a rough estimate, a unit cost of $300/mi was used.

Phase 1 to include all Classification Yard tracks.

C-6.2.14 Quality Control Inspection.

Although listed last, quality control inspection is an essential element for a successful track rehabilitation. It is an effective means of assuring that all work reflects good workmanship and is performed according to the contract specifications.

Phase	$ Estimate
1	29,950
2	33,470
Total	$63,420

Note: Inspection cost estimate based on $35/Hour basic labor and overhead charge, or $280/Day, and $100/Day subsistence expenses. Total = $380/Day.

Allowance for travel to and from site of one round trip/week = $500.

Total Inspection Cost/Week = $2,400.

Phase 1 and 2 estimated to require 5 weeks each of on-site inspection.

C-7 CONCLUSIONS AND RECOMMENDATIONS.

Proper track restoration will involve remedial work that requires special attention. It is essential that this work be done by skilled workers, with knowledgeable and attentive supervision.

As indicated in the report, there are still some areas that need further examination before detailed contract specifications can be made, particularly in the improvement of drainage in areas where track washouts have occurred. Include these additional determinations as part of the final design process.

If the design work is to be contracted to an outside organization, it is recommended that a single design/inspection package be considered. Having the track work designed and inspected by the same organization has great potential for improved quality control and accountability throughout the project.

To further clarify the work plan and contract specifications, mark the work requirements (by type and location) in the field, whenever practical. This might include: marking with paint those switch ties that need replacement, setting flags or stakes to indicate the limits where extra shoulder ballast is required, painting a code at each road crossing to indicate which type of reconstruction is to be done, and noting any other indicators that help guide the field work.

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APPENDIX D GLOSSARY

ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AHJ	the Authority Having Jurisdiction
ASTM	American Society of Testing and Materials
AREMA	American Railway Engineering and Maintenance-of-Way Association
AWPA	American Wood Preservers Association
AFCEC	Air Force Civil Engineer Center
BIA	Bilateral Infrastructure Agreement
CAPY	capacity
CCR	criteria change request
CONUS	The Continental U.S.
CWR	continuous welded rail
DoD	Department of Defense
ESQD	Explosive Safety Quantity Distances
FEMA	Federal Emergency Management Agency
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
ITO	Installation Transportation Officer
MUTCD	Manual of Uniform Traffic Control
NAVFAC	Naval Facilities Engineering Systems Command
OTM	other track materials
OCONUS	Outside the Continental U.S.
POL	petroleum, oil and lubricants
Q-D	quantity-distance
RTCH	Rough Terrain Container Handler

SOFA	Status of Forces Agreements
TI	technical instructions
TM	technical manual
UFC	Unified Facilities Criteria
U.S.	United States
USACE	U.S. Army Corps of Engineers

APPENDIX E REFERENCES

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

A Policy on Geometric Design of Highways and Streets, 2018, 7th Edition, Washington, DC

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION (AREMA)

Manual for Railway Engineering, Volumes 1 - 4, Published Annually, Washington, DC

Portfolio of Trackwork Plans, Published Annually, Washington, DC

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

Annual Book of ASTM Standards

AMERICAN WOOD PROTECTION ASSOCIATION

American Wood Protection Association Standards, Published Annually, Birmingham, Alabama

ASSOCIATION OF AMERICAN RAILROADS

Signal Manual of Recommended Practice, Washington, DC

DEPARTMENT OF TRANSPORTATION-FEDERAL HIGHWAY ADMINISTRATION

Manual on Uniform Traffic Control Devices for Streets and Highways

Railroad-Highway Guide Crossing Handbook

TEXTBOOKS

Hay, William W. 1982. *Railroad Engineering*. John Wiley & Sons, New York, NY

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 1-200-01, *DoD Building Code*

UFC 3-201-01, *Civil Engineering*

UFC 3-250-11, *Soil Stabilization and Modification for Pavements*

UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

UFC 4-860-03, *Railroad Track Maintenance and Safety Standards*

US ARMY CORPS OF ENGINEERS OMAHA DISTRICT

Standard Details for Chain-Link Security Fences and Farm Style Fences

Standard Details for Railroad Construction, Sheets C-5.1 – C-5.24

UFC 4-860-03
13 FEBRUARY 2008

UNIFIED FACILITIES CRITERIA (UFC)

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U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	**Date**	**Location**

_____

This UFC supersedes the TM 5-628/AFR 91-44 dated 1 April 1991, Navy draft MO 103.9 dated 2001, and UFC 4-860-03FA Railroad Track Standards dated 16 January 2004.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

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UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Description of Changes: UFC 4-860-03 unifies the Army/Air Force Handbook of Railroad Track Standards with the Navy's Railroad Trackage Field Assessment Manual the into one Department of Defense UFC manual.

Reasons for Changes:

- Consolidation of DOD railroad track standards into one single document.

- Consolidation of both railroad track maintenance standards and safety standards into a singular technical manual.

Impact: Inspection frequencies remain unchanged and the quality of track required remains nearly the same. These factors reflect a negligible cost impact as a result of the required track maintenance activities. However, the following benefits should be realized:

- Improvement in installation personnel's ability to determine the level of effort required for each track inspection.

- DOD Inspections that will be more consistent with the Federal Railway Administration (FRA) safety standards used for commercial trackage.
- Proper and expanded use of new technology and materials, such as new types of ties that have gained industry acceptance.

- Improvement of railroad track inspections and overall railroad management due to the much greater use of table formats for clarity and understanding.

- Improved inspections since the UFC now differentiates between railroad maintenance requirements and the very minimal FRA safety standards.

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CHAPTER 1

INTENT AND APPLICATION

1-1. INTRODUCTION.

a. The Department of Defense's (DOD) railroad system is a critical asset for both peacetime and mobilization missions.

b. The standards in this UFC are presented to protect investments in track maintenance and rehabilitation and to ensure that DOD's railroad track is maintained at the level needed to support mission requirements. The standards in this UFC provide maintenance standards for each possible type of deficiency addressed in the Federal Railroad Administration (FRA) *Track Safety Standards*. DOD policy is to maintain its railroad track at a standard that exceeds FRA Class 2 safety standards and adhere to additional DOD speed restrictions as stated in this UFC. The following standards specifically identify separate thresholds for safety standards and maintenance standards. If a standard is not specifically listed as a safety standard, it shall be used as a maintenance standard. For Navy installations, NAVFAC Instruction (NAVFACINST) 11230.1, *Inspection, Certification, and Audit of Crane and Railroad Trackage*, shall also be used based on category of track and amount of use.

c. Simply meeting the minimum standard required in this UFC is not necessarily the best, most cost-effective, long-term maintenance policy. The frequent occurrence of substandard or restricted conditions indicates the need for a comprehensive track evaluation to determine if major repair or rehabilitation is warranted.

1-2. DEFINITIONS.

The following standards are discussed in this UFC:

a. ***Safety Standards.*** Based on the degree of hazard, these standards provide minimum safe operating limits for specific defects. FRA and DOD safety standards are addressed in Appendix F for comparison with maintenance standards. When established safety limits are exceeded, speed restrictions or “No Operation” shall be applied and enforced.

b. ***Maintenance Standards.*** These standards provide limits for specific defects and should be used to determine when maintenance is desirable and should be accomplished. This allows for maintenance or repair before the condition exceeding safety standards develops. Each installation shall develop a maintenance policy for additional defects not addressed in this UFC.

1-3. REFERENCES.

Appendix A contains a list of references used in this UFC.

1-4. INTENT.

a. These standards define the minimum required maintenance condition levels for railroad track. These standards shall be used for inspection and routine maintenance of railroad track by in-house or contract personnel.

b. These standards are not intended for, and shall not be used as specifications for, new construction or major track rehabilitation. The guidance given for Navy projects in UFC 4-860-02N, *Design: Trackage*, and for Army and Air Force projects in UFC 4-860-01FA, *Design: Railroad Design and Rehabilitation*, with Unified Facilities Guide Specification (UFGS) 05650, *Railroad Track and Accessories*, and/or host nation industry/government

standards will continue to apply to new construction and the complete reconstruction of segments of existing facilities.

c. Should the commercial carrier serving the installation require a more restrictive FRA standard or criteria not included in these standards, the installation track shall be maintained to meet the carrier's requirements.

d. The judgment of the designated track inspector and the criteria presented in this UFC must supplement each other in the application of these standards.

1-5. TRACK CATEGORIES. All railroad track shall be maintained in accordance with one of the following categories:

Category	Types of Track and Use	Minimum FRA Class of Track Safety Standard
A	All active mainline track, or other active track with speed greater than 10 mph	2
B	Active passing track, sidings, yard tracks, holding track, classification yard or storage track	2
C	Inactive track; no current mobilization requirements	0

1-6. APPLICATION.

a. ***Requirements versus Recommendations.*** In this UFC, the words “shall” and “is required” indicate requirements of the standards that must be met as prescribed by NAVFACINST 11230.1 for the Navy or AR 420-72 for the Army. Recommendations are indicated by the words “may,” “should,” and “it is recommended that….” These recommendations represent good maintenance practice. **DOD policy is to maintain the railroad track at full compliance with these maintenance standards and to restrict operations on any track below the safety standards.**

b. ***Condition Levels*.** These standards establish four levels of track condition. These condition levels indicate relative seriousness of defects, allow comparison of different types of defects, and provide a means for prioritizing repair work. The three track condition levels are as follows:

(1) *Full Compliance:* Track that meets all the requirements of the standards. Track at this level has, at most, only minor defects and should be fully capable of handling all train operations within the operating rules of the installation. Routine maintenance is required to maintain this condition level, and repair work will generally be only minor.

(2) *Restricted Operation:* Track has defects serious enough to make it unsuitable for operations greater than 10 mph, essentially “normal yard speed.” Based on the inspector’s judgment, track which has defects serious enough to make it unsuitable for operations at 10 mph may be reduced to 5 mph. Essentially, a train may be allowed to “crawl” over the track. This level is intended as a warning zone to indicate that the track is approaching a condition that will require removal from service.

(3) *No Operation:* Track has defects serious enough to require removal from service. At this level, the operation of trains over the track is generally considered hazardous. Operations shall not be allowed except as noted in paragraph 1-6.c.(5).

c. ***Operating Restrictions.***

(1) These standards establish minimum required condition levels and also identify track conditions requiring restriction or suspension of train operations. It is intended that a track inspector apply the required restriction or suspension immediately upon discovery of the substandard condition, and that the track be repaired to meet the appropriate condition level as soon as practical. A track restriction shall require the operational speed to be less than posted speed, but not more than 10 mph.

(2) *Notification of Track Restriction.*

(a) Army Track. The certified track inspector shall notify both the train operating personnel first and the director of public works (DPW) immediately upon the discovery of any condition that would warrant any restriction below normal operating practices. The DPW shall notify the installation transportation officer (ITO) verbally and in writing of any condition requiring train operations to be restricted or suspended.

(b) Air Force Track. The track inspector shall notify both the train operating personnel and the base civil engineer (BCE) immediately upon the discovery of any condition that would warrant any restriction below normal operating practices. The BCE shall notify the base traffic management officer (TMO) verbally and in writing of any condition requiring train operations to be restricted or suspended.

(c) Navy Track. The track inspector shall notify both the train operating personnel and the trackage certifying official immediately upon the discovery of any condition that would warrant a restriction beyond normal operating practices or a suspension in operations. Documentation and notification of restricted or non-certification of track shall be performed by the certifying official in accordance with NAVFACINST 11230.1.

(3) *Operations over Restricted Track.* For locations where operating restrictions have been imposed, the speed of the train or other on-track vehicles shall be reduced to the required level before the first wheel reaches the defective area and not increased until the last wheel has passed the defective area.

(4) *Removal of Track Restriction.* A track restriction may be removed after all defects resulting in the restriction have been repaired.

(a) Army Track. The certified track inspector shall notify the DPW upon completion of the repairs. The DPW shall notify the ITO in writing that the restrictions have been lifted.

(b) Air Force Track. The restriction shall not be considered removed until the TMO receives written notification of removal from the BCE.

(c) Navy Track. The trackage certifying official shall recertify the trackage repaired to the level allowed by repairs made. Certification and notification will be in accordance with NAVFACINST 11230.1.

(5) *Track Removed From Service.* Any portion of track where conditions fall below the minimum operable track condition (track condition is at the “No Operation” level) shall be closed to operations until repairs are completed. However, such track may be used under written permit from the track management authority and in the presence of a track inspector. During operations over the closed portion of track, the track inspector shall have visual contact with the train operator at all times and be prepared to signal the train crew to stop. For Navy track, movement of hazardous materials over track removed from service will be in accordance with NAVFACINST 11230.1.

d. Judgment of the track inspector shall govern. A track inspector shall have the authority to impose operating restrictions beyond the minimum required in these standards when conditions warrant.

e. Defective conditions or combinations of conditions may be found which are not directly addressed in these standards. In such cases, a track inspector shall exercise judgment in applying an appropriate operating restriction.

CHAPTER 2

INSPECTION OF TRACK AND RECORD KEEPING

2-1. TRACK INSPECTORS' QUALIFICATIONS. Track inspectors are responsible for conducting safety inspections (paragraph 2-3.c) and detailed track inspections (paragraph 2-3.).

a. ***Army.*** For Army track, the individual who completes the required track inspections shall be a certified track inspector as specified in AR 420-72.

b. ***Air Force.*** For Air Force track, the individual who completes the required track inspections shall be qualified to perform such inspections as designated by the BCE.

c. ***Navy.*** The individual who completes the required track inspections shall meet the requirements of NAVFACINST 11230.1 and be designated by the activity's certifying official.

2-2. RESPONSIBILITY OF THE TRACK INSPECTORS.

a. The designated track inspector is responsible for:

(1) Assuring that inspections are performed in accordance with this chapter and for Navy installations the additional requirements of NAVFACINST 11230.1.

(2) Examining the track to determine whether the track condition complies with the safety requirements and the maintenance standard requirements addressed in this UFC.

(3) Reporting any deficiencies from the full compliance condition level.

2-3. CATEGORIES OF INSPECTIONS.

a. ***Continuous Operator Inspection.*** Safety checks shall be conducted daily or before use. In addition, on-the-job observations shall be going on at all times when equipment is working. Railroad operations personnel shall be encouraged to observe and report track problems, deficiencies, obstructions and the "feel" of the track. Items to be aware of are broken rails and other rail defects, faulty switch point closure, indication of wide gage, poor alignment or surface (profile), loose crossing planks, wheel flanges hitting frog points and joint bars, working spikes and loose joints, rail pull-a-parts, evidence of imminent track buckling, blocked drainage, scour at bridges, and the threat of slides. All these things can contribute to train derailments and should be brought to the attention of the responsible person for correction.

b. ***Preventive Maintenance Inspection.*** Preventive maintenance is a continuous working inspection, examination of component parts, lubrication, adjustment, and minor repair. If not affecting the full compliance level, maintenance defects shall be corrected during the next maintenance cycle.

(1) *Navy Installations Only.* Further discussion of requirements and instructions on performing preventive maintenance are provided in NAVFACINST 11230.1.

c. ***Safety Inspection***. Safety inspection is that inspection of track performed in accordance with paragraphs 213.233, 213.235 and 213.239 of the FRA Track Safety Standards (see Appendix E) and this UFC. The purpose of this inspection is to identify defects that require restricted operations or no operations on the track being inspected.

(1) *Schedule.* As a minimum, track shall be inspected at the following interval:

Track Category	Traffic Frequency	Minimum Required Inspection Frequency
A	Mainline Track – Off-station Navy only*	Weekly
A & B	Two or more movements per week	Monthly
A & B	Greater than one movement per month but less than two movements per week	Quarterly
A & B	One movement or less per month	Semi-annual
C	No movements or inactive	Annual detailed inspection only (See Chapter 15)

***For Navy installation only**: Off-station track is defined as that track belonging to the Navy that extends outside the main station through residential and/or commercial public areas.

(2) *Inspection Method.* Track inspections shall be made on foot or in an on-track vehicle at a speed which is conducive to effective track inspection, but in no case to exceed 5 mph. Turnouts, rail crossings, and bridges shall be inspected on foot.

(3) *Inspection Records.* The inspector shall complete and sign the Track Inspection Record on the day the inspection is made. Inspection records must specify the track inspected, date of inspection, location and nature of any deviation from the requirements, proposed corrective action, and the remedial action taken. Inspection reports which document deficiencies resulting in a track falling below its designated condition level shall be kept on file until all deficiencies have been corrected. As a minimum, inspection records shall be retained for at least one year after the inspection covered by the report. An example record is provided in Figure B-1. A reproducible master of the Track Inspection Record is provided in NAVFACINST 11230.1 or in Appendix B as used in the RAILER software.

d. *Detailed Track Inspection.* A detailed inspection shall be made to support sustainment, restoration and maintenance (SRM). Detailed inspections are conducted annually. Detailed inspections will be supported by engineering evaluations when there is any doubt of physical condition. The Track Inspection Record discussed in paragraph 2-3.c.(3) should be used to document detailed inspections. The purpose of the detailed inspection is to identify all track defects including those exceeding maintenance standards provided in this UFC. Results of this inspection will not only be used to establish urgent repairs, but by using the inspection reports and relating them to the activity's basic trackage requirements, its in-house capabilities, priorities, available funding, and other factors, the annual and long-range trackage maintenance and repair programs are developed and programmed.

e. *Electric/Electromechanical Grade Crossing Signals.* The inspection and testing of electric/ electromechanical signals at road–railroad grade crossings shall be performed at the frequency specified in paragraph 10-6.b and documented in accordance with paragraph 10-6.c.

f. ***Internal Rail Defect Inspection.*** Internal rail defect inspection shall be performed on class A and B railroad tracks at five-year intervals as specified in paragraph 7-2.b.

g. ***Special Safety Inspections.***

(1) *Infrequently Used Track.* Track that has not been used for a period of six months or more shall be inspected prior to the first movement over the track.

(2) *Mass Rail Movement.* For track that has not been inspected within the last two months, a track inspection is recommended before any mass rail movement (15 cars or more).

(3) *Unusual Occurrences.* Track inspections shall be conducted following unusual occurrences such as derailment, accident, flood, fire, earthquake, severe storm, or other occurrence that could have an adverse effect on the track structure. These inspections shall be conducted before the first movement over the track following the unusual occurrence.

2-4. INSPECTION OF PARTIALLY VISIBLE TRACK.

a. At locations where vegetation, dirt, debris, or other undesirable materials cover the ties and/or rail preventing effective track inspection, the undesirable material shall be removed and a thorough track inspection performed. Train operation shall not exceed 10 mph until the undesirable materials are removed and a thorough track safety inspection is performed.

b. At locations where ballast or other material is installed to meet operational requirements, sufficient material shall be removed to spot-check trackage.

c. ***Paved Areas.***

(1) In road crossings and other paved areas where complete inspection of the track is not possible, the track inspector must be alert for external signs of track deterioration. External signs indicating track deterioration are:

(a) Changes in gage and/or crosslevel.

(b) Settlement of the rails (changes in track profile).

(c) Excessive vertical or lateral movement of the rails as a train passes.

(d) Deterioration (cracking or breaking up) of the pavement in the vicinity of the track.

(2) Based on indication of defects with consideration taken for age and usage, activities shall establish a program to spot-check trackage encased in pavement.

(3) *Operating Restrictions for Track in Pavement.* When external signs of track deterioration develop, particular attention should be given to the track geometry measurements through the paved area. Track geometry measurements—combined with visual indications of lateral and vertical movement and the requirements for road crossing flangeways—shall be used to assign operating restrictions for the track through the paved area.

2-5. TRACK MAPS AND TRACK SCHEMATICS.

Track maps are essential in identifying and locating the components of the track network. Installations shall maintain a complete, accurate, and up-to-date set of track maps for use by maintenance and engineering personnel.

a. ***Track Charts.*** As described in the documents below, track charts may be used to supplement track maps.

(1) Army/Air Force: TM 5-627/AFM 91-33, *Maintenance of Trackage*.

(2) Navy: MO-103, *Maintenance of Trackage*, and NAVFACINST 11230.1.

b*. Criteria:*

(1) *Scale.* Track maps should be drawn to a legible scale. The scale should be shown on each page of the map.

(2) *Title.* Track maps should contain a standard title block.

(3) *Legend.* Track maps should contain a legend identifying all symbols used on the track map.

c. *Track Data.* Data presented on track maps should include:

(1) All track, active and inactive.

(2) Track name or identification for each track.

(3) Track category for each track.

(4) Buildings, loading docks, bridges, trestles, culverts, and other structures on or adjacent to the railroad roadway.

(5) Highway and road crossings.

(6) Connections to serving railroads.

(7) Limits of track ownership and maintenance responsibilities.

(8) Installation property lines and railroad right-of-way lines.

(9) Rail weight and section.

(10) Turnout identification number and weight and section.

(11) Degree of curvature for all curves.

(12) Grades and profile information.

(13) Track stationing or mileposts.

d. *Track Schematics.* Non-scaled, condensed track plans describing layout of tracks and turnouts. They are useful in track inspection reporting and record keeping.

CHAPTER 3

ROADWAY

3-1. ROADWAY.

a. ***Inspection.*** The roadway shall be inspected for the following defects:

(1) Ballast/subgrade pumping.

(2) Erosion of embankments and cut slopes.

(3) Embankment sliding or slippage.

(4) Potential slope stability problems.

(5) Settlement at approaches to bridges and road crossings.

(6) Washouts under and adjacent to the track.

If any of these defects are present, remedial action is required within a time frame necessary to prevent damage to the track structure.

b. ***Hazardous Conditions.*** Any condition presenting a hazard to the safe movement of trains shall be corrected before the first movement over that location.

3-2. DRAINAGE.

a. ***General.***

(1) A well-drained roadbed is essential to good track maintenance.

(2) Any attempts to divert water onto the roadway or to obstruct ditches or drainage structures shall be reported immediately to the trackage certifying official.

(3) Drains, ditches, and other open drainage structures shall be protected to prevent hazard to personnel.

b. ***Size and Design.*** Ditches and other drainage structures (culverts, drains, and drop inlets) shall be of sufficient size and construction to handle the expected flow of water.

c. ***Obstructions.*** Ditches and drainage structures shall be maintained to allow the free passage of water. At locations where flow is obstructed or otherwise inadequate, remedial action is required. During construction operations adjacent to the track structure, all ditches and other drainage structures shall be kept unobstructed.

d. ***Inspection.***

(1) Inspection and cleaning of drainage structures and channels shall be performed at least annually, preferably in the fall in anticipation of spring runoffs.

(2) Inspections of ditches and other drainage structures during and after heavy rains are recommended to assure that these structures are adequate to carry the runoff.

(3) Drainage ditches and structures shall be inspected for the presence of:

(a) Brush.

(b) Drift.

(c) Excessive ice and snow.

(d) Other obstructions that may interfere with the flow of water.

If any of these are present, immediate remedial action is required to prevent damage to the roadway and track structure.

(4) Particular attention shall be given to drainage conditions at turnouts, rail crossings, road crossings, bridge ends, and all locations where conditions may restrict adequate drainage.

(5) For obstructed or partially collapsed drainage structures, a safety standard shall be implemented to restrict speeds.

3-3. VEGETATION.

a. Vegetation shall be controlled so that it does not:

(1) Grow within the ballast section or obstruct ballast drainage.

(2) Interfere with adequate visibility (sight distance) at grade crossings.

(3) Obstruct visibility of location markers, switch position indicators, signs, or signals.

(4) Obstruct drainage.

(5) Interfere with the safe operation of trains.

(6) Prevent proper track inspection.

(7) Present a fire hazard to timber structures.

(8) Interfere with personnel walking within 8 feet of the track centerline.

(9) Brush the sides of engine or rolling stock.

b. ***Vegetation Interference.*** At locations where vegetation interferes with the effective inspection of the track or train operations, train operations shall be restricted until the vegetation is removed and a thorough track inspection is performed.

c. ***Vegetation Control.*** Undesirable vegetation growing within the roadway shall be removed by chemical or manual means. Chemical vegetation control shall be accomplished as prescribed in the following manuals:

(1) Army: AR 200-5, *Pest Management Program*, and TM 5-630, *Natural Resources Land Management*.

(2) Air Force: AFI 32-1053, *Pest Management Program*.

(3) Navy: OPNAVINST 6250.4, *Pest Management Program*.

d. ***Desirable Vegetation.*** Vegetation such as crown vetch may be planted and grown on the slopes of cuts and fills and in other locations within the roadway to prevent erosion. The growth of desirable vegetation should be controlled to meet the requirements of paragraph 3-3.a.

CHAPTER 4

BALLAST

4-1. GENERAL. Ballast is a select material placed on the subgrade to:

a. Provide adequate drainage of the track.

b. Restrain the track laterally, longitudinally, and vertically under the dynamic loads imposed by trains and the thermal stresses induced in the rails by changing temperature.

c. Distribute the load of the track and trains to prevent overstressing the subgrade.

4-2. SELECTION CRITERIA.

a. Considerations for selecting materials to be used as ballast include:

(1) Size and gradation.
(2) Shape (angularity).
(3) Weight.
(4) Strength.
(5) Durability.
(6) Cleanliness (no dirt or fines).
(7) Economics.

b. New ballast materials used in the maintenance of track shall meet the requirements specified in the AREMA *Manual For Railway Engineering*, Chapter 1, Part 2.

4-3. MAINTENANCE.

a. The ballast section should be clean, free-draining, and free of vegetation, soil (mud), and other foreign materials.

b. During major maintenance or track rehabilitation, dirty or fouled crushed stone or slag ballast meeting the requirements of paragraph 4-2.b may be cleaned/screened or reconditioned and reused.

c. Ballast materials shall provide a full crib and uniform shoulders, but shall not be allowed to cover or be at a level above the top of the ties. At turnouts, ballast shall not interfere with moveable parts of switches and sufficient clearance shall be maintained around switch rods and connecting rods. See paragraph 8-3.g, “Pocketing Switches.”

CHAPTER 5

TIES

5-1. GENERAL. The functions of a tie are to:

a. Maintain gage.

b. Maintain surface (profile).

c. Maintain alignment.

d. Distribute the load from the rail to the ballast and subgrade.

The inability of a tie to adequately perform any of the above functions constitutes a defective tie.

5-2. WOOD TIES.

a. *Tie Selection, Treatment and Inspection.*

(1) *Tie Selection.* New ties selected for the maintenance of track shall be adequately seasoned and treated and meet the requirements specified in the AREMA *Manual For Railway Engineering*, Chapter 30, Part 1, for 6-inch grade and the preferred 7-inch grade ties. The preferred species for ties are the following hardwoods: red oak, white oak, beech, ash, and hickory ties. Gum ties can also be used if local experience reflects satisfactory service. Where softwoods are used, the southern pine and Douglas fir species are preferred. Southern pine is not recommended for main line track or areas with high humidity. Beech and ash ties can also be used if local experience reflects satisfactory experience.

(2) Treatment. Ties shall be pressure-treated in accordance with the most current version of the American Wood Preserver's Association (AWPA) Standard C6. See UFGS 05650 for tie treatment recommendations.

(3) *Inspection.* It is recommended that all timber ties be inspected by an independent, qualified, professional inspector. Inspections should take place at producing plants where the ties can be inspected in the white (before treatment) and after treatment. Accepted ties are to be branded (stamped) by the inspector responsible for the acceptance.

(4) *Switch Ties & Turnout Ties.* It is recommended that switch ties be mixed oak hardwood.

b. *Installation.* Ties shall be installed perpendicular to the rails and properly tamped and spiked. Ties shall be installed with the top of the tie (or the tie plate) in full contact with the base of the rail and the bottom of the tie near the rail seat in full contact with the ballast.

c. *Identification of Defective Wood Ties.* A wood tie is defective if it is:

(1) Broken through.

(2) Split or otherwise impaired to the extent that it will not hold spikes or other rail fasteners.

(3) So deteriorated that the tie plate can move laterally more than 0.5 inch relative to the crosstie.

(4) Cut by the tie plate more than 2 inches.

(5) Cut by wheel flanges, dragging equipment, fire, etc., to a depth of more than 2 inches within 12 inches of the base of the rail, frog, or load-bearing area.

(6) Rotted, hollow, or generally deteriorated to a point where a substantial amount of the material is decayed or missing.

(7) Ties that are “end-broken.” End-broken ties often can be broken beneath the base plate and the defect is not noticeable except for a small rise in the end of the tie, from a plane of the center portion.
These defects are shown in Figure 5-1.

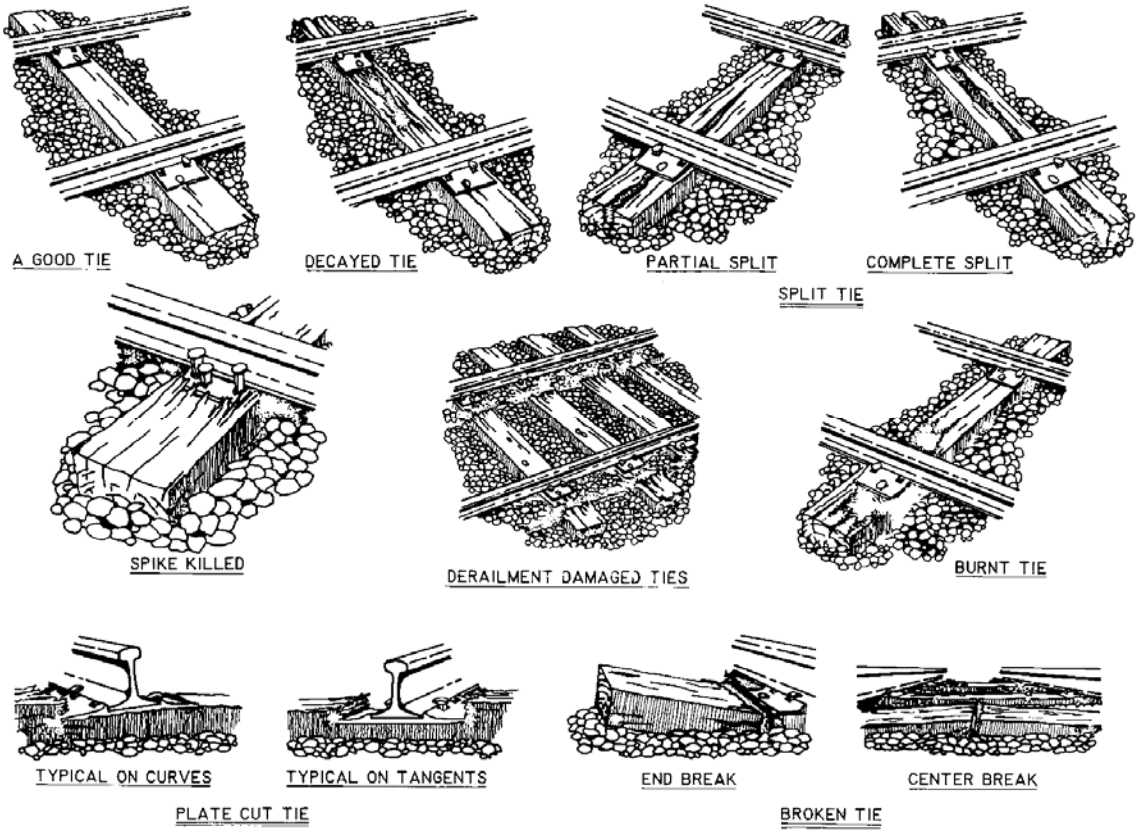


Figure 5-1. Examples of Good and Defective Ties

5-3. CONCRETE TIES.

a. ***Tie Selection.*** New concrete ties selected for the maintenance of track shall meet the requirements specified in AREMA *Manual for Railway Engineering*, Chapter 30, Part 4. Mixing wood and concrete ties in the same track section is not recommended. Concrete ties are very susceptible to impact, leading to premature failure when used in jointed track and require a more substantial ballast section.

b. ***Switch Ties.*** At this time, few concrete switch ties are being manufactured due to weight and difficulty in handling; hardwood switch ties are recommended.

c. ***Installation.*** Ties shall be installed perpendicular to the rails and properly tamped and fastened. Ties shall be installed with the top of the tie in full contact with the base of the rail and the bottom of the tie near the rail seat in full contact with the ballast.

d. ***Identification of Defective Concrete Ties.*** A concrete tie is defective if:

(1) Tie is broken across under one or both rail seats.

(2) Tie is broken across in the center and showing signs of further deterioration, loss of tension in pre-stressing wires, exposure of wires, crumbling, etc.

(3) Tie is broken longitudinally, resulting in loss of ability to hold one or both cast-shoulders in place.

(4) Both cast-shoulders in one rail are loose. (One loose shoulder per rail is not sufficient cause for removal unless it is causing some distress to adjacent ties.)

(5) Tie is damaged by derailment or dragging equipment which, in the opinion of the track inspector, should be replaced. It should be noted that quite serious damage can be done to the tie ends without seriously affecting the performance of the tie.

5-4. PLASTIC TIES

a. ***Tie Selection.*** Various plastic ties have been tested and proven to provide adequate support and low maintenance. Plastic ties shall have textured sides to provide stability. See UFGS 05650 for material requirements. Plastic ties can be cost-effective in areas of high decay. The weight of plastic is similar to wood and mixing wood and plastic ties in the same track section is permissible.

b. ***Installation.*** Ties shall be installed perpendicular to the rails and properly tamped and fastened. Ties shall be installed with the top of the tie in full contact with the base of the rail and the bottom of the tie near the rail seat in full contact with the ballast. Plastic ties can be installed with either cut or screw spikes, with screw spikes recommended.

c. ***Identification of Defective Plastic Ties.*** Plastic ties shall be treated as wood ties for determining defective ties. See paragraph 5-2.c.

5-5. STEEL TIES AND COMPOSITE TIES.

a. Advances in steel tie technology have proven successful and practical and should be considered as a possible alternative in replacing wood ties.

b. One type of composite tie is a hardwood tie treated with borates to prevent decay and rot from fungus, insects, and termites, then encapsulated in a tough plastic covering. Another composite tie is one which includes high-density polyethylene, rubber, and fiberglass with certain proprietary inert filler materials. Yet another composite tie is produced with fiberglass blown foam and molded into various tie sizes and lengths.

5-6. GENERAL.

a. ***Improper Tie Support (Down or Hanging Ties).*** Ties that do not support both rails are considered defective. If these ties are not materially defective, they shall be ballasted, tamped up, and respiked/refastened to fully support the rails.

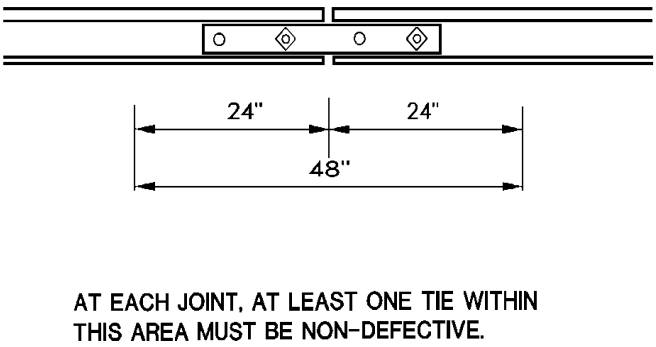


Figure 5-2. Required Tie Support at Joints (Safety Standard)

b. ***Missing Fasteners***. Ties that are installed, but not spiked with a sufficient number of spikes in accordance with paragraph 6-3.c., are considered defective. If these ties are not materially defective, necessary spikes shall be added.

c. ***Tie Requirements***.

(1) Track shall have a minimum number of non-defective ties per 39-foot rail length in combination with a maximum number of consecutive defective ties as specified below:

	Minimum Number of Non-Defective Ties per 39 Feet	
	Tangent & Curves Less Than 2°	**Curves Equal to or Greater Than 2°**
Maintenance		
Category A	12	13
Category B	10	11
Safety		
Restricted	8	10
No Operation	7	9

	Number of Consecutive Defective Ties	
	Tangent and Curves Less Than 2°	**Curves Equal to or Greater Than 2°**
Maintenance	3	2
Safety		
Restricted	4	3
No Operation	5	4

(2) *Joint Ties.* All joints shall be supported by the number of non-defective ties specified below. The centerline of these joint ties shall be within 24 inches of the rail ends as shown in Figure 5-2. Safety standard: Any track without a non-defective tie within 24 inches of the rail ends shall be "No Operations."

	Minimum Number of Non-Defective Ties per Joint
Maintenance	
Category A	2
Category B	1
Safety	
No Operation	0

d. ***Tie Spacing***. The center-to-center distance between adjacent ties usually ranges from 19 to 22 inches. The recommended tie spacing for new track is given below:

Track Category	Tie Spacing (Inches)	Number of Ties per 39-ft Rail
A	19.5	24
B	21	22

Army Criteria: For all track with an average tie spacing greater than 22 inches (less than 22 ties per 39-foot rail), the desired spacing should be established during the next maintenance or rehabilitation cycle.

Navy & Air Force Criteria: The maintenance standards shall require a maximum average center-to-center tie spacing of 24 inches within the distance of a rail length. For track having average tie spacing greater than 24 inches, the desired spacing should be established during the next major maintenance or rehabilitation cycle.

e. ***Missing Ties***. The maintenance standard requires all missing ties to be replaced. The safety standards consider a missing tie a defective tie and any location where the center-to-center tie spacing measured along either rail exceeds 48 inches to be "Restricted Operations," unless at a joint, which will be "No Operations."

f. ***Skewed Ties***. A skewed tie is a tie that is not perpendicular to the rails by more than the tie width. Slightly skewed or individual skewed ties are not serious. A section of track with skewed ties indicates a problem area (possible tight gage) that should be investigated (see Chapter 12, "Track Geometry"). Maintenance standards require that where localized areas have three or more ties skewed greater than 8 inches, the cause of the skewing shall be corrected and the ties straightened.

CHAPTER 6

OTHER TRACK MATERIALS (OTM), TIE PLATES, ANCHORS, RAIL FASTENINGS, ETC.

6-1. GENERAL MAINTENANCE STANDARD

a. All OTM shall be the proper size and type (sections) as specified in Chapters 4 and 5 of the AREMA *Manual For Railway Engineering* and the following:

(1) *Army*: UFC 4-860-01FA and TM 5-627.

(2) *Air Force*: UFC 4-860-01FA and AFM 91-33.

(3) *Navy*: UFC 4-860-02N, Appendix A, Section 5, and MO-103.

b. OTM shall not be flame cut or otherwise altered.

c. OTM that are of improper type, broken, or otherwise defective shall be replaced with the proper size (weight) and type (sections) material.

6-2. TIE PLATES.

a. ***Use.*** Tie plates distribute the applied loads from the rail to the tie as well as assist in keeping the rail in position. Their use is especially important on curves where they provide additional lateral restraint.

b. ***Type.*** Tie plates may be of either the single shoulder type (Figure 6-1) or the double shoulder type (Figure 6-2). Plates may be canted or flat. Canted plates are preferred, particularly in curves; however, canted and flat plates cannot be mixed together.

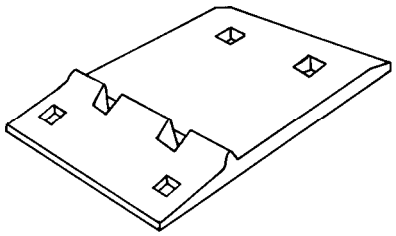


Figure 6-1. Single Shoulder Tie Plate

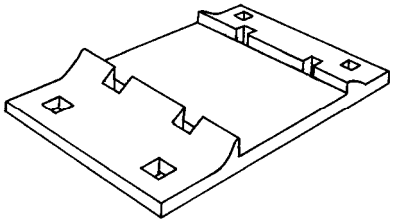


Figure 6-2. Double Shoulder Tie Plate

c. ***Installation.*** For track without tie plates, plates shall be installed on replacement ties during tie renewals or installed during rail replacement.

d. ***Shifted Plates***. Where the shoulder of a tie plate has become lodged beneath the base of the rail, the spikes shall be pulled, the spike holes plugged, the tie plate properly reset, and the rail respiked.

6-3. SPIKES.

a. The rail shall have a sufficient number of fasteners (spikes) to effectively maintain gage and provide sufficient rail restraint. Spikes provide primarily lateral support for the rail.

b. Spikes shall be:

(1) Of proper size for the tie plates used.

(2) Driven vertically and square with the rail.

(3) Either of the cut or screw type.

(4) Driven with approximately 0.125 inch of space remaining between the head of the spike and the base of the rail.

c. ***Spiking Pattern.***

(1) On tangent track and curves of 4 degrees or less, spikes shall be installed as shown in Figure 6-3.

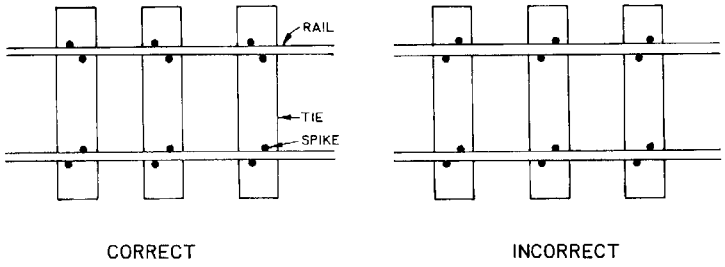
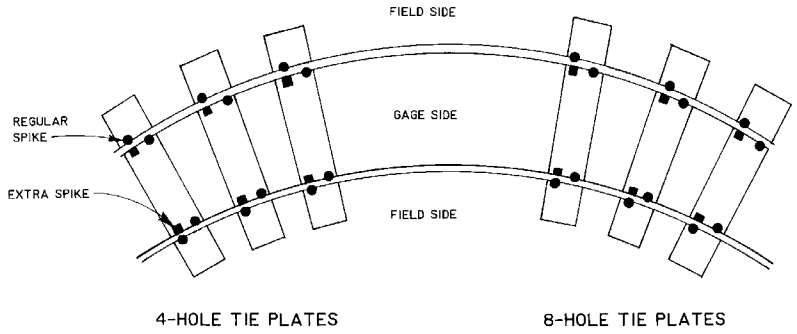


Figure 6-3. Spiking Pattern for Tangents and Curves of 4 Degrees or Less

(2) On curves greater than 4 degrees but less than 36 degrees and on the curved side of turnouts, the use of an additional spike per tie plate as shown in Figure 6-4 is recommended. However, it is acceptable to have the third spike on the field side of the rail. A maximum 12-degree curve is recommended for typical railroad applications.



Note: Extra spike can be on the field side and is preferred by the Army.

Figure 6-4. Spiking Pattern for Curves Greater than 4 Degrees but Less than 36 Degrees

(3) On curves of 36 degrees and greater the use of two additional spikes per tie plate as shown in Figure 6-5 is recommended.

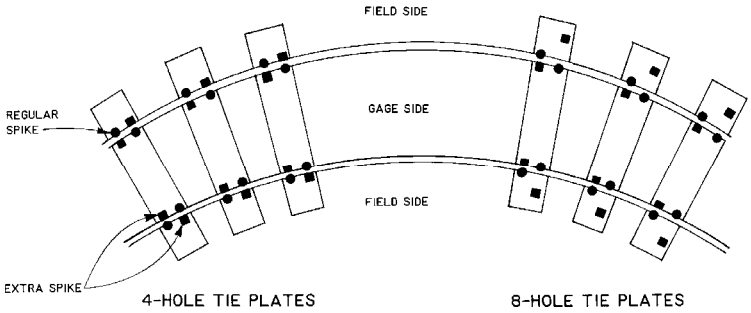


Figure 6-5. Spiking Pattern for Curves 36 Degrees and Greater

(4) Spikes shall not be installed through the slots in skirted-type slotted joint bars (angle bars) as shown in Figure 6-6. Correct spiking is shown in Figure 6-7.

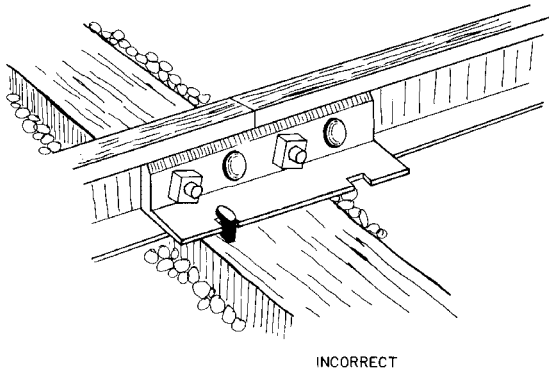


Figure 6-6. Incorrect Spiking of Angle Bars

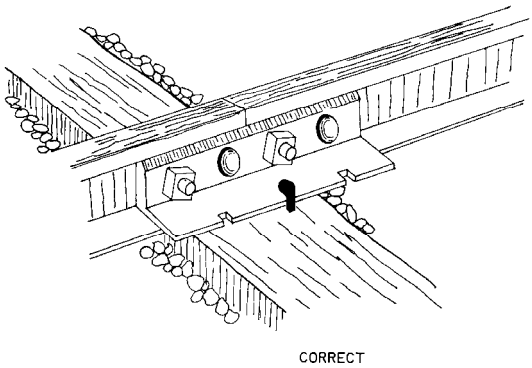


Figure 6-7. Correct Spiking of Angle Bars

(5) Correction of incorrect spiking patterns. An incorrect spiking pattern by itself is not a cause for removing and redriving spikes. However, an incorrect spiking pattern shall be corrected when other maintenance requires the spikes to be removed. Old spike holes shall be plugged to prevent accelerated tie deterioration.

d. ***Missing and Loose Spikes.*** Maintenance standards require missing spikes to be replaced. Old spike holes shall be plugged with a treated tie plug before replacing the

spikes. Loose spikes shall be removed, the holes plugged, and the spikes redriven. Gage shall be checked at these locations. Safety standards permit the track to be restricted at the track inspector's discretion.

e. ***Spikes Beneath Rail Base.*** Maintenance standards require where the head of a spike has become lodged beneath the base of a rail, the spike shall be removed immediately, the hole in the tie plugged, and the spike properly redriven. A spike lodged beneath the rail base is an undesirable condition that can lead to a broken rail base.

f. ***Other Hold-Down Devices.*** Maintenance standards require any defective hold-down device to be replaced. Safety standards permit the track to be restricted at the track inspector's discretion.

6-4. JOINTS.

a. ***Joint Bars.*** Rails shall be joined with proper factory-designed and -constructed joint bars. Joint bars shall not be altered with a flame in any manner, including the bolt holes. Maintenance standards require joint bars not meeting these requirements to be replaced. Safety standards require the track to be restricted until repairs are completed.

b. ***Compromise Joints.*** Rails of different weight and/or section shall be joined with proper factory-designed and -forged compromise bars, taper rails, or offset thermite welds. Safety standards require track to be restricted until all non-factory items are replaced.

c. ***Cracked or Broken Joint Bars.*** Maintenance standards require cracked or broken joint bars to be replaced. Safety standards require:

(1) Track to be "No Operation" when one or both joint bars are cracked or broken between the center bolt holes.

(2) Operations shall not be permitted over any location where both joint bars are broken, or where worn or loose joint bars allow vertical movement of either rail with respect to the other.

d. ***Bolts.*** Maintenance standards require each joint to be bolted with at least two bolts in each rail tightened to approximately 400 foot-pounds of torque which develops between 25,000 and 30,000 pounds of tension in the bolts.

(1) All bolts shall be of proper size and tightly in place. Proper bolt installation is shown in Figure 6-8.

(2) Bolts shall be installed with AREMA spring washers. Nuts shall be installed against the spring washer as shown in Figure 6-8. At least one full bolt thread shall extend past the outside of the nut.

(3) Bolts shall be installed so the nuts will run alternately on the inside and outside of the rail as shown in Figure 6-9.

(4) Whenever bolts and joint bars are removed, the rail in the joint area and the contact surfaces of the joint bar shall be cleaned (wire brushed) and lubrication applied to the joint bar and the bolt threads. New joint bars and bolts shall be lubricated before installation.

(5) Safety standards require a restriction if all bolts are loose or if there is only one bolt through a rail. No operations are permitted over locations where all bolts in one rail are missing or ineffective.

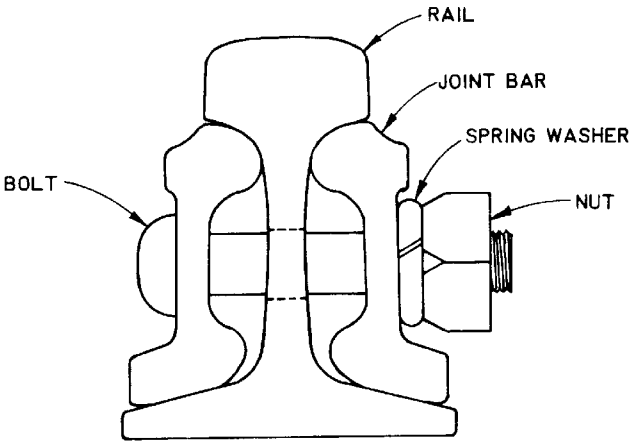


Figure 6-8. Proper Bolt Installation

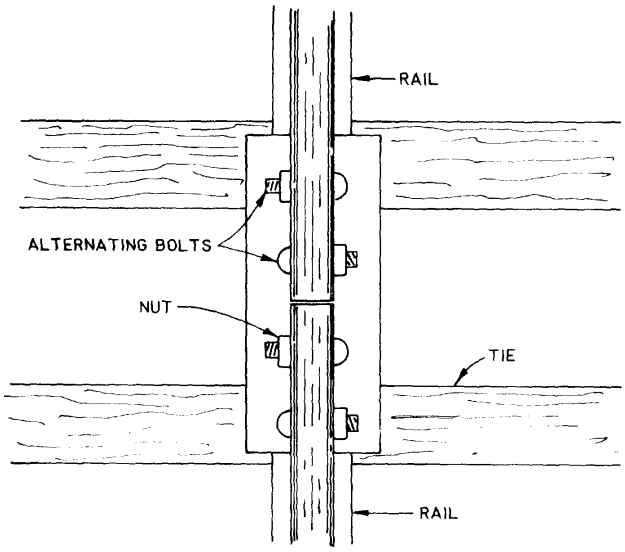


Figure 6-9. Alternating Bolt Pattern

e. ***Loose and Missing Bolts.***

(1) Maintenance standards require loose bolts to be tightened (approximately 400 foot-pounds) during the next maintenance activity. Bolts that cannot be tightened shall be replaced.

(2) Maintenance standards require that missing bolts be replaced.

f. ***Rail End Mismatch.*** Rail end mismatch on the tread portion or the gage side shall not exceed the following:

Rail End Mismatch (Inch*)*

	Tread	Gage Side
Maintenance	GT 0.125	GT 0.125
Safety		
Restriction	N/A	GT 0.1875
No Operation	GT 0.25	GT 0.25

g. ***Joint Gap.*** Standard rail gaps in properly drilled new rails and punched joint bars produce a rail gap of 0.125 to 0.25 inch. As the bolts, bars and rails wear, a gap of 0.5 to 0.625 inch may develop in some rail joints with track usage. Greater gaps indicate a potential problem. Rail joint gap shall not exceed the following:

	Joint Gap (Inch)
Maintenance	GT 0.75
Safety	
Restriction	GT 1.25
No Operation	GT 2

h. ***Joints in Restricted Areas***. It is recommended that the joint be thermite-welded whenever a joint is installed within 20 feet of a road crossing, the outer perimeter of any structure, or any location that restricts access to the joint.

i. ***Shims***. All shims shall be removed from joints. See UFGS 05650 for proper joint gap determination when replacing rails. Failure to compensate for the temperature could result in buckled track or pull-apart.

6-5. RAIL ANCHORS (MAINTENANCE STANDARD).

a. Rail anchors are designed to fit tight on the base of the rail. It is, therefore, extremely important to know the weight and section of the rail when ordering the anchors. Rail anchors help prevent the longitudinal movement of rails commonly known as “running” or “creeping.” Rail anchors should be used at locations where the track is subject to serious longitudinal movement from thermal stresses (rail expansion) or traffic conditions.

b. ***Rules for Anchor Application.*** General rules on the use of rail anchors are:

(1) Anchors shall be applied to the gage side of the rail base against the same tie face on opposite rails.

(2) Anchors shall grip the base of the rail firmly and have full bearing against the face of the tie.

(3) When the bearing of the rail anchor against the tie has been disturbed by removal of the tie, the anchor shall be removed and reapplied to the new tie.

(4) Anchors shall not be moved by driving them along the rail.

(5) Skewed ties shall be straightened before applying rail anchors.

c. Rail anchors not meeting requirements of 6-5.a and 6-5.b should be removed and reapplied.

d. ***Anchor Locations.***

(1) Where used, a minimum of eight anchors (four in each direction [boxed]) per 39-foot rail (or 16 anchors per 80-foot rail) is recommended as shown in Figure 6-10. Steep grades increase the importance of anchors and may justify more than the minimum number shown in Figure 6-10. If additional anchors are required, it is recommended to box-anchor approximately every third tie.

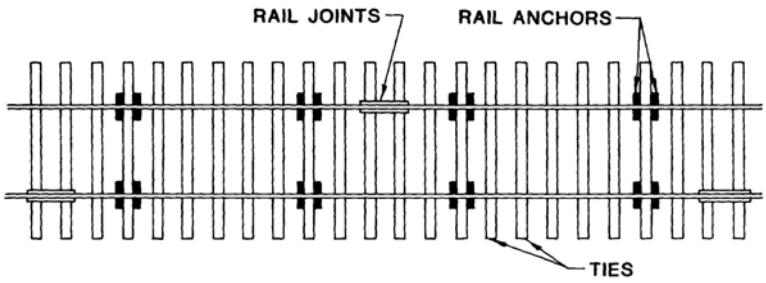


Figure 6-10. Recommended Minimum Anchoring Pattern for 39-foot Rails.

(2) *At Open Deck Bridges.* Where anchors are used on track approaching open deck bridges, every third tie should be box-anchored (four anchors per tie) for at least two rail lengths off each end of the bridge. No anchors shall be applied on the bridge itself.

(3) *At Rail Crossings.* Where anchors are used on track approaching rail crossings, every third tie should be box anchored (four anchors per tie) for at least two rail lengths in all directions from the crossing.

(4) *Turnouts*. Anchoring in turnouts is optional and can be used to correct geometry problems. Where used, every other tie (that can be anchored) should be anchored.

6-6. GAGE RODS.

a. ***Use.*** Gage rods are not required but are sometimes needed to help maintain proper track gage. However, they are **not** a substitute for good track maintenance and good tie conditions. Gage rods are sometimes used at the following locations:

(1) On sharp curves where there is difficulty holding the gage.

(2) In turnouts just ahead of the switch points and on the curved closure rail.

b. ***Spacing***. Where gage rods are used in sharp curves, two to four rods should be installed next to the joint on the outside rail and at evenly spaced intervals along the rail length.

c. ***Application.*** Gage rods should be installed at right angles to the rail with the jaws firmly gripping the base of the rail.

d. ***Maintenance.***

(1) Gage rods shall be kept tight while maintaining the proper track gage; ensure gage is not affected by over-tightening of gage rods.

(2) Bent or broken gage rods shall be replaced where track conditions warrant their continued use.

(3) Gage rods shall not be tightened if spikes are holding the rail from moving. It may be necessary to pull the spikes, plug the tie, tighten the rods to gage, then respike.

CHAPTER 7

RAIL

7-1. DEFECTIVE RAIL AND REMEDIAL ACTIONS.

a. Standards for rail defects are presented in Table 7-1. Remedial actions for rail defects are presented in Table 7-2. Where rail defects have been identified but remedial action has not been completed, the operating restrictions presented in Table 7-1 shall apply. Appendix C provides a glossary of common rail terms and brief descriptions of the common rail defects that may be observed in track.

b. ***Multiple Defects.*** Any individual rail having two or more of the transverse fissure or fracture type defects listed in Table 7-1, whether they are the same or different, shall be removed and replaced in lieu of other remedial actions.

c. ***Worn Rails.*** On rail suspected of being worn more than the allowances provided for in Table 7-1, wear measurements shall be taken at the center and at each end of the rail not more than 1 foot from the end of the joint bar. Rail wear measurements shall consist of a vertical head wear measurement and a horizontal side wear measurement as shown in Figure 7-1. Appendix D presents a table of details and properties for various rail sections and may be used to assist in identifying rail weight and sections for estimating the amount of rail wear.

Table 7-1. Rail Defect Standards

	Maintenance Standard		*Safety Standard*	
	Maximum Defect Category for Track Category		*Restricted (10mph) Operation*	*Close to Traffic*
Defect Type	*A*	*B*		
Bolt hole crack	RI	0.75”	GT 1.5”	BO
Bolt Hole – torch cut (3)	RI	RI	RI	*
Broken base	RI	RI	*	GT 6”
Corrosion (rail base)	0.25”	0.25”	*	*
Complete break	RI	RI	RI	RI
Crushed (flattened) head	RI	RI	GT 0.375”	BO
End Batter	0.25”	0.25”	GT 0.375”	GT 0.5”
Defective weld (1)	20%	20%	GT 20%	GT 40%
Fissure-compound (1)	RI	RI	GT 20%	GT 40%
Fissure-Transverse (1)	RI	RI	GT 20%	GT 40%
Fissure-detail (1)	RI	RI	GT 20%	GT 40%
Fracture-engine burn (1)	RI	RI	GT 20%	GT 40%
Head/web separation	RI	2”	GT 4”	BO (2)
Piped rail	RI	2”	GT 4”	BO (2)
Horizontal split head	RI	2”	GT 4”	BO (2)
Vertical split head	RI	2”	GT 4”	BO (2)
Split web	RI	2”	GT 4”	BO (2)
Flow on gage face	0.1875”	1/4”	GT 0.3125”	*
Running surface damage	0.25”	1/4”	GT 0.375”	GT 0.5”
Short rail	13’	13’	*	*
Torch cut rail	RI	RI	*	*
Wear - up to 90 lb rail				
Horizontal side wear	0.375”	0.375”	GT 0.5”	*

Table 7-1. Rail Defect Standards

Vertical head wear	0.375”	0.375”	GT 0.375”	*
Wear - 100 lb to 119 lb rail				
Horizontal side wear	0.5”	0.5”	GT 0.625”	*
Vertical head	0.375”	0.375”	GT 0.375”	*
Wear - rail above 119 lb				
Horizontal side wear	0.625”	0.625”	GT 0.75”	*
Vertical head wear	0.5”	0.5”	GT 0.5”	*

Notes:

1. Defect testing normally reports these defects as small (S), medium (M), or large (L). General relationship to size is:
   Small: 10–20% of head area.
   Medium: 21–40% of head area.
   Large: 41+% of head area.
Need to request inspector performing ultrasonic rail inspection to provide estimated percent of rail head affected by defect.

2. Rails having longitudinal defects accumulating to 3 feet or more in any 10 feet of rail shall be closed to traffic.

3. Include bolt holes anywhere in the rail.

4. Abbreviations:
   RI = Repair Immediately
   BO = Break Out in railhead
   GT = Greater Than
   LT = Less Than
   N/A = Not Applicable

* The activity shall evaluate the severity of each such defect and shall classify the degree of hazard based on engineering judgment and experience.

Table 7-2. Remedial Action for Rail Defect

Defect Type	Remedial Actions		
	Replace Entire Defective Rail	Crop Defect [2, 3]	Apply Joint Bars (Fully Bolted)
Bolt hole crack	Allowed	Allowed	---
Broken base	Allowed	Allowed	Not Allowed
Corrosion (rail base)	REQUIRED	Not Allowed	Not Allowed
Complete break - clean and square	Preferred	---	Allowed [3]
Complete break - rough or angled	Preferred	Allowed	Not Allowed [4]
Crushed head	Preferred	Allowed	Not Allowed [4]
Defective weld	---	Allowed	Preferred
End Batter	Allowed	Allowed	---
Fissure-compound [5]	Preferred	Allowed	Allowed [3]
Fissure-transverse [5]	Preferred	Allowed	Allowed [3]
Fracture-engine burn [5]	Preferred	Allowed	Allowed
Head/web separation	REQUIRED	Not Allowed	Not Allowed
Piped rail	REQUIRED	Not Allowed	Not Allowed
Running surface damage	Allowed	Allowed	Not Allowed
Short rail	REQUIRED	---	---
Horizontal split head	REQUIRED	Not Allowed	Not Allowed
Vertical split head	REQUIRED	Not Allowed	Not Allowed
Split web	REQUIRED	Not Allowed	Not Allowed
Torch cut rail ends	Allowed	Allowed	Not Allowed
			Not Allowed
Torch cut bolt hole	Allowed	Allowed	
Wear	REQUIRED [6]	---	---
Flow on gage face	Preferred	Allowed	---

Notes:

1. If two or more of these defects are found in any individual rail, that rail shall be replaced.

2. Rails may be cropped by cutting the rail with a rail saw or other appropriate cutting tool at least 6

Table 7-2. Remedial Action for Rail Defect

inches either side of the defect. 3. Not allowed if results in a rail length of less than 13 feet (see "Short Rail" below). 4. May be allowed as an emergency measure until defect is removed, provided train operations are speed-restricted. 5. If broken through or cracked out, rules for rough or angled complete break apply. 6. Rail with wear on only one side may be transposed if the horizontal wear does not exceed 0.375 inch. 7. Short lengths of flow may be ground off.

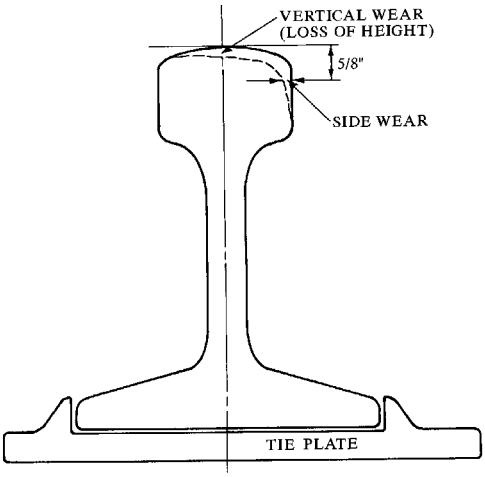


Figure 7-1. Rail Wear Measurement

d. ***Base Corrosion.*** Rail shall be removed from track if the base is corroded such that more than 0.25 inch play is allowed in the rail as shown in Figure 7-2.

e. ***End Batter.*** Rail end batter is measured 0.5 inch from the rail end with an 18-inch straightedge laid only on the rail being measured as shown in Figure 7-3. Table 7-2 presents remedial actions for end batter.

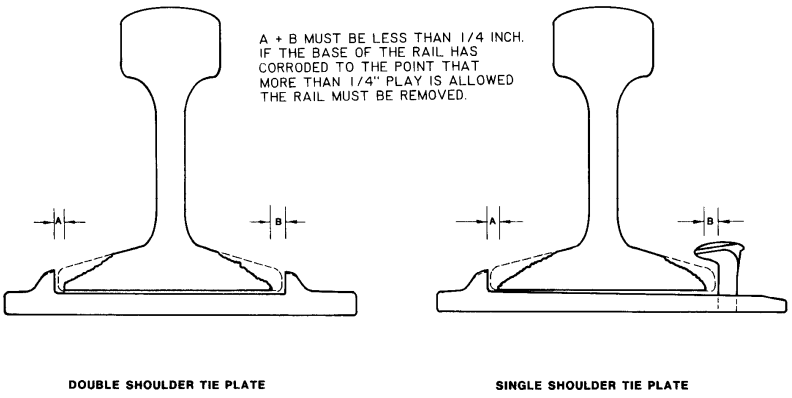


Figure 7-2. Rail Base Corrosion Measurement

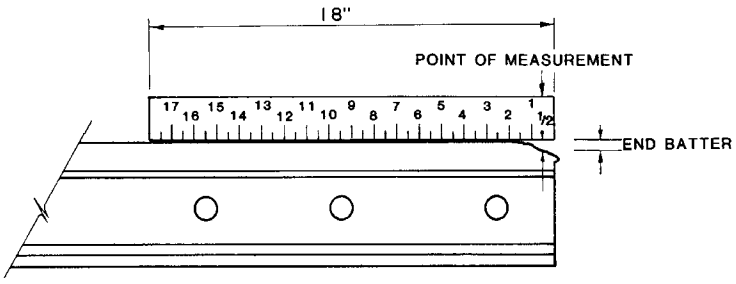


Figure 7-3. End Batter Measurement

f. ***Running Surface Damage.*** Rail running surface damage (e.g., deep engine burns, dents, equipment gouges) is measured at the midpoint of an 18-inch straightedge laid on the railhead over the defect.

7-2. RAIL MAINTENANCE.

a. ***Rail.*** New rail used in the maintenance of track shall meet the requirements specified in the AREMA *Manual For Railway Engineering*, Chapter 4.

b. ***Internal Defect Inspection.*** A "continuous search" internal rail defect inspection shall be performed on all active track. This internal rail defect inspection should be conducted using ultrasonic inspection techniques at a maximum of five-year intervals.

c. ***Torch Cut.*** Rail shall not be flame cut in any manner. This includes cropping the rail end, burning bolt holes, and trimming mismatched ends. Rail shall be cut using a mechanical or abrasive rail saw or other appropriate cutting tool.

d. ***Short Rail.*** Rail less than 13 feet in length shall not be installed in track.

7-3. LIGHTWEIGHT RAIL. Lightweight rail is defined as rail weighing less than 90 pounds/yard. Research has shown that lightweight rail may not be suitable for use in track subjected to heavy wheel loads.

a. Rail weights of 70 pounds/yard or less should be replaced if that rail will experience carloads of more than 50 tons (25,000-pound axle loads.)

b. Rail weighing 75 to 85 pounds/yard may be adequate depending upon tie and ballast support conditions. A structural evaluation and stress analysis is necessary to determine the adequacy of these rail weights. Rail not adequate to support the desired wheel loads should be replaced.

c. The replacement of any lightweight rail in Categories A and B track should be considered when planning major repair and/or rehabilitation projects.

CHAPTER 8

TURNOUTS

8-1. GENERAL. Turnouts are designed to divert trains from one track to another. Good turnout maintenance is essential for the safe and efficient operation of trains. Major components of a turnout are the switch, frog, and guardrails. Figure 8-1 shows a typical split switch turnout with the various parts identified. Tongue and mate switches used in paved areas are also commonly found in Navy trackage.

8-2. GENERAL REQUIREMENTS.

a. ***Materials***. All materials used within the limits of a turnout shall:

(1) Be factory-designed and -constructed.

(2) Be the proper weight and section.

(3) Be properly installed.

(4) Not be flame-cut or otherwise altered.

b. ***Rail.*** All rail used within the limits of a turnout shall be of the same weight and section. Compromise joints are not permitted within the limits of a turnout and shall be removed in the next maintenance cycle.

c. ***Ties.*** The standards in Chapter 5 of this UFC shall apply to ties within the limits of a turnout. Interlaced cross ties are not permitted and shall be removed in the next maintenance cycle.

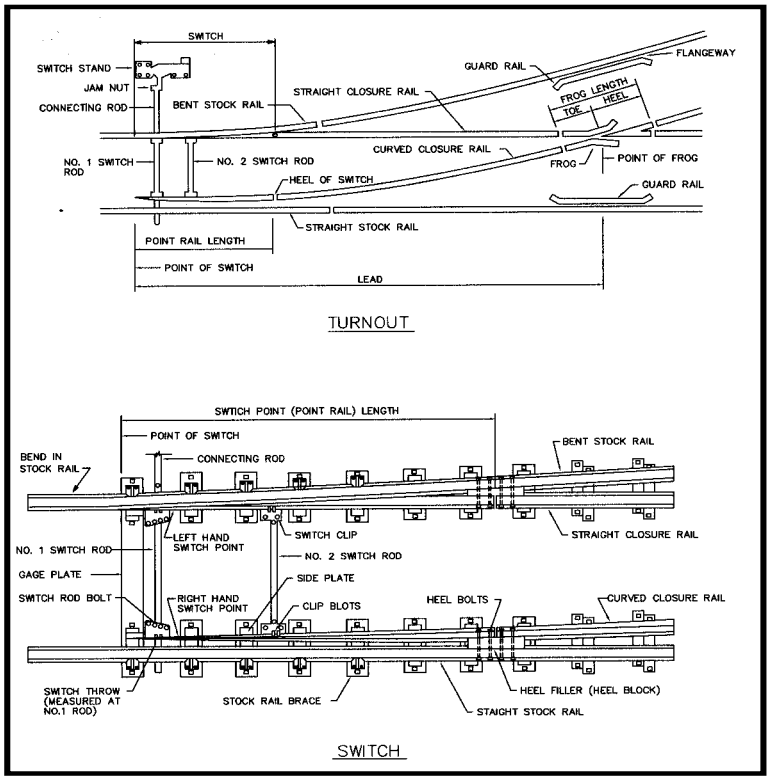


Figure 8-1. Parts of a Turnout

d. ***Track Geometry.*** The track inspector shall rate turnout track geometry as "Full Compliance," "Maintenance Required," "Restricted" or "No Operation" to conform to the standards in Chapter 12 and this chapter.

e. ***Reversing Tangent.*** It is recommended that the tangent between the frog and any reverse curve past the frog be no less than 50 feet in length as shown in Figure 8-2.

f. ***Switch Stand Placement.***

(1) The switch stand shall be installed so that when the switch is lined for the normal (main) route, the connecting rod keeps the points closed with a pulling (rather than a pushing) force. In most cases this will mean installing the stand on the diverging side of the turnout as shown in Figure 8-2.

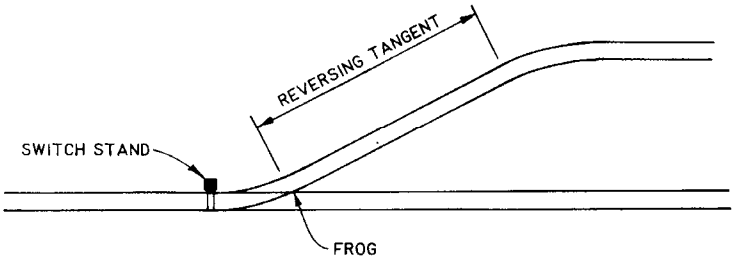


Figure 8-2. Reversing Tangent Length and Switch Stand Placement

(2) When a ground-throw stand is used, the handle shall point toward the frog when the switch is lined for the normal (main) route.

g. ***Cleaning, Lubrication, and Adjustment***. As scheduled, but at least annually, switches and switch stands shall be cleaned, lubricated, and adjusted. For Navy installations see NAVFACINST 11230.1 for additional guidance.

h. ***Plates.*** The proper type and size of tie plates shall be used. Double shoulder plates are preferred.

8-3. SWITCHES AND SWITCH STANDS.

a. Switches shall be inspected for the following defects:

(1) Switch difficult to operate.

(2) Gap between the switch point and the stock rail. Check with points in both positions. (See paragraph 8-3.b.)

(3) Worn or chipped switch points. (See paragraph 8-3.c.)

(4) Point of switch higher than stock rail. (See paragraph 8-3.c.)

(5) Point rail beyond taper lower than stock rail. (See paragraph 8-3.c.)

(6) Damaged or missing switch stand lever latches or switch point lock. (See paragraph 8-3.d)

(7) Loose, damaged, or improperly installed switch stand. (See paragraph 8-3.f and 8-3.g.)

(8) Loose, damaged, or missing jam nut at the end of the connecting rod. (See paragraph 8-3.h.)

(9) Bent, damaged, loose, binding, or improperly installed connecting rod, switch rods, or switch clips. (See paragraph 8-3.h.)

(10) Loose, damaged, or missing switch clip, switch rod, or connecting rod bolts. (See paragraph 8-3.h.)

(11) Loose, damaged, or missing heel bolts; cracked or improper heel joint bars or heel filler. (See paragraph 8-3.i.)

(12) Loose, damaged, or missing rail braces. (See paragraph 8-3.j.)

(13) Loose, damaged, or missing slide plates; dirt and debris buildup on slide plates.

(14) Missing cotter keys on switch rod and switch clip bolts. (See paragraph 8-3.i.)

(15) Debris in flangeways. (See paragraph 8-3.l.)

(16) Debris obstructing switch rods and connecting rod. (See paragraph 8-3.h.)

(17) Loose, damaged or missing point rail stops.

b. ***Switch Point Gap.*** Maintenance standards require an adjustment if the switch can be thrown and locked in either direction with a 0.25-inch spacer between the switch point and the stock rail or if the gap is greater than zero. Safety standards require restricted track at over 0.25-inch up to 0.375-inch gap and no operations if gap is over 0.375 inch.

c. ***Switch Points.***

(1) If the switch point is chipped, broken, or worn more than 0.5 inch down and 6 inches back from the point, maintenance standards require the switch point to be restored or replaced. (See Figure 8-3.)

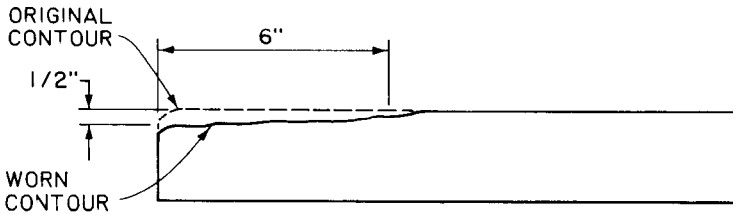


Figure 8-3. Switch Point Contour

(2) If switch point is worn or damaged beyond these limits or the top surface of the switch point is higher than the stock rail, safety standards require operation through the turnout to be restricted.

(3) If the point rail beyond the taper is lower than the top of the stock rail, no operations shall be permitted. Metal flow shall be removed by grinding to ensure proper closure. Figure 8-4 shows the proper elevation of the switch point and point rail with respect to the stock rail.

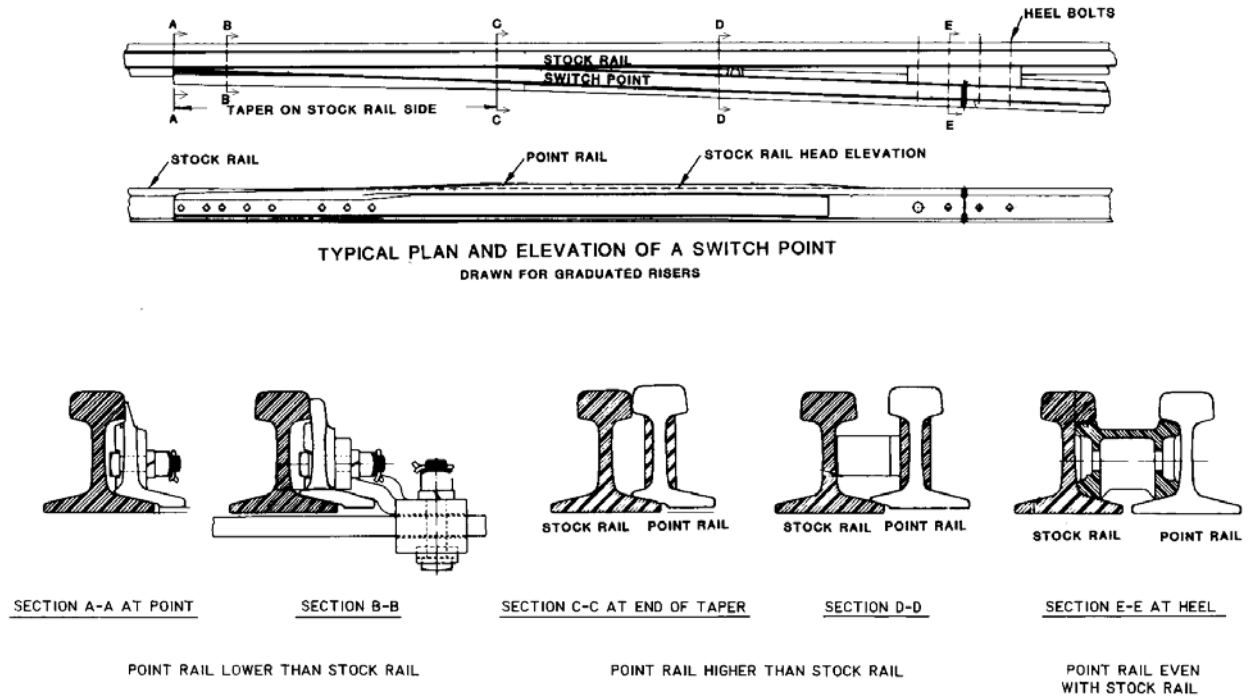


Figure 8-4. Switch Point Plan and Elevation.

d. ***Switch Stand Lever Latches and Point Locks.*** Safety standards require turnouts with latches that are missing, damaged, insecure, or otherwise inoperative, to be "No Operation."

e. ***Switch Stand.*** Maintenance standards require the switch stands to be fully secured to the head block ties to prevent any unintentional movement of the switch points. Where operations through the switch result in visible lateral movement of the switch stand or opening of the switch points (point gap), safety standards require "No Operation."

f. ***Connecting Rod, Switch Rods, and Switch Clips.***

(1) Maintenance standards require that these parts shall be installed and maintained to allow unobstructed motion when the switch is thrown. Rods and clips shall not contact adjacent ties. Damaged parts shall be replaced and improperly installed parts shall be adjusted. Washers or similar spacers shall not be permitted between the switch clip and the switch point. The jam nut at the adjustable end of the connecting rod shall be kept tight against the clevis.

(2) Safety standard is "No Operation" if the connecting rod, switch rod, or switch clip is insecurely fastened or is damaged. Where washers or similar spacers do not have full contact surface areas between the clip and switch point, operations through the turnout shall be restricted. Spacers, if needed, shall be constructed of steel plate with the dimension of the back of the switch clip and thickness, as required.

g. ***Pocketing Switches***. Ballast shall not be allowed at a level that will interfere with the smooth operation of the switch.

(1) The ballast level in cribs beneath the connecting rod, switch point rails, and switch rods should be at least 2 inches below any steel. In regions where the snow and ice accumulate or frost heave is a problem, at least 4 inches of clearance should be provided. This should be checked and performed in the fall.

(2) For switches where this clearance is not provided, the cribs shall be pocketed to provide adequate clearance.

h. ***Connecting Rod Bolts, Switch Rod Bolts, and Clip Bolts.*** Maintenance standards require that connecting rod and switch rod bolts shall be installed with the nut on top and cotter keys in place. Clip bolts shall have cotter keys. If bolts are not tight, safety standards require restricted operation.

i. ***Switch Heel (Bolts, Fillers, and Joint Bars).***

(1) *Maintenance Standards.* The heel of the switch shall be secure and the supporting switch ties solidly tamped. Where there are no existing heel blocks (filler), hook plates shall be used to secure the heel of the switch. The inside joint bar (nearest the track center) should be a bent bar per AREMA design. Remember, this assembly is a hinge allowing the switch rail to pivot in the joint assembly.

(2) Safety standards require restricted operation if any heel bolts are loose or missing, or the heel is otherwise not fully secure.

j. ***Rail Braces.***

(1) *Maintenance Standards.* Rail braces are essential to provide proper lateral support to the stock rails. Rail braces shall be fully secured to the tie and tight against the outside of the stock rail on both sides of the turnout. Rail braces should be installed in accordance with the appropriate plans for a given length point rail found in the AREMA *Portfolio of Track Plans*. It is recommended that non-adjustable rail braces be installed on each switch tie from the point of switch to within two ties of the switch heel. Adjustable rail braces should be installed per the AREMA *Portfolio of Track Plans*.

(2) Safety standards require restricted operation through the turnout if there are less than four rail braces properly secured to the tie and tight against the outside of each stock rail while switch is thrown.

k. ***Point Rail Stops***. Safety standards require track with bent or missing point stops to be "Restricted Operations."

l. ***Debris in Flangeways.*** Flangeways shall be kept clear of debris. Any obstructions, including ice and packed snow, shall be removed.

8-4. FROGS.

a. ***Frog Point.***

(1) Maintenance standards require frogs to be restored if the point is chipped, broken, or worn more than 0.5 inch below the original top surface and 6 inches back from the original point location. (See Figure 8-5)

(2) Safety standards require the track to be restricted for frog points with wear greater than 0.625 inch.

b. ***Frog Tread Surface.***

(1) Maintenance standards require a frog to be restored when the tread surface is worn more than 0.3125 inch below its original contour. Frogs that cannot be rebuilt and restored to a "like new" condition shall be replaced.

(2) Safety standards require the track to be restricted if the frog tread surface is worn greater than 0.375 inch below its original contour. (See Figure 8-5)

(3) If welding repairs are made on the frog, the tread portion of the frog will be restored before restoring the point.

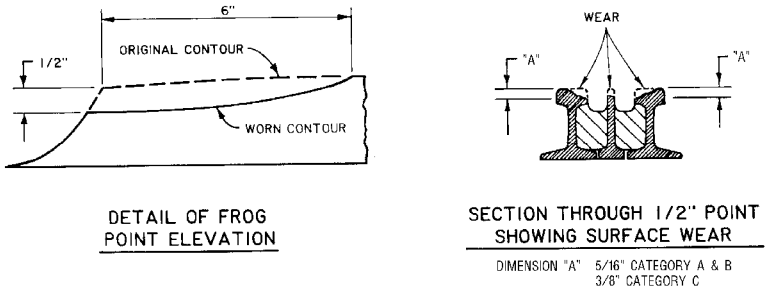


Figure 8-5. Frog Point and Tread Contours

c. ***Guarding Face of Self-Guarded Frogs.***

(1) *Maintenance Standards.* The raised guarding face on a self-guarded frog shall not be worn more than 0.3125 inch. (See Figure 8-6)

(2) Safety standards require the track to be "No Operation" if the raised guarding face on a self-guarded frog is more than 0.375 inch.

d. ***Repairing Self-Guarded Frogs.*** If repairs are made to a self-guarded frog without removing it from service, the raised guarding face and tread portion must be restored before rebuilding the point.

e. ***Frog Bolts***. All frog bolts shall be in place and tight.

f. ***Frog Flangeway Width.*** Standard frog flangeway width is 1.875 inches. Standards for frog flangeway width are presented in Table 8-1. (See Figure 8-7)

g. ***Flangeway Depth.*** Standard frog flangeway depth is 1.875 inches. Standards for frog flangeway depth are presented in Table 8-1. (See Figure 8-7)

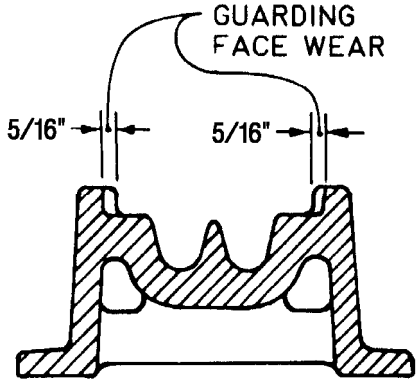


Figure 8-6. Allowable Wear on Guarding Face of Self-Guarded Frog

8-5. GUARD RAILS.

a. Guard rails shall be in place, properly positioned, and fully secured with guard rail plates placed with the shoulder against the guard rail. All guardrail bolts shall be in place and tight.

b. Guard rails shall be installed so the straight guarding face (the portion of the guard rail parallel with the running rail) extends in advance of the frog point a distance at least equal to the values given in Table 8-2.

c. ***Guard Check Gage.*** Standard guard check gage is 54.625 inches. Standards for guard check gage are presented in Table 8-1. (See Figure 8-7) After the measurements are taken and appear satisfactory, if visual observations indicate that the frog point is being hit by the wheel flanges, a careful inspection must be made to determine the cause of the problem. Something may be loose. Remember, these are static measurements that are being taken.

d. ***Guard Face Gage***. Standard guard face gage is 52.75 inches. Standards for guard face gage are presented in Table 8-1. (See Figure 8-7)

e. ***Guardrail Flangeway Width.***

(1) Standard guardrail flangeway width is 1.875 inches. Standards for guardrail flangeway width are presented in Table 8-1. (See Figure 8-7)

(2) Excessive wear on a guardrail is often indicated by a wide guardrail flangeway measurement or by tight guard check gage. Typically, guardrail flangeway widths of 2.125 inches or greater indicate that maintenance or replacement of the guardrail may be needed.

8-6. GAGE MEASUREMENT.

See Chapter 12 for gage measurements.

Table 8-1. Measurements and Operating Restrictions for Frogs and Guard Rails

	Measurement			
	Maintenance Standards		Safety Standard Operating Restrictions	
Parameter	*(New or Fully Restored)*	*Minimum*	*Restriction*	*No Operations*
Frog Flangeways				
Width	1-7/8 in. (1.875 in.)	1-5/8 in (1.625 in.)	LT 1-5/8 in. (1.625 in.)	LT 1-1/2 in. (1.50 in.)
Depth	GE 1-7/8 in. (1.875 in.)	LT 1-5/8 in. (1.625 in.)	LT 1-1/2 in. (1.50 in.)	LT 1-3/8 in. (1.375 in.)
Guard Check Gage	54-5/8 in. (54.625 in.)	LT 54-3/8 in. (54.375 in.)	LT 54-1/4 in. (54.25 in.)	LT 54-1/8 in. (54.125 in.)
Guard Face Gage	52-3/4 in. (52.75 in.)	GT 53 in. (53.00 in.)	GT 53-1/8 in. (53.125 in.)	GT 53-1/4 in. (53.25 in.)
Guard Rail Flangeway:				
Width	1-7/8 in. (1.875 in.)	1-5/8 in. (1.625 in.)	LT 1-5/8 in. (1.625 in.)	LT 1-1/2 in. (1.50 in.)

Note: GE = greater than or equal to, LT = less than, GT = greater than

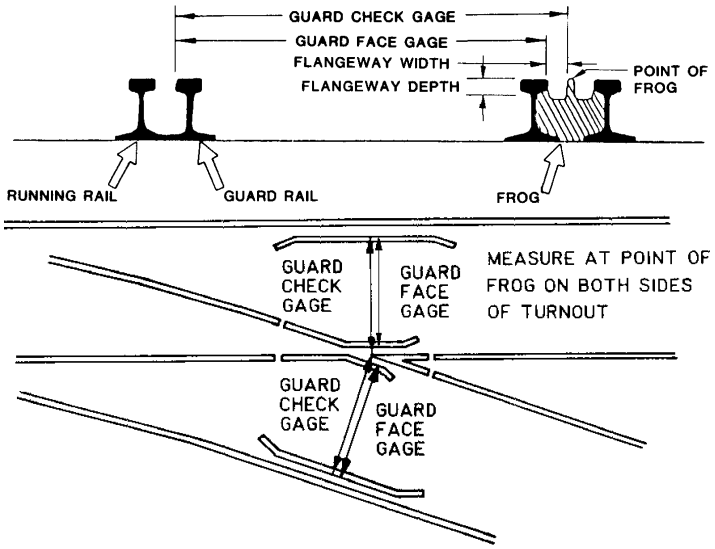


Figure 8-7. Measurement of Flangeway Width, Flangeway Depth, Guard Check Gage, and Guard Face Gage

Table 8-2. Minimum Length of Straight Guarding Face in Advance of Frog Point

Frog Number	Length (Inches)
4, 5, 6, 7, 8, 9, 10	14
11, 12, 14	18
15, 16	26
18, 20	30

CHAPTER 9

RAIL CROSSINGS

9-1. GENERAL. Rail crossings are designed to carry one track across another at grade. Drainage is vital in protecting the subgrade from increased impacts.

9-2. MAINTENANCE REQUIREMENTS.

a. *Size.* Rail crossings shall be the proper weight and section for the rails being joined.

b. *Flangeway Width and Depth*. Standards for rail crossing flangeways are identical to the frog flangeway standards given in Table 8-1 and shall be used.

c. *Debris in Flangeways.* Flangeways shall be kept clear of debris. Any obstructions, including ice and packed snow, shall be removed.

d. *Bolts.* All crossing bolts shall be in place and tight. Loose bolts shall be tightened and bolts that cannot be tightened shall be replaced. Missing bolts shall be replaced.

e. *Special Components.* All broken or damaged components shall be replaced or repaired.

9-3. ANCHORS. Where rail anchors are used on track approaching rail crossings, every third tie should be box-anchored (four anchors per tie) for at least two rail lengths in all directions from the crossing.

CHAPTER 10

ROAD CROSSINGS

10-1. DRAINAGE.

a. Adequate drainage is essential for satisfactory long-term performance of the track and roadway crossing.

b. Water shall not be allowed to pond on or near the track at a road crossing.

c. Catch-basins, gutters, ditches, sub-drains, and culverts should be properly installed and kept free of debris.

10-2. FLANGEWAYS.

a. ***Flangeway Width.*** Maintenance standards require the flangeway width in a road crossing to be no less than 2.5 inches nor greater than 3 inches. Safety standards require "Restricted Operation" for formed flangeway widths less than 1.75 inches.

b. ***Flangeway Depth.*** Maintenance standards require the flangeway depth in a road crossing to be no less than 2 inches. Safety standards require "Restricted Operation" for flangeway depth less than 1.5 inches.

c. ***Debris.*** Flangeways shall be kept clear of debris. Any obstructions, including ice and packed snow, shall be removed immediately.

10-3. TRACK.

a. ***Ties, Tie Plates, and Spikes.*** When crossings are rebuilt, all ties within the crossing limits and for at least 20 feet beyond each end of the crossing shall be replaced, fully tie plated, and spiked with eight rail-holding spikes on each tie (see Figure 10-1). For crossings, the use of hardwood ties is recommended.

b. ***Joints***. Bolted rail joints are not desirable in road crossings. When crossings are rebuilt, it is highly recommended that all joints within the crossing and up to 20 feet outside the crossing be welded.

c. ***Rail Anchors.*** Where the track on either side of the crossing is anchored, it is recommended that the anchoring pattern be continued through the crossing, provided that the crossing panels can accommodate anchors.

10-4. CROSSING SURFACES AND MATERIALS.

a. It is essential that the crossing surface be maintained to provide a smooth crossing for vehicles and to prevent vehicle tires from striking the rails. The crossing surface shall be maintained at an elevation level with the top of the rails. Additionally, there shall be a smooth transition between the crossing surface and the adjoining pavement.

b. During routine track inspections the inspector should take note of the general condition of the crossing materials and report any damage or condition requiring repair or replacement. Any condition observed in a road crossing which would cause a hazard to motor vehicles using the crossing should be corrected immediately.

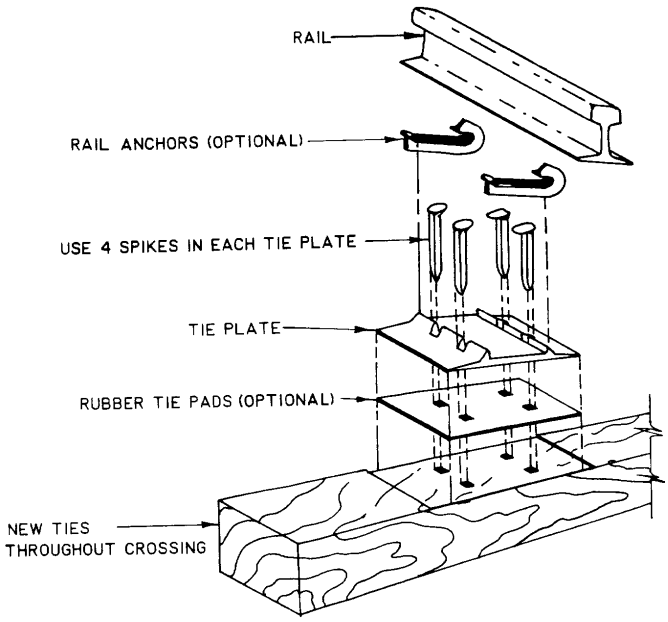


Figure 10-1. Track Construction for Road Crossing

10-5. GRADE CROSSING PROTECTION—SIGNS AND SIGNALS. During routine track inspections, the inspector should observe the condition of all whistle posts, highway warning signs and crossbucks, and signals. Signs and signals should be easily legible and clearly visible to the highway user. Signs and signals shall conform to the requirements of the Federal Highway Administration (FHA) *Manual on Uniform Traffic Control Devices* (MUTCD), Part 8, "Traffic Controls for Highway–Rail Grade Crossings." Additional guidance may be obtained from the FHA *Railroad–Highway Grade Crossing Handbook*.

10-6. ELECTRIC/ELECTROMECHANICAL GRADE CROSSING SIGNALS. Inspection and maintenance of electric and/or electromechanical signals should conform to manufacturer's recommendations, state/local requirements, and the FRA Part 234 "Grade Crossing Signal System Safety." Paragraph 10-6.a and b summarizes the minimum requirements of the FRA standards. The inspections and tests described are performed to determine if the warning system and its component parts are maintained in a condition to perform their intended function. Any electromagnetic device, relay or other electromagnetic device that fails to meet the requirements of the tests shall be removed from service until corrected. All reference to "system" in the remainder of this section shall refer to the grade crossing signal system. The inspector shall meet the qualifications of FRA Part 212.231. Signals shall be inspected once each month.

a. *Maintenance Standards.*

(1) *Location of Plans.* Plans required for proper maintenance and testing shall be kept at each system location (equipment cabinet). Plans shall be legible and correct.

(2) All control circuits shall operate on a fail-safe principle.

(3) Operating characteristics of electromagnetic, electronic, or electrical apparatus shall be maintained in accordance with the limits within which the system is designed to operate.

(4) When any essential component fails to perform its intended function, the cause shall be determined and the faulty component adjusted, repaired, or replaced

immediately. Until repair is completed, comply with appropriate action to flag vehicular traffic in accordance with activity/installation regulations or, for the Navy, paragraph 3.3.f of NAVFAC P-301, *Navy Railway Operating Handbook*.

(5) During testing or performing work on signals or track structure, which affects the integrity of the warning system, alternative methods must be provided to maintain safety for the highway user. Immediately after repairs, adjustments, or replacements have been completed, an appropriate test of the affected equipment must be made to verify that the system is operating as intended.

(6) Highway-rail grade crossing warning system apparatus shall be secured against unauthorized entry (i.e., locked equipment cabinet).

(7) Each circuit that affects the proper functioning of a grade crossing warning system shall be kept free of any ground or combination of grounds that will permit a current flow of 75 percent of more of the release value of any relay or electromagnetic device in the circuit.

(8) A standby source of power shall be provided with sufficient capacity to operate a warning system for a reasonable length of time during a period of primary power interruption. The designated capacity shall be specified on the plans (Paragraph 10-6.a.(1)). Batteries shall be checked as follows:

(a) Keep battery terminals, vent caps and cell casings clean. Keep terminals lightly coated with no-oxide grease.

(b) Keep electrolyte at the correct level in each cell.

(c) Check the charging rate and adjust as necessary.

(d) Measure and record the voltage of each cell.

(9) Flashing light units shall*:*

(a) Be properly positioned and aligned and shall be visible to a highway user approaching the crossing.

(b) Be maintained to prevent dust and moisture from entering the interior of the unit. Roundels and reflectors shall be clean and in good condition.

(c) Flash alternately. The number of flashes per minute for each light unit shall be 35 minimum and 65 maximum.

(10) Each gate arm light shall be maintained in such condition as to be properly visible to approaching highway users. Gates shall be cleaned and lubricated as necessary. Lights and light wire shall be secured to the gate arm.

(11) The voltage at each lamp shall be maintained at no less than 85 percent of the prescribed rating for the lamp.

(12) Each gate arm, when in the downward position, shall extend across each lane of approaching highway traffic and shall be clearly viewable by approaching highway users. Each gate arm shall start its downward motion not less than three seconds after flashing lights begin to operate and shall be in a horizontal position at least five seconds before the train arrives at the crossing.

(13) System must activate at least 20 seconds prior to rail traffic occupying a grade crossing.

(14) Train detection apparatus shall be maintained to detect a train or railcar in any part of a train detection circuit. If the presence of sand, rust, dirt, grease, or other foreign matter is known to prevent effective shunting, flagging of the crossing shall be accomplished.

(15) Each train detection circuit shall detect the application of a shunt of 0.06-ohm resistance when the shunt is connected across the rails of any part of the circuit.

(16) Each set of fouling wires in a train detection circuit shall consist of two discrete conductors, each maintained in such condition to ensure proper operation of detection apparatus when the circuit is shunted.

(17) Each non-insulated rail joint located within the limits of a train detection circuit shall be bonded by means other than joint bars and the bonds shall be maintained in such condition to ensure electrical conductivity.

(18) Each insulated rail joint shall be maintained to prevent current flowing between rails separated by the insulation in an amount sufficient to cause failure of the detection circuit.

(19) A switch, when equipped with a switch circuit controller connected to the point and interconnected with warning system circuitry, shall be maintained so that the warning system can only be cut out when the switch point is within 0.5 inch of full reverse position.

(20) Each wire shall be tagged or otherwise marked so that it can be identified at each terminal. Tags and other marks shall be made of insulating material and so arranged that tags and wires do not interfere with moving parts of the apparatus.

(21) Insulated wire shall be protected from mechanical injury. The insulation shall not be punctured for test purposes. A splice in underground wire shall have insulation resistance at least equal to that of the wire spliced.

(22) Wire on a pole line shall be securely attached to an insulator that is properly fastened to a cross arm or bracket supported by a pole or other support. Wire shall not interfere with other wires on the pole line. An open-wire transmission line operating at 750 volts or more shall be placed not less than 4 feet above the nearest cross arm carrying active warning system circuits.

(23) Each sign mounted on a signal system post shall be in good condition and be visible to the highway user.

b. ***Inspections and Tests.*** Inspection and tests of electric/electromechanical signals shall be performed to determine if the warning system and its component parts are maintained in a condition to perform their intended function. Any electronic device, relay, or other electromagnetic device that fails to meet the requirements of tests required by this UFC shall be removed from service and shall not be restored to service until its operating characteristics are in accordance with the limits within which such device or relay is designed to operate. Additional tests, adjustments, cleaning and lubrication in accordance with the equipment manufacturer shall be accomplished. Proper precautions must be taken to protect highway traffic and safe operation of trains before any changes or tests are initiated on a highway-grade crossing warning system.

(1) *Monthly Inspection and/or Tests.*

(a) Ground Tests: A test of grounds on each energy bus furnishing power to circuits that affect the safety of the warning system operation. (See paragraph 10-6.a.(7))

(b) Standby Power: Standby power shall be tested. (See paragraph 10-6.a.(8))

(c) Flashing Light Units: Each flashing light unit shall be inspected for proper visibility, dirt and damage to roundels and reflectors. Lenses shall be cleaned and bulbs replaced, as necessary. (See paragraph 10-6.a.(9)(b))

(d) Gate Arms and Gate Mechanism: Each gate arm and mechanism shall be inspected and observed for proper operation. (See paragraph 10-6.a.(10) and (12))

(e) Warning System Operation: Each crossing warning system, including warning bells or other stationary audible warning devices, shall be tested to determine that it functions as intended. (See paragraph 10-6.a.(15))

(f) Highway traffic signal pre-emption interconnection shall be tested.

(2) *Quarterly Inspections and/or Tests.*

(a) Cut-out circuits shall be tested at least every three months to determine that the circuit functions as intended. A cutout circuit is any circuit or device that overrides the operation of the automatic warning system. This includes both switch cutout switches and devices that enable personnel to manually override the system operation.

(b) Insulated rail joints, bond wires, and track connections shall be inspected. (See paragraph 10-6.a.(17) and (18))

(3) *Annual Inspection and/or Tests.*

(a) Flashing Light Units and Lamp Voltage:

1. Each flashing light unit shall be inspected for proper alignment and frequency of flashes in accordance with installation specifications. (See paragraph 10-6.a.(9)(a) and (c))

2. Lamp voltage shall be tested. (See paragraph 10-6.a.(11))

(b) Gate mechanism hold-clear devices shall be tested for proper operation.

(c) Each crossing warning system shall be tested for the prescribed warning time. (See paragraph 10.6.a.(13))

(d) Timing Relays and Timing Devices: Each timing relay and timing device shall be tested. The timing shall be maintained at not less than 90 percent nor more than 110 percent of the 41 predetermined time intervals. The predetermined time intervals shall be shown on the plans or marked on the timing relay or timing device.

(4) The following shall be tested at the frequency indicated:

(a) Relays affecting the proper functioning of a crossing warning system:

1. Alternating current centrifugal relays shall be tested every 12 months.

2. Alternating current vane-type relays, direct current polar-type relays and relays with soft iron magnetic structure shall be tested every two years.

3. Other type relays shall be tested at least every four years.

(b) Insulation resistance tests, wires in trunking and cables:

1. Insulation resistance tests shall be made on wires or cables every 10 years.

2. Insulation resistance tests shall be made between all conductors and ground, between conductors in each multiple conductor cable and between conductors in trunking. Insulation resistance tests shall be performed when wires, cables and insulation are dry.

3. When insulation resistance of wire or cable is found to be less than 500,000 ohms, prompt action shall be taken to repair or replace the defective wire or cable. Until replacement is completed, insulation resistance testing shall be made annually. A circuit with a conductor having an insulation resistance of less than 200,000 ohms shall not be used.

c. ***Results of Inspections and Tests.*** Results of inspections and tests made in accordance with paragraph 10-6.b shall be recorded. A sample form is provided in Appendix B, Figure B-3. The inspector shall sign each record. Each record shall be retained for two years or until the next reported inspection, whichever is longer. Each record shall indicate activity name, crossing inventory name, place and date, equipment tested, results of tests, repairs, replacements, adjustment made, and condition in which the apparatus was left.

CHAPTER 11

BRIDGES

11-1. GENERAL.

a. For inspection purposes, track standards are applied to the bridge ties and all the components resting on them. Bridge standards are applied to those components supporting the bridge ties and below.

b. All track bridges shall be equipped with inner guardrails. Guardrails may be an appropriate safety measure for tracks located under bridge overpasses.

c. Rail anchors shall not be installed on track over open deck bridges. Any anchors found on track over an open deck bridge shall be removed immediately.

11-2. BRIDGE INSPECTION AND LOAD RATINGS.

a. Railroad bridges shall be inspected using the procedures and checkpoints described in NAVFAC MO-322, *Inspection of Shore Facilities*, for the Navy; TM 5-600/AFJPAM 32-1088, *Bridge Inspection, Maintenance and Repair*, for the Air Force and Army; and AR 420-72 for the Army. For the Air Force, the BCE is responsible for determining the inspection requirements. The minimum frequency for inspecting railroad bridges is every two years.

b. Structure analysis based on current loading or larger anticipated loadings shall be maintained on file in accordance with NAVFACINST 11230.1 for Navy activities and AR 420-72 for Army garrisons.

11-3. DANGEROUS CONDITIONS. Inspectors shall note any condition of a bridge that might adversely affect train operations. Such conditions shall be reported immediately to the proper authorities. Train operations over the structure shall not be permitted until a damage or in-depth inspection is completed and has documented that the bridge is sufficient for normal operations.

CHAPTER 12

TRACK GEOMETRY

12-1. GENERAL.

a. One rail shall be designated as the line rail. This rail establishes the alignment of the track. Either rail may be used as the line rail on tangent track so long as the same rail is used for the entire length of the tangent. The outside rail in a curve is always the line rail.

b. In curves, the inside rail is designated as the grade rail. The grade rail is the reference from which superelevation is applied to the outside rail of the curve.

c. During routine track inspections, track geometry measurements shall be taken as a minimum at the following locations:

(1) Wherever there are visual indications of track geometry deviations.

(2) Wherever track geometry deviations were previously detected, unless the deviation has been corrected.

(3) Other locations as specified in this chapter.

12-2. GAGE.

a. ***Definition.*** Gage is the distance between the two rail heads, measured at right angles to the rails in a plane 0.625 inch below the top surface of the rail head as shown in Figure 12-1. Gage measurements shall include any evidence of lateral movement under load, such as any space between the field side rail base and tie plate shoulder.

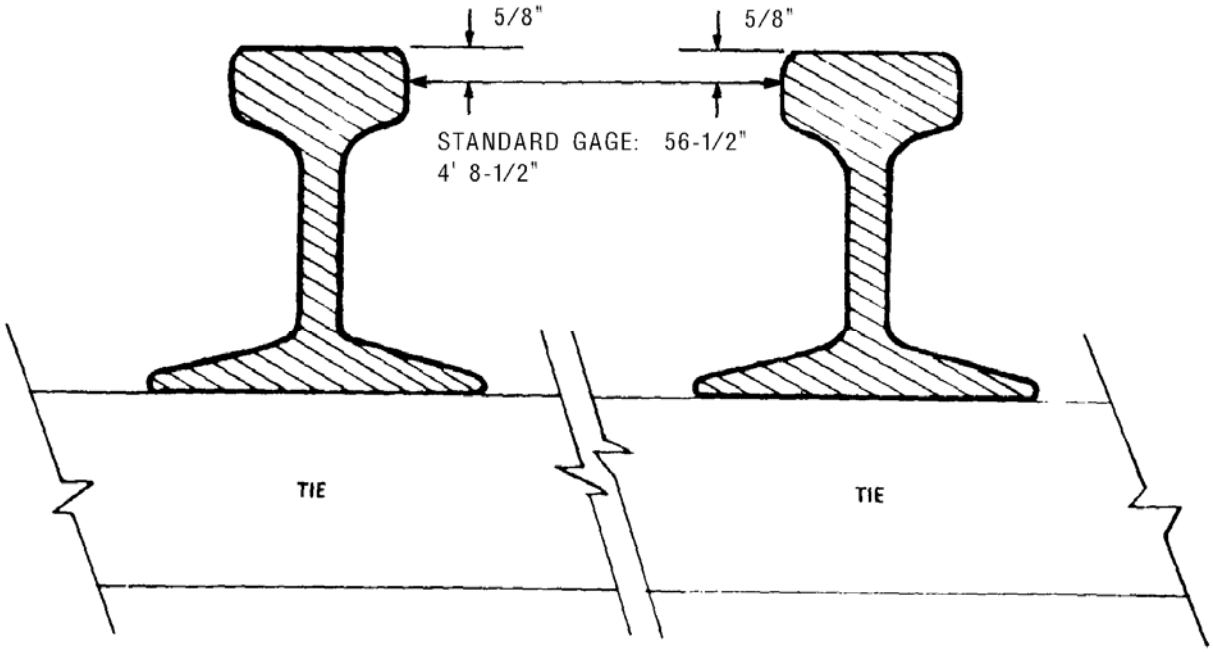


Figure 12-1. Gage Measurement

b. ***Measurement Locations.*** During routine track inspections, gage shall be measured at the following locations:

(1) In turnouts, just ahead of switch points (ahead of the bend in the stockrail) and at the joints in curved closure rails. (See Figure 12-2)

(2) Two measurements at the heel of the switch for the straight rail and the turnout side.

(3) At the point of frog on both sides of turnouts and rail crossings. (See Figure 12-2)

(4) Wherever there is a dark streak running along the field side of the top surface of the railhead.

(5) Wherever wear marks on a tie indicate lateral tie plate movement.

(6) Where a significant gap exists between the rail base and outside shoulder of the tie plate.

(7) At locations where ties are badly skewed.

(8) In road crossings.

(9) Near the beginning and ending of curves.

(10) In curves greater than 6 degrees, gage shall be measured in at least three well-spaced locations within the curve. Outside rail joints should also be observed for gage widening.

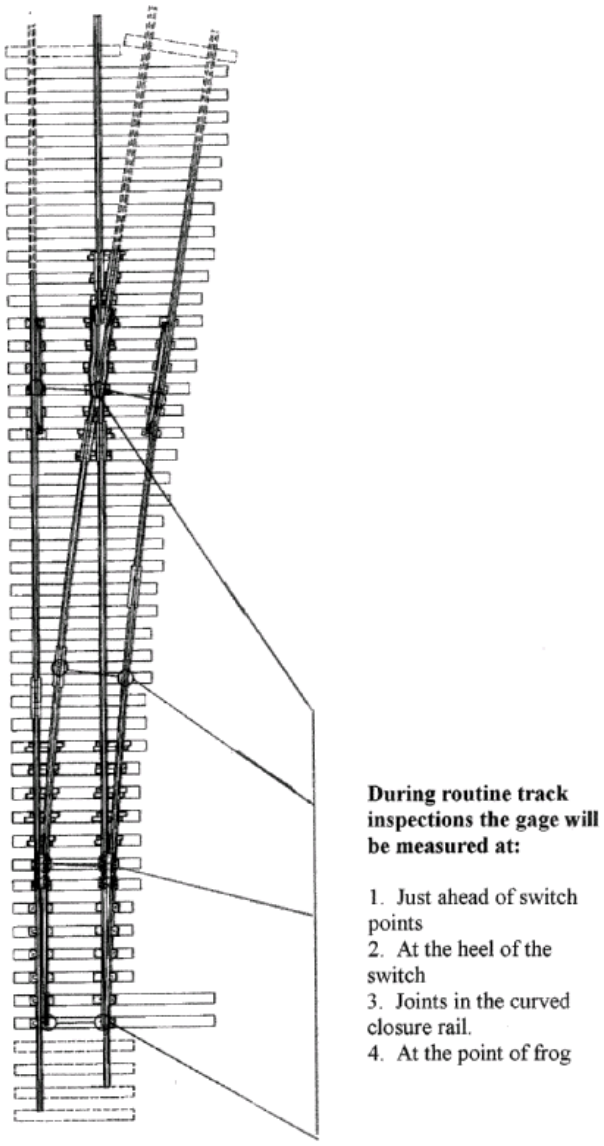


Figure 12-2. Required Gage Measurement Locations Within Turnouts

c. *Standard Gage.* Standard gage is 56.5 inches. Track will be gaged to this standard except in curves with high degrees of curvature (see Table 12-1) or other unusual conditions where the engineer in charge does not recommend standard gage.

Table 12-1a. Recommended Gage for Curved Track (Navy & Air Force)

Degree of Curvature	Recommended Gage (Inches)
Up to 12 degrees	56.5
Over 12 degrees up to 14 degrees	56.625
Over 14 degrees up to 16 degrees	56.75

Over 16 degrees up to 18 degrees	56.875
Over 18 degrees,	57

Table 12-1b. Recommended Gage for Curved Track (Army)

Degree of Curvature	Recommended Gage (Inches)
Up to 22 degrees	56.5
Over 22 degrees up to 26 degrees	56.625
Over 26 degrees up to 30 degrees	56.75
Over 30	56.875

d. Standards for gage are as follows:

Safety Standards Allowable Gage (Inch)				**Maintenance Allowable Gage (Inch)**	
Restriction		*No Operations*		*Min*	*Max*
Min	*Max*	*Min*	*Max*		
56	GT 57.5	LT 56	GT 57.75	56.125	57.5

12-3. CROSSLEVEL.

a. ***Definition.*** Crosslevel is the difference in elevation between the top surfaces of the two rails measured at right angles to the track, as shown in Figure 12-3. Crosslevel measurements shall include any evidence of vertical movement under load.

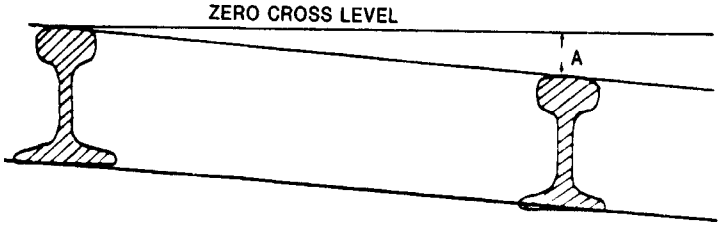


Figure 12-3. Crosslevel Measurement

b. ***Designated Crosslevel.*** On tangent track, the designated crosslevel is zero. On curved track, the designated crosslevel is equal to the designated superelevation.

c. Standards for the allowable deviation from designated elevation for crosslevel are as follows:

Track Category	Safety Standard (Inches)		Maintenance Standard (Inches)
	Restriction	*No Operation*	
A	GT 2	GT 3	GT 1.25
B	GT 2	GT 3	GT 1.5

12-4. SUPERELEVATION.

a. ***Definition.*** Superelevation is the intended increase in elevation of the outer rail above the inner rail in a curve.

b. ***Reverse Superelevation.*** Safety standards require a restriction if the outside rail of a curve is lower than the inside rail by more than 0.5 inch. Maintenance standards require the outside rail of a curve to be at the same elevation or above the inside rail.

c. ***Maximum Superelevation.*** The outside rail of a curve may not be more than 4 inches higher than the inside rail.

d. ***Uniform Superelevation.*** If a curve is superelevated, the superelevation shall be uniform throughout the curve.

e. ***Superelevation Runoff.*** Superelevation runoff shall be at a uniform rate and shall extend at least the full length of the spiral. If no spiral is present, the superelevation runoff shall be accomplished on the tangent track. Safety standards require a restriction if the superelevation runoff exceeds –1.75 inches in any 31 feet of rail. Maintenance standards recommend a target of 1 inch of runoff in 31 feet.

f. ***Recommended Superelevation.*** The recommended superelevation for a given maximum operating speed for curved track can be determined from Table 12-2. Table 12-2 reflects the recommended 0.5 inch of unbalance. Safety standards require a restriction if the curve superelevation exceeds 3 inches of unbalance. Three (3) inches of unbalance would be equal to 2.5 inches less than the recommended values of superelevation in Table 12-2. Maintenance shall be performed during the next maintenance cycle when the superelevation exceeds 1.5 inches of unbalance. One and one-half (1.5) inches of unbalance would be equal to 1 inch less than the recommended values of superelevation in Table 12-2. If reverse superelevation exists see paragraph 12-4.b.

Table 12-2. Recommended Superelevation for Curved Track

Degree of Curvature	*Maximum Operating Speed (mph)*							
	10	*15*	*20*	*25*	*30*	*35*	*40*	*45*
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1.00	0.50	0.50	0.50	0.50	0.50	0.50	0.75	1.00
1.50	0.50	0.50	0.50	0.50	0.50	0.75	1.25	1.75
2.00	0.50	0.50	0.50	0.50	0.75	1.25	1.75	2.25
2.50	0.50	0.50	0.50	0.50	1.00	1.75	2.25	3.00
3.00	0.50	0.50	0.50	0.75	1.50	2.00	2.75	3.75
3.50	0.50	0.50	0.50	1.00	1.75	2.50	3.50	
4.00	0.50	0.50	0.50	1.25	2.00	3.00	4.00	

Degree of Curvature	*Maximum Operating Speed (mph)*							
	10	*15*	*20*	*25*	*30*	*35*	*40*	*45*
4.50	0.50	0.50	0.75	1.50	2.25	3.25		
5.00	0.50	0.50	1.00	1.75	2.75	3.75		
5.50	0.50	0.50	1.00	2.00	3.00			
6.00	0.50	0.50	1.25	2.25	3.25			
6.50	0.50	0.50	1.25	2.25	3.50			
7.00	0.50	0.75	1.50	2.50	4.00			
7.50	0.50	0.75	1.50	2.75				
8.00	0.50	1.00	1.75	3.00				
8.50	0.50	1.00	2.00	3.25				
9.00	0.50	1.00	2.00	3.50				
9.50	0.50	1.00	2.25	3.75				
10.00	0.50	1.00	2.25	4.00				
10.50	0.50	1.25	2.50	4.00				
11.00	0.50	1.25	2.50					
11.50	0.50	1.25	2.75					
12.00	0.50	1.50	2.75					
13.00	0.50	1.50	3.25					
14.00	0.50	1.75	3.50	TRAINS SHALL NOT BE OPERATED ON CURVES AT SPEEDS WHICH REQUIRE MORE THAN 4 IN. SUPERELEVATION				
15.00	0.75	1.75	3.75					
16.00	0.75	2.00	4.00					
17.00	0.75	2.25						
18.00	1.00	2.25						
19.00	1.00	2.50						
20.00	1.00	2.75						

Notes for Table 12-2:

1. At least 0.5 inch of superelevation is recommended on all curves as indicated to prevent reverse superelevation. On curves that historically do not retain the minimum 0.5 inch of superelevation, the next maintenance cycle should surface the curve with 1 inch of superelevation.
2. Safety standards should use the 3-inch unbalanced formula in accordance with the FRA *Track Safety Standards*.
3. Superelevation calculated using 0.5-inch unbalanced formula, i.e.:

$$E = (0.0007DV^2)-0.5$$

where: E = Superelevation, inches, D = Degree of Curvature V = Speed, mph. All values have been rounded to 0.25-inch increments.

Examples:

To determine superelevation:

-Enter table at maximum operating speed.
-Go down to maximum degree of curvature.
-Read Superelevation.

Known:

-Maximum operating speed: 25 mph.
-Degree of curvature: 8°

Required superelevation is 3.00 inches.

4. Cross-level (paragraph 12-3) shall determine the need for maintenance (related to superelevation) on curves.

12-5. WARP.

a. ***Definition.*** Warp is the difference in crosslevel between any two points less than or equal to 62 feet apart. Warp is determined as follows:

(1) Use the line rail as the reference rail.

(2) Measure the crosslevel at any two points less than 62 feet apart, normally at joints in the rail. If the reference rail is lower than the opposite rail, the sign of the measurement is negative (-). If the reference rail is higher than the opposite rail, the sign of the measurement is positive (+).

(3) *Determining Warp*. If both signs are the same, drop the signs and subtract the smaller measurement from the larger measurement. If the signs are different, drop the signs and add the measurements. Figure 12-4 presents an example of the warp calculation.

b. ***Designated Warp.*** The designated warp on both tangent and curved track is zero.

c. ***Maintenance and Safety Standards.*** Standards for the maximum allowable deviation due to warp are as follows:

Safety Standards (Inches)		Maintenance Standards (Inches)
Restriction	*No Operation*	
GT 2.25	GT 3.0	GT 1.75

d. All measurements taken at joints within the 62-foot distance must be calculated for warp. Assuming 39-foot rails, in addition to calculating warp at AB & AC, warp shall also be checked at AD as shown on Figure 12-4.

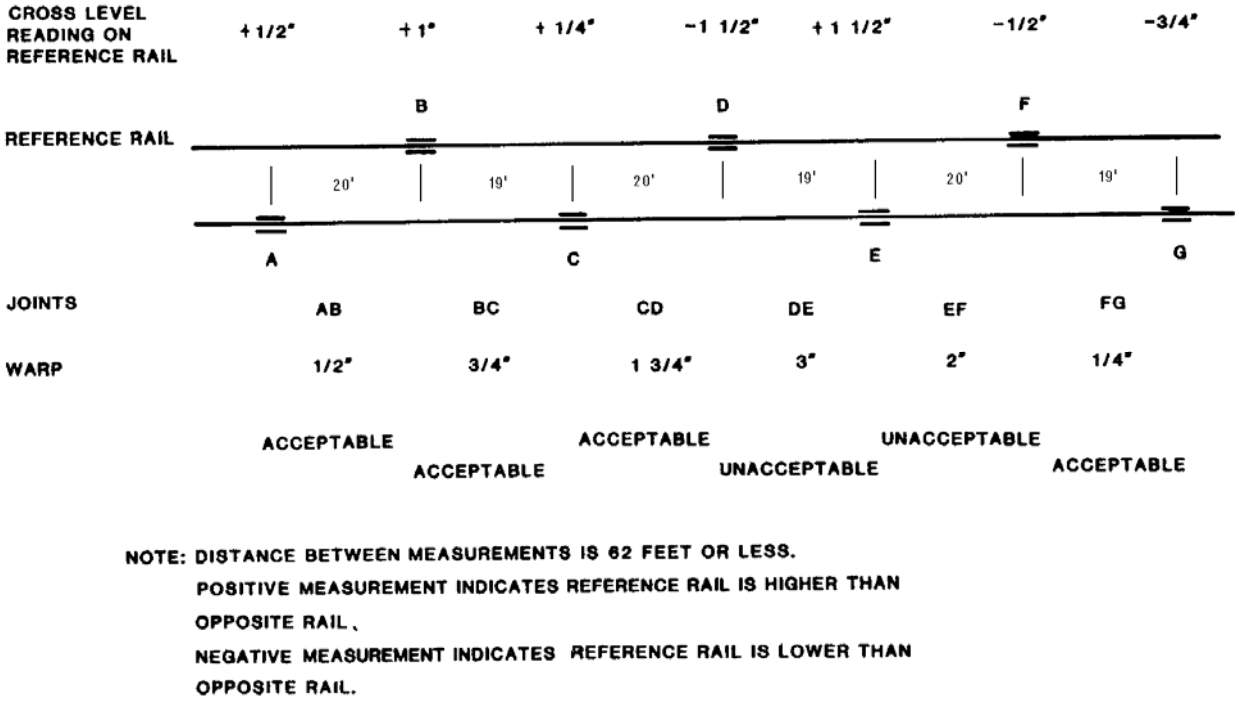


Figure 12-4. Determination of Warp

12-6. ALIGNMENT.

a. ***Definition.*** Alignment is the relative position of the rails in a horizontal plane.

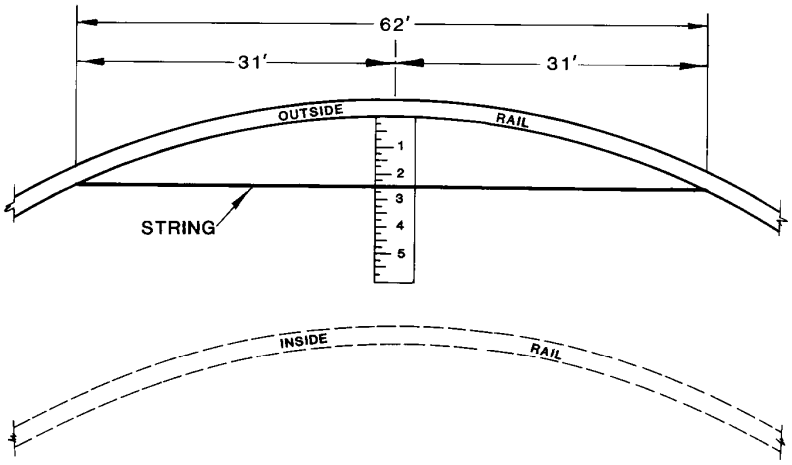
b. ***Measurement.*** Alignment is measured at the midpoint of a 62-foot string line stretched along the gage side of the line rail at a distance of 0.625 inch below the top of the railhead. The alignment measurement is the distance in inches from the midpoint of the string line to the gage side of the line rail. It is measured at right angles to the string line.

c. ***Designated Alignment.*** For tangent track the designated alignment is zero. For curved track the designated alignment is the degree of curvature. In spirals the change in curvature will be at a uniform rate.

d. ***Curvature Measurement.*** On curves, 1-inch distance from the 62-foot string line to the line rail equals approximately 1 degree of curvature, as shown in Figure 12-5. If the degree of curvature is not known, it can be determined as follows:

(1) Beginning at a point near the center of the curve, mark at least two stations spaced 31 feet apart in both directions along the line rail.

(2) Measure the alignment at each station, including the beginning point, and average the measurements. This average measurement is the approximate degree of curvature.



MEASUREMENTS OF ALIGNMENT USING A 62 FOOT STRINGLINE:

1. STRETCH STRING WITH ENDS AGAINST GAGE SIDE OF LINE RAIL 5/8″ BELOW THE SURFACE OF THE RAIL.
2. MEASURE AT THE MID- POINT (31′) FROM STRING TO GAGE SIDE OF RAIL 5/8″ DOWN
3. ONE INCH EQUALS APPROXIMATELY ONE DEGREE OF CURVATURE.

EXAMPLE ILLUSTRATES A MEASUREMENT OF ABOUT 2-1/2″, OR APPROXIMATELY 2 DEGREES 30 MINUTES OF CURVATURE FOR THE ONE ISOLATED SPOT WHERE THE MEASUREMENT WAS TAKEN.

Figure 12-5. Measurement of Curve Alignment

e. ***Safety and Maintenance Standards.*** Standards for the maximum allowable deviations from designated alignment are as follows:

Track Category	Safety Standard (Inch)		Maintenance Standard (Inch)
	Restriction	*No Operation*	
A & B	GT 3	GT 5	GT 2

12-7. PROFILE.

a. ***Definition.*** Profile is the relative elevation of the two rails along the track. Profile deviation is the deviation from uniform profile on either rail at the midpoint of a 62-foot chord.

b. ***Safety and Maintenance Standards.*** When the maintenance standards are exceeded, maintenance shall be performed in the next cycle. Standards for the allowable deviations from uniform profile are as follows:

Track Category	Safety Standards (Inch)		Maintenance Standards (Inch)
	Restriction	*No Operation*	
A & B	GT 2.75	GT 3	GT 2.25

CHAPTER 13

CLEARANCES

13-1. MEASUREMENT. Vertical clearance shall be measured vertically from the top surface of the rail. Side clearance shall be measured horizontally from the centerline of the track.

13-2. CLEARANCE REQUIREMENTS, TANGENT TRACK. Clearances for tangent track shall not be less than those listed in Table 13-1 and shown in Figure 13-1.

13-3. CLEARANCE REQUIREMENTS, CURVED TRACK.

a. For each degree of curvature, side clearances shall be increased 1.5 inches over that required in Table 13-1 and Figure 13-1.

b. When an obstruction is located adjacent to tangent track but the track is curved within 80 feet of the obstruction, the side clearances shall be increased by the following amounts:

Distance from Obstruction to Curved Track (Feet)	Increase per Degree of Curvature (Inches)
0–20	1.5
21–40	1.125
41–60	0.75
61–80	0.375

13-4. TRACK CENTERS. The minimum spacing between the centerlines of adjacent tracks shall be maintained as given below and state department of transportation (DOT) clearance requirements shall also be checked as a minimum:

Type of Tracks	Minimum Center-to-Center Distance
Yard, loading, and storage tracks	13 feet (recommend 14 feet)
Yard track parallel to main or running track	15 feet
Passing track	15 feet

13-5. CHANGES TO CLEARANCES. Whenever changes in alignment or elevation are made, clearances shall be checked for compliance with the criteria given in this chapter. This is especially important in the vicinity of buildings, bridges, overhead structures, platforms, and tunnels. All four vertical clearance points (see Figure 13-1) under bridges/structures shall be measured. The least dimension shall govern for clearance.

Table 13-1. Clearance Requirements for Tangent Tracks

Obstruction	Required Clearance
Vertical Clearances	
Overhead wires: open supply, arc wires, service drops	
0 to 750 volts	27 feet
750 to 15,000	28 feet
Exceeding 15,000 volts	30 feet
Other overhead wires	27 feet
Building entrances (including engine-houses)	18 feet
Overhead	22 feet
Other overhead obstructions	22 feet
Side Clearances	
Buildings	8 feet 6 inches
Buildings without platforms (delivery required)	8 feet
Platforms	
Freight platforms up to 4 feet maximum height	6 feet 2 inches
Refrigerator car platforms up to 3 feet 3 inch	6 feet 2 inches
Refrigerator car platforms 3 feet 3 inch to 4 feet high	8 feet
Low platforms (less than 8 inches high)	5 feet
Engine-house entrances	6 feet-6 inches
Building entrances (other than engine-houses)	8 feet
Canopies over platforms (canopy height 16 feet or less)	8 feet
Fences, retaining walls, utility poles, and other obstructions	8 feet 6 inches
Bridges	8 feet
Signs	8 feet
All loose, palliated, and stacked materials	8 feet
Parked vehicles	8 feet

Note: In curves, side clearances shall be increased 1.5 inches for each degree of curvature.

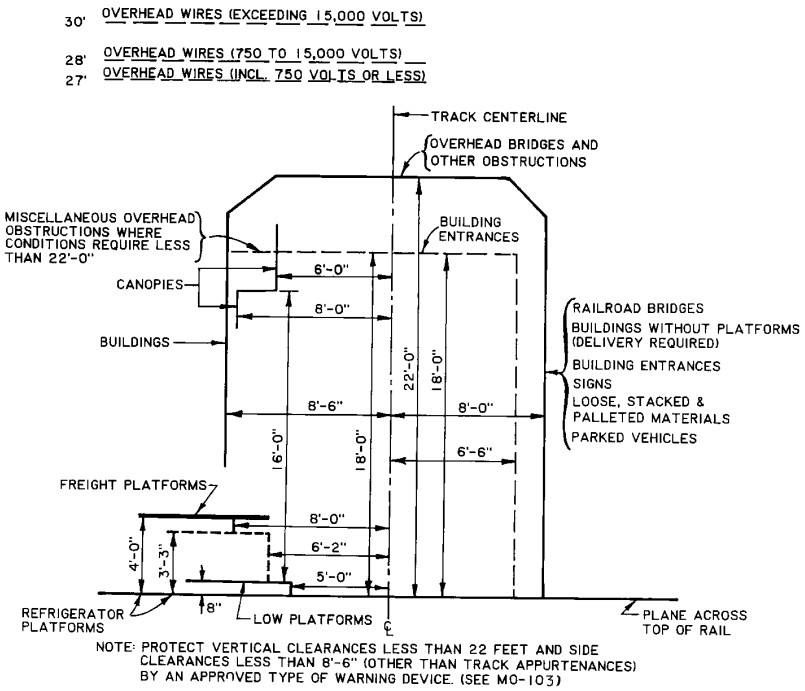


Figure 13-1. Minimum Clearances for Tangent Track

CHAPTER 14

MISCELLANEOUS TRACK APPLIANCES

14-1. TRACK SCALES. The inspection, maintenance, and calibration of railroad track scales are covered in the Association of American Railroads *Scale Handbook*, published annually as a part of the AREMA *Manual for Railway Engineering*. Track scales should be inspected and calibrated periodically in accordance with the recommendations given in the *Scale Handbook*.

14-2. BONDED AND GROUNDED TRACK.

a. Certain tracks used for the loading/unloading of fuels and ordnance are required to be bonded and grounded. Grounding requirements are given in UFC 4-860-01FA for Army and Air Force installations, and NAVSEA OP 5, *Ammunition and Explosives Ashore Safety Regulations for Handling, Storing, Production, Renovation and Shipping*, for the Navy. During maintenance of bonded and grounded track, care shall be taken to maintain the integrity of the rail bonds, ground rods, and connections.

b. During routine track inspections, the general condition of the bonds, ground wires, and connections shall be observed. Loose or missing bonds or connections shall be repaired immediately. The occurrence of excessive corrosion in the terminal areas of the bond wires and ground wires indicates a need for cleaning, repair, or replacement. Bonds and grounds shall be replaced if there is a large difference in electrical potential between the rails.

14-3. DERAILS.

a. Derails shall be maintained in good operating condition.

b. Derails shall be maintained free of lost motion that would allow it to be operated without removing the lock.

c. Derails shall be kept clean and painted in order to be readily visible to operating personnel.

d. Derails, normally supplied in 1-inch increments allowing no more than 0.5 inch of shimming, shall be properly installed for the rail to which it is applied.

14-4. OTHER TRACK APPLIANCES. Other track appliances, like bumper stops and cushion heads, wheel stops, etc., shall be in good working order for their intended use. Wheel stops are not designed for, nor shall they be used as, bumper stops. They are only designed to keep cars from rolling off the end of a track or past a point.

CHAPTER 15

MAINTENANCE ACTIVITIES FOR CATEGORY C TRACK

15-1. GENERAL. The minimum level of maintenance for inactive (Category C) track will be consistent with the anticipated future mission of the activity and the particular track involved. This chapter summarizes the general requirements.

15-2. MAINTENANCE REQUIREMENTS.

a. Maintenance of rail, ties, and ballast shall be discontinued.

b. Drainage shall be maintained in accordance with paragraph 3-2.

c. Damaging vegetation in the ballast, roadbed, and ditches shall be controlled in accordance with paragraph 3-3.

d. Bridges and other track structures shall be maintained in structurally sound condition with respect to their expected loading.

e. Clearances addressed in Chapter 13 shall be maintained to ensure that permanent facilities are not constructed within the railroad right-of-way.

f. If there is a mobilization requirement, switches shall be kept properly adjusted and fully operational.

15-3. INACTIVATION AND DISPOSAL. In accordance with NAVFAC P-73, *Real Estate Procedures Manual*, for Navy activities; AR 420-72 and AR 405-90, *Disposal of Real Estate*, for Army; and AFI 32-9004, *Disposal of Real Estate*, for Air Force installations, action will be taken to dispose of track having no foreseeable need.

APPENDIX A

REFERENCES

A-1. GOVERNMENT PUBLICATIONS.

Departments of the Army, Navy, and Air Force

AR 405-90/AFI 32-9004	Disposal of Real Estate
AR 420-72	Transportation Infrastructure and Dams
AR 200-5/AFI 32-1053/OPNAVINST 6250.4	Pest Management Program
NAVFACINST 11230.1	Inspection, Certification and Audit of Crane and Railroad Trackage
NAVFAC MO-322, Vol I & II	Inspection of Shore Facilities
NAVFAC P-73	Real Estate Procedures Manual
NAVFAC P-301	Navy Railways Operating Handbook
NAVSEA OP 5	Ammunition and Explosives Ashore Safety Regulations for Handling, Storing, Production, Renovation and Shipping
TM 5-600/AFJPAM 32-1088	Bridge Inspection, Maintenance, and Repair
TM 5-627/AFM 91-33/MO-103	Maintenance of Trackage
TM 5-629/MO-314	Natural Resources – Weed Control and Plant Growth Regulation
TM 5-630	Natural Resources Land Management
UFC 4-860-01FA	Design: Railroad Design and Rehabilitation
UFC 4-860-02N	Design Trackage
UFC 4-860-01FA	Design: Railroad Design and Rehabilitation
UFGS 05650	Railroad Track and Accessories

Department of Transportation

Federal Highway Administration	Manual on Uniform Traffic Control Devices – Part 8 Traffic Control for Highway-Rail Grade Crossings
	Railroad-Highway Grade Crossing Handbook
Federal Railroad Administration	Track Safety Standards Code of Federal Regulations, Title 49, Chapter II, Part 213
	Grade Crossing Signal System Safety, Code of Federal Regulations, Title 49, Chapter II, Part 234

NON-GOVERNMENT PUBLICATIONS

American Railway Engineering & Maintenance-of-Way Association,
8201 Corporate Drive,
Suite 1125
Landover, MD 20785

Manual for Railway Engineering & Portfolio of Trackwork Plans

American Wood Preservers' Association,
P.O. Box 5690
Granbury, TX 76049

C6	Crossties and Switch Ties - Preservative Treatment by Pressure Process
P2	Standard for Creosote and Creosote Solutions
P3	Standard for Creosote Petroleum Oil Solution

APPENDIX B

TRACK INSPECTION RECORD AND TURNOUT INSPECTION CHECKLIST

B-1. To aid in the inspection of track, the Track Inspection Record, Turnout Inspection Checklist, and Highway Grade Crossing Warning System Inspection/Test Report provided in Figures B-1, B-2, and B-3 are available for use. These forms can also be found in NAVFACINST 11230.1. Figures B-4 through B-10 show the inspection worksheets for use with the RAILER Engineered Management System (EMS). These forms are intended for recording inspection findings in the RAILER software database after returning to the office. Alternatively, an electronic track inspection program, RAILER Remote Entry Database (RED), can be used to collect and record data on a tablet PC for electronic upload to the RAILER software. The RAILER database keeps an electronic record of the inspection defects and automatically reports the current standard condition level for each. Policies can also be created to match each defect up to its corrective work action. Note that, in general, each RAILER inspection form requires information about the inspector name, inspection date, track and segment. In addition, inspection information includes the type of defect, location, length, density, quantity, and other component-specific information. Some forms are formatted as checklists to provide the inspector a list of everything that needs to be verified during an inspection—the Turnout Inspection Worksheet (Figure B-7) is one example of this. Information on RAILER EMS is available at the following website:
http://www.tac.uiuc.edu/software/railer/railer.html

Appendix E provides a summary of the maintenance standards and safety standards.

B-2. TRACK INSPECTION RECORD.

a. ***Intent and Application.*** The Track Inspection Record is intended for use as a record of scheduled maintenance, safety, and special track inspections. This form will be used for each operational and special track inspection to record the type and location of deviations from the standards, degree of hazard, proposed corrective action and time frame for completion, and the actions taken to correct the deviation. For scheduled maintenance inspections, the inspector shall record the location and description of deficiencies. Completed records shall be provided to the appropriate office for action.

b. The form includes identifying information such as installation name, reporting organization, inspector's name (both printed and signed), and the inspection date. The remainder of the form is available for listing deviations observed during the track inspection. In this section one line is normally used to record each deviation, although two or more lines may be required if additional comments are needed. Figure B-1 presents an example of a Track Inspection Record. A description of each of the columns on this form is given below:

Degree of Hazard: The hazard of each defect shall be provided in accordance with NAVFACINST 11230.1 for Navy installations. Army and Air Force Installations shall use local guidance policy. Abbreviations for degree of hazard are provided on the bottom of the Track Inspection Record.

Catastrophic - CAT
Critical - CRIT
Marginal - M

Location Milepost or Station Number: Location of the deviation as referenced to the installations system of track stationing. May be recorded as stations or as Milepost + Feet.

Examples: Stations: 0+00, 6+39, 102+06
Mileposts: 0+0000, 0+639, 1+4926

Deficiency Description: Brief description of the deficiency of deviation observed in the track.

Examples: -Wide gage 57.875 inches
-Small amount of vegetation growing on track

Proposed Corrective Action and Time Frame: What needs to be done to correct the deviation and when. This should include the application of operating restrictions where required.

Examples: -Limit speed to 10 mph, regage, and respike as soon as possible
-Spray for vegetation control within 1 month

Follow-up Actions: Action taken and date completed: what was done to correct the problem and the date repairs were completed.

Examples: 10 mph restriction applied 10/2/00; Repaired 10/15/00;
Herbicide application 6/2/01

B-3. TURNOUT INSPECTION CHECKLIST.

a. *Intent and Application.* The Turnout Inspection Checklist is intended for use in the inspection of turnouts.

b. *Use.* The Turnout Inspection Checklist includes identifying information such as activity name, inspector's name, track identification (track name or number for identifying track), turnout identification (turnout number), and inspection date.

c. Additional sections are provided for the major components of the turnout such as ties, switch and stand, frog, and guard rails and for additional required data such as measurements and general items.

d. To assist in the use of this form and to promote consistent reporting, standard responses are supplied for many of the items. The applicable response should be circled for each item. If the printed response does not cover the situation or if an additional comment is required, a number can be placed in the blank after "Note ___" and the comments written in the "Notes" space provided at the bottom of the form. Blank spaces have been provided where items require a numerical response or a measurement. For multiple items such as rail braces, blanks have been provided before the responses so that a number may be indicated. For example, if two rail braces were loose, one is broken, and one is missing, the response would be:

OK 2 Loose 1 Damaged 1 Missing Note____

e. Some turnouts may be equipped with self-guarded frogs that do not require the presence of guard rails. In cases where there is a self-guarded frog and no guard rails, the entire section of the form titled "Guard Rails" should be crossed out and the words "Self-Guarded" written in the upper-right corner of the section. This will indicate that there are no guard rails in the turnout. If the frog is self-guarded and there are guard rails, the guard rails shall be inspected and the appropriate sections of the form completed.

f. The requirements for turnouts are found in Chapter 8. Figure B-2 presents an example of a completed Turnout Inspection Checklist.

B-4. HIGHWAY GRADE CROSSING WARNING SYSTEM INSPECTION/TEST REPORT (See Figure B-3)

a. *Intent and Application*. The Highway Grade Crossing Warning System Inspection/Test Report is intended for use in the inspection of electric/ electromechanical grade crossing signals as discussed in paragraph 10-6.

b. *Use.* The Highway Grade Crossing Warning System Inspection/Test Report includes identifying information such as activity name, inspector's name, crossing location (track name and highway designation), DOT/AAR Crossing Inventory Number (if applicable), and inspection date.

c. A checklist is provided, divided into Parts A, B, and C. Part A is the monthly requirements, Part B is the quarterly requirements and Part C is the annual requirements. When performing a monthly inspection, Part A is completed. When performing a quarterly inspection, Parts A and B are completed. When performing an annual inspection, Parts A, B and C are completed. Additional space is provided to indicate repairs, replacements, adjustments made and condition in which the apparatus was left. Areas are available for recording standby power battery voltages.

Figure B-1. Example Track Inspection Record

TRACK INSPECTION RECORD

TYPE OF INSPECTION:
[ ] SCHEDULED MAINTENANCE [ ] SAFETY INSPECTION
[✓] CONTROL INSPECTION [ ] OPERATIONAL INSPECTION

ACTIVITY: Anywhere Naval Weapons Station

TRACK NAME OR ID: North Main

REPORT DATE: 9/9/97

INSPECTOR (PRINT OR TYPE & SIGN): John R. Doe John R. Doe

INSPECTION ORGANIZATION: FMED

DEGREE OF HAZARD	LOCATION MILEPOST OR STATION	DEFICIENCY DESCRIPTION	PROPOSED CORRECTIVE ACTION AND TIMEFRAME	FOLLOW-UP ACTIONS: ACTION TAKEN	FOLLOW-UP ACTIONS: DATE COMPLETED
CAT	1+75	4 Consecutive Defective Ties	Close to Traffic	Track closed	9/9/97
			Replace ties; ASAP	Ties Replaced	9/12/97
M	2+35	Vegetation (Brush) growing	Cut Brush Along ROW		
		near track	within 2 months		
CRIT	4+00	Broken Joint Bar (Between	Class 1 Restriction (10mph)	Restriction Applied	9/9/97
		Center Bolt Holes	Replace Bar; within 1 week	Repaired	9/14/97
CRIT	5+80	Wide Gage - 57 7/8"	Class 1 Restriction (10mph)	Restriction Applied	9/9/97
			Regage + Respike (ASAP)	Repaired	9/12/97
		EXAMPLE			

LEGEND: Degree of Hazard CAT - Catastrophic CRIT - Critical M- Marginal

Figure B-2. Example Turnout Inspection Record

Highway Grade Crossing Warning System
INSPECTION/TEST REPORT

TURNOUT INSPECTION CHECKLIST

ACTIVITY: Anywhere Naval Weapons Station | REPORTING ORGANIZATION: FMED | INSPECTOR (PRINT OR TYPE/SIGNATURE): John R. Doe / John R. Doe

TRACK IDENTIFICATION: North Main | TURNOUT IDENTIFICATION: # 11 | TURNOUT SIZE: #8 | SWITCH POINT LENGTH: 16'-6" | DATE: 9/9/97

GENERAL

Are All Materials Proper Size?	YES	(NO)	NOTE 1
Is Rail Same Weight and Section?	(YES)	NO	NOTE___
Are Flangeways Clear of Debris?	(YES)	NO	NOTE___
Are Crib Areas Clear of Debris?	(YES)	NO	NOTE___
Surface (GOOD)	FAIR	POOR	NOTE___
Alignment (GOOD)	FAIR	POOR	NOTE___

FROG

Point	(OK)	WORN ___"	CHIPPED	BROKEN	(NOTE) 6
Top Surface	OK	(WORN) 1/4"	BROKEN	DAMAGED	(NOTE) 6
Bolts:	OK	2 (LOOSE)	1 (MISSING)	___DAMAGED	NOTE___
Guarding Face (Self guarded Frog Only):	OK	WORN	BROKEN	DAMAGED	NOTE___

TIES

Total Number Defective:	3	NOTE___
Maximum Number of Consecutive Defective:	1	NOTE___
Number of Occurrences of Defective Joint Ties	0	NOTE___

GUARD RAILS

Position - Straight	OK	(IMPROPER)	(NOTE) 7			
Turnout	(OK)	IMPROPER	NOTE___			
Condition - Straight	OK	WORN (INSECURE)	BROKEN	(DAMAGED)		(NOTE) 7
Turnout	OK	WORN (INSECURE)	BROKEN	DAMAGED		NOTE___
Clamps/Fillers - Straight	OK	(LOOSE)	BROKEN	DAMAGED		NOTE___
Turnout	OK	(LOOSE)	BROKEN	DAMAGED		NOTE___
Bolts - Straight	OK	1 (LOOSE)	2 (MISSING)	___ DAMAGED		NOTE___
Turnout	OK	3 (LOOSE)	___ MISSING	___ DAMAGED		NOTE___

SWITCH AND STAND

Switch Operates Without Difficulty?	(YES)	NO (Describe Problem)				NOTE___
Switch Stand:	OK	INSECURE	(DAMAGED)			(NOTE) 2
Point Lock/Lever Latches:	OK	MISSING	DAMAGED	LOOSE		(NOTE) 3
Point Gap - Left (NONE)	LESS THAN 1/8"		1/8" OR GREATER	1/4" OR GREATER		NOTE___
- Right: NONE	LESS THAN 1/8"		(1/8" OR GREATER	1/4" OR GREATER		NOTE___
Point Condition - Left	(OK)	WORN	CHIPPED	BROKEN		NOTE___
- Right:	OK	(WORN) ≈ 1/4"	CHIPPED	BROKEN		NOTE___
Is Point LOWER Than Stock Rail?		Left: (YES) NO		Right: (YES) NO		NOTE___
Is Point Rail Beyond Taper HIGHER Than Stock Rail?		Left: (YES) NO		Right: (YES) NO		NOTE___
Connecting Rod	(OK)	BENT	DAMAGED	LOOSE	BINDING	NOTE___
Jam Nut:	(OK)	NONE	DAMAGED	LOOSE	MISSING	NOTE___
Switch Rods:	(OK)	__BENT	__DAMAGED	__LOOSE	__BINDING	NOTE___
Switch Clips:	(OK)	__BENT	__DAMAGED	__LOOSE	__BINDING	NOTE___
Connecting Rod Bolt:	(OK)	___LOOSE	____DAMAGED		___MISSING	NOTE___
Nut On Top?	(YES)	NO	Cotter Key In Place?		YES (NO)	
Switch Rod Bolts:	OK	1 (LOOSE)	____DAMAGED		___MISSING	NOTE___
Nut On Top?	(YES)	NO	Cotter Key In Place?		YES (NO)	
Slide Plates: OK	___LOOSE	4 DIRTY	___DAMAGED		___MISSING	(NOTE) 4
Rail Braces - Straight Side:	OK	4 (LOOSE)	2 (DAMAGED)		___MISSING	NOTE___
Turnout Side	OK	2 (LOOSE)	___DAMAGED		1 (MISSING)	(NOTE) 5
Heel Filler: (OK)	___ INSECURE	___CRACKED/BROKEN			___MISSING	NOTE___
Heel Bolts:	OK	1 (LOOSE)	___DAMAGED		___MISSING	NOTE___
Heel Joint Bars/Shoulder Bars: :	(OK)	___LOOSE	___DAMAGED		___MISSING	NOTE___

MEASUREMENTS (Inches)

	Straight Side	Turnout Side
SWITCH		
Gage Just Ahead of Points:	56 3/4	
Gage @ Switch Heel	56 1/2	57
CURVED CLOSURE RAILS:		
Gage at Joints:	56 5/8	57 1/4
		57 3/8
FROG:		
Gage at Point:	56 1/2	57 1/4
Flangeway Width:	1 3/4	1 3/4
Flangeway Depth:	1 3/4	1 5/8
GUARD RAILS		
Guard Check Gage:	54 5/8	54 3/4
Guard Face Gage:	52 7/8	53
Flangeway Width:	1 3/4	2 1/4

NOTES:
1) Homemade bars, field side of heel
2) Stand cracked
3) Needs oiling
4) Needs cleaning & lubrication
5) Rail braces - Improperly positioned
6) Point worn slightly, surface worn ≈ 1/4"
7) Straight side guard rail has been hit & damaged. New guard rail needed. Reposition existing guard rail, and secure until replacement is available.

Activity _____

Location _____ **Crossing No.** (if any) _____

Monthly (Part A) Check (√) Box for Compliance	Quarterly (Part B) Check (√) Box for Compliance (Perform A + B)	Annual (Part C) Check (√) Box for Compliance (Perform A + B + C)
☐ Observe Relays ☐ Check Voltages / Fuses ☐ Standby Power Test ☐ System Operation ☐ Clean Crossing Roundels ☐ Observe Flasher Operation ☐ Check for Locks ☐ Inspect / Service Batteries ☐ Check AC & DC Grounds ☐ Inspect Pedestrian Bells ☐ Inspect Signs and ***Crossbucks***	☐ Check Flasher Alignment and Focus ☐ Inspect All Track Wires ☐ Inspect Rail Bonds ☐ Check Insulated Joints ☐ Inspect Approach Batteries ☐ Check Push Button Cutouts ☐ Check Main AC Supply ☐ Circuit Plans in Relay Case ☐ Inspect Poles and *Foundations*	☐ Inspect Flasher Relay ☐ Check Lamp Voltages ☐ Check Timing Circuits ☐ Check Warning Time ☐ Verify Equipment ☐ Verify Frequencies ☐ Check Circuit Plans

Battery Bank Name	Cell Type	**Voltage ---- With Charge**
		ON OFF
Main _____	_____	_____ _____
Electronic _____	_____	_____ _____
Island Circuit _____	_____	_____ _____
Approach 1 _____	_____	_____ _____
Approach 2 _____	_____	_____ _____
Approach 3 _____	_____	_____ _____
Approach 4 _____	_____	_____ _____

Repair, Replacements, Adjustments (if none, so state)

_____

_____

_____

Notes: _____

_____

_____

Signature: _____ **Date:** _____

(Signal Maintainer)

Figure B-3 Highway Grade Crossing Warning System Inspection/ Test Report

Figure B-4 Safety Inspection Worksheet

(Used in lieu of Detailed Worksheets

Inspector: _____ Date:_____ Sheet

Track	Segment	Location	Rail	Component	ID*	Defect**	Qty

If no new safety defects are found, state "No New Defects" for each track/segment combination. If a work order is to be issued to correct a defect, check "WO". Use reverse side for comments. *ID refers to Turnout ID, Crossing, etc. ***See Defect List.

Tie Detailed Inspection Worksheet

Track:_____ Segment:_____ Inspector:_____ Date:_____
Begin Location:_____ End Location:_____

Defect Description	Occurrence Tally	Total
Single Defective Tie		
Single Defective Joint Tie		
All Joint Ties Defective (1 Tie)		
Isolated* Defective Tie Cluster (2 Ties)		
Isolated Defective Tie Cluster (3 Ties)		
Isolated Defective Tie Cluster (4 Ties)		
Isolated Defective Tie Cluster (5 Ties)		
Adjacent* Defective Tie Cluster (2 Ties)		
Adjacent Defective Tie Cluster (3 Ties)		
Adjacent Defective Tie Cluster (4 Ties)		
Adjacent Defective Tie Cluster (5 Ties)		
Isolated Cluster with 1 Joint Tie** (2 Ties)		
Isolated Cluster with 1 Joint Tie (3 Ties)		
Isolated Cluster with 1 Joint Tie (4 Ties)		
Isolated Cluster with 1 Joint Tie (5 Ties)		
Defective Joint Tie Cluster** (2 Ties, 1 Joint Tie)		
Defective Joint Tie Cluster (2 Ties, 2 Joint Ties)		
Defective Joint Tie Cluster (3 Ties, 1 Joint Tie)		
Defective Joint Tie Cluster (3 Ties, 2 Joint Ties)		
Defective Joint Tie Cluster (3 Ties, 3 Joint Ties)		
Defective Joint Tie Cluster (4 Ties, 1 Joint Tie)		
Defective Joint Tie Cluster (4 Ties, 2 Joint Ties)		
Defective Joint Tie Cluster (4 Ties, 3 Joint Ties)		
Defective Joint Tie Cluster (4 Ties, 4 Joint Ties)		
Defective Joint Tie Cluster (5 Ties, 1 Joint Tie)		
Defective Joint Tie Cluster (5 Ties, 2 Joint Ties)		
Defective Joint Tie Cluster (5 Ties, 3 Joint Ties)		
Defective Joint Tie Cluster (5 Ties, 4 Joint Ties)		
Defective Joint Tie Cluster (5 Ties, 5 Joint Ties)		
Single Missing Tie		
2 Consecutive Missing Tie Cluster		
3 Consecutive Missing Tie Cluster		
All Joint Ties Missing (1 Tie)		
All Joint Ties Missing (2 Ties)		
Improperly Positioned Ties (Skewed, etc.)		
Center to Center Distance Along Either Rail > 48"		
Center to Center Distance Along Rail At Joint > 48"		

Figure B-5 Tie Detailed Inspection Worksheet

*Isolated: >= two good ties separate; otherwise Adjacent. **Jt Tie Cluster: All jt ties are defective. If a work order is to be issued for a specific item, state location and defect on reverse. Categorize tie clusters on designated curves separately.

Turnout Inspection Worksheet (Components)

Figure B-6 Track Geometry Detailed Inspection Worksheet

Inspector:_____ Date:_____ Sheet _____ of _____

Track	Location	Ref Rail	Type*	BA**	Measurement	Relative***	Length	WO

Record number of defective components in each category. If “Defect Free” check “DF”. If N/A, cross out or ignore. If a work order is to be issued to correct a defect, check “WO”. Use reverse side for comments. *See specific defect in cell.

Turnout Inspection Worksheet (Components)

Track:_____ Turnout:_____ Inspector:_____ Date:_____

Component	DF	Imp. Size	Imp. Type	Loose	Imp. Pos.	Damaged	Worn	Missing	Other*	WO
Switch Stand										
Target/Lamp									Paint Faded	
Ground Throw Lever										
Point Locks/Lever Latches										
Jam Nut										
Connecting Rod										
Switch Rods										
Switch Clips									Imp. Spacer	
Connecting Rod Bolts										
Switch Rod Bolts										
Clip Bolts										
Cotter Keys										
Insulation Filler										
Switch Points (Left)									Metal Flow	
Switch Points (Right)									Metal Flow	
Switch Point Protector										
Point Rail (Left)										
Point Rail (Right)										
Point Stop (Left)										
Point Stop (Right)										
Reinforcing Bar (Left)										
Reinforcing Bar (Right)										
Reinforcing Bolts/Rivets										
Stock Rail									Metal Flow	
Straight Rail									Metal Flow	
Gauge Plate										
Rail Braces - Rigid (Left)									<4 Functional	
Rail Braces - Adjustable (L)									<4 Functional	
Rail Braces - Rigid (Right)									<4 Functional	
Rail Braces - Adjustable (R)									<4 Functional	
Slide Plates										
Turnout Plates										
Twin Tie Plates										
Heel Filler (Left)										
Heel Filler (Right)										
Heel Joint Bolts (Left)										
Heel Joint Bolts (Right)										
Heel Joint Bars (Left)										
Heel Joint Bars (Right)										
Frog (General)										
Frog Point									Metal Flow	
Frog Top Surface									Metal Flow	
SG Frog Guard Faces (Left)										
SG Frog Guard Faces (Right)										
SP Frog Hinged Wing Rail										
SP Frog Springs, etc.										
Frog Bolts										
Frog Plates										
Guard Rails (Left)										
Guard Rails (Right)										
Guard Rail Fillers (Left)										
Guard Rail Fillers (Right)										
Guard Rail Bolts (Left)										
Guard Rail Bolts (Right)										
Guard Rail Clamps (Left)										
Guard Rail Clamps (Right)										
Guard Rail Plates (Left)										
Guard Rail Plates (Right)										

Figure B-7. Turnout Inspection Worksheet (Components)

Record number of defective components in each category. If “Defect Free” check “DF”. If N/A, cross out or ignore. If a work order is to be issued to correct a defect, check “WO”. Use reverse side for comments. *See specific defect in cell.

Grade Crossing Detailed Inspection Worksheet

(Includes Rail Crossings)

Track:_____ Turnout:_____ Inspector:_____ Date:_____

Location:_____

General						**WO**
Switch Difficult to Operate	Y	N				
Rail Weight or Section Change	Y	N				
Debris in Crib Area	Y	N				
Line and Surface	DF	Good	Fair	Marginal	Poor	
Less Than 4 Functional Rail Braces (Left)	Y	N				
Less Than 4 Functional Rail Braces (Right)	Y	N				

Ties	**Tie Size**	**WO**
Defective		
Defective Joint		
Skewed		

Defective Tie Clusters	**2**	**3**	**4**	**5**	**WO**
Isolated					
Adjacent					
Isolated w/1 Joint Tie					
Joint Tie Cluster					

Measurements (Left)		**WO**	**Measurements (Right)**		**WO**
Switch Point Gap (Left)			Switch Point Gap (Right)		
Gauge at Switch Point			Comments:		
Gauge at Switch Heel					
Gauge at Joint in Curved Closure Rail (1st)					
Gauge at Joint in Curved Closure Rail (2nd)					
Gauge at Frog Toe (Left)			Gauge at Frog Toe (Right)		
Gauge at Frog Point (Left)			Gauge at Frog Point (Right)		
Gauge at Frog Heel (Left)			Gauge at Frog Heel (Right)		
Frog Flangeway Width (Left)			Frog Flangeway Width (Right)		
Frog Flangeway Depth (Left)			Frog Flangeway Depth (Right)		
Guard Rail Flangeway Width (Left)			Guard Rail Flangeway Width (Right)		
Guard Check Gauge (Left)			Guard Check Gauge (Right)		
Guard Face Gauge (Left)			Guard Face Gauge (Right)		

Figure B-8. Turnout Inspection Worksheet (General, Ties and Measurements)

If a crossing is “Defect Free,” so state. If a work order is to be issued to correct a defect, check “WO” box. Use reverse side for comments. *See RAILER Defect List. **Record flangeway width/depth and affected length, if improper.

Grade Crossing Detailed Inspection Worksheet

(Includes Rail Crossings)

Inspector:_____ Date:_____ Sheet _____ of _____

Track	Location	Name	Defect* or Measurement**	Qty	UM	WO

Figure B-9. Grade Crossing Detailed Inspection Worksheet (Includes Rail Crossings)

If a crossing is "Defect Free," so state. If a work order is to be issued to correct a defect, check "WO" box. Use reverse side for comments. *See RAILER Defect List. **Record flangeway width/depth and affected length, if improper.

Rail, F+OTM, Ballast, Drainage, and Appliances Detailed Inspection Worksheet
(Includes Inspection Impaired)

Track:_____ Segment:_____ Inspector:_____ Date:_____
Begin Location:_____ End Location:_____ Sheet _____ of _____

Location*	Rail	Component**	Defect***	Length	Density	Qty	UM	WO

Figure B-10. Rail, F+OTM, Ballast, Drainage, and Appliances Detailed Inspection Worksheet
(Includes Inspection Impaired)

If a work order is to be issued, check “WO” box. Use reverse side for comments. *Record multiple rail defects in the same rail as the same location. **Rail, F+OTM, etc. ***See RAILER Defect List. If a component is “Defect Free”, so state..

APPENDIX C

FIELD IDENTIFICATION OF RAIL DEFECTS

C-1. RAIL DEFECTS MAY BE OBSERVED IN TRACK. Table 7-1 presents a listing of rail defects and appropriate maintenance and safety standards. This appendix presents definitions relating to rail and brief descriptions of the common rail defects observed in track. Figure C-1 presents common rail nomenclature, and Figure C-2 shows the relative positions of planes through the rail.

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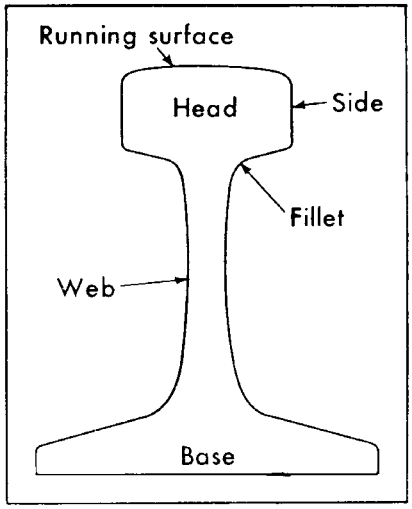


Figure C-1. Rail Nomenclature

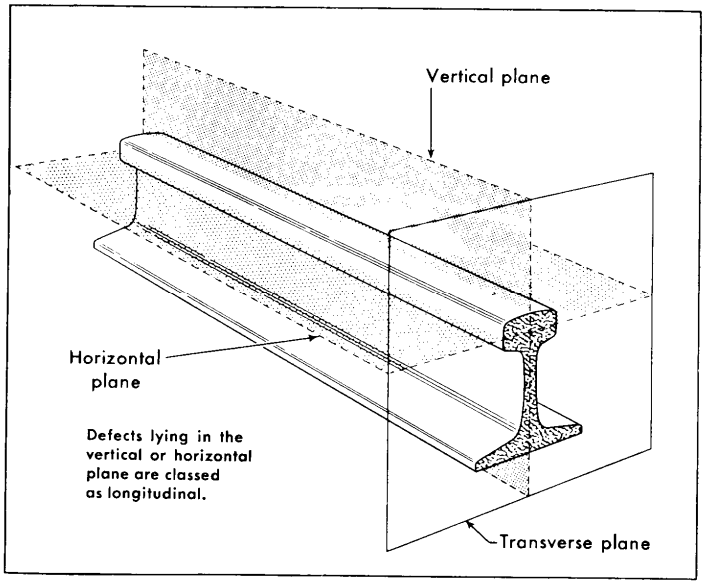


Figure C-2. Relative Positions of Planes Through a Rail

C-2. DEFINITION OF TERMS. The following are common terms related to rail and rail defects. For Navy installations, NAVFAC MO-103 presents additional terms and information.

a. *Bleeding*. Reddish-brown streak on a rail indicating internal rusting.

b. *Field Side*. The side of the rail away from the wheel flange.

c. *Gage Side*. The side of the rail closest to the wheel flange.

d. *Head Checks*. Transverse surface cracks on the gage corner of rails resulting from cold-working the surface metal; sometimes referred to as gage checks.

e. *Percent Size*. The percentage of rail head cross-sectional area weakened by a rail defect. Used only with transverse defects.

f. *Relaid Rail*. Rail that is worn but still usable, taken from track and reused in another location. Sometimes referred to as relayer rail.

g. *Shatter Crack*. Initiation of a transverse fissure resulting from entrapped hydrogen gas present in a steel rail that was cooled too rapidly. Control-cooling the rails and vacuum-degassing the molten steel have practically eliminated the hydrogen problem.

h. *Transposed Rail*. Rail that is moved from one side of the track to the other side without turning the rail so that the gage and field sides are interchanged.

i. *Tread*. The path of wheel in contact with the running surface of the rail.

j. *Turned Rail*. Rail with some wear that has been removed, turned, and replaced in track so the gage and field sides are interchanged.

C-3. FIELD IDENTIFICATION OF RAIL DEFECTS. These descriptions are presented in alphabetical order to assist in identifying defective rails in track. Refer to NAVFAC MO-103 for additional information.

a. *Bolt Hole Crack*.

(1) *Description.* A progressive fracture originating at a bolt hole.

(2) *Appearance in Track.* Bolt hole cracks are not visible until a bolt or a joint bar has been removed unless the defect has progressed beyond the bar. They may be recognized by a hairline crack extending from the bolt hole (Figure C-3).

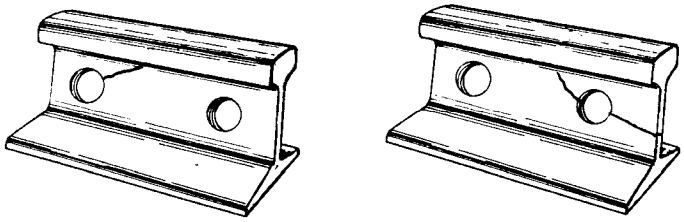


Figure C-3. General Appearance of Bolt Hole Cracks

b. *Broken Base*.

(1) *Description.* Any break in the base of the rail.

(2) *Appearance in Track*. Generally appears as a half-moon crack break in the rail base. Figure C-4 illustrates three different appearances of broken bases.

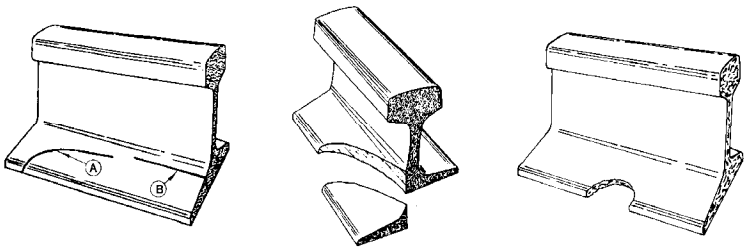


Figure C-4. General Appearance of Broken Base

c. *Complete Break (Broken Rail)*.

(1) *Description.* A complete transverse separation of the head, web, and base of the rail in which there is no sign of a fissure and in which none of the other defects described herein are found.

(2) *Appearance in Track.* May appear as a hairline crack running completely around the rail, usually accompanied by bleeding or a separation of the rail at the break with one or both of the broken ends battered down (Figure C-5).

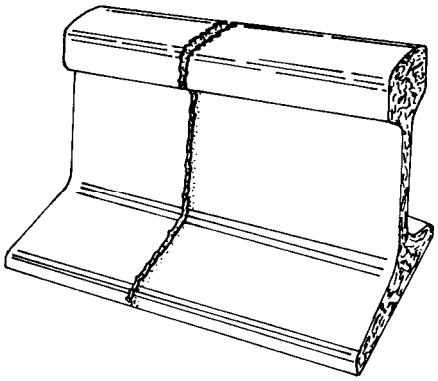


Figure C-5. General Appearance of Broken Rail

d. *Compound Fissure*. See "Transverse Defects," paragraph C-3.z.

e. *Corrosion*.

(1) *Description.* The decaying or corroding of the metal in the web or base of the rail.

(2) *Appearance in Track*. Pits or cavities in the upper base or the web of the rail. In advanced stages, a significant loss of material is evident.

f. *Corrugation*.

(1) *Description.* A repeated wavelike pattern on the running surface of the rail. Corrugations develop over a long period of time. A number of factors contribute to the development of corrugations with the actual cause dependent on the track and operating conditions.

(2) *Appearance in Track.* Small, hard, bright, short-pitch ridges along the running surface of the rail, varying anywhere from 2 to 18 inches apart and usually less than 0.0625 inch deep. Although the individual waves (ridges) are usually only a short distance apart, the corrugations may extend over a considerable distance (Figure C-6).

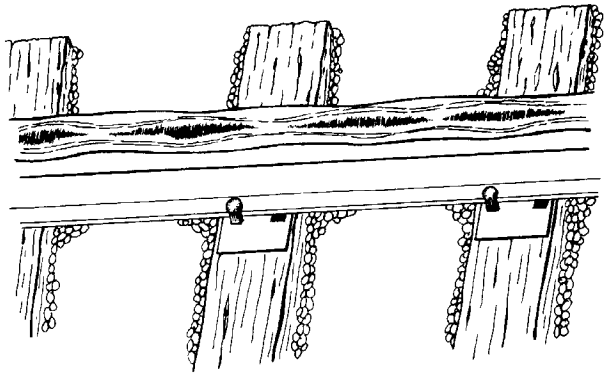


Figure C-6. General Appearance of Corrugation

g. ***Crushed (Flattened) Head*.**

(1) *Description.* The flattening of several inches of the rail head is generally caused by a soft spot in the steel. A crushed head is usually accompanied by a crushing down of the metal but with no signs of cracking in the fillet under the head. The origin of a crushed head is usually a soft spot in the steel of the head, which gives way under heavy wheel loads.

(2) *Appearance in Track.* Generally appears as:

(a) Flattening and widening of the head for several inches with the entire head sagging.

(b) Small cracks in a depression on the running surface.

(c) In advanced stages, a bleeding crack may be present at the fillet under the head (Figure C-7).

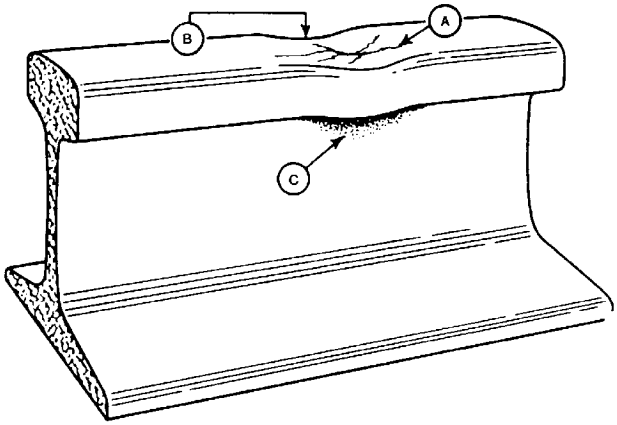


Figure C-7. General Appearance of Crushed Head

h. ***Defective Weld*.**

(1) *Description.* A progressive transverse separation within an area where two rails have been joined by welding or a rupture at a weld due to incomplete penetration of weld metal between the rail ends, lack of fusion, entrainment of slag and sand, or shrinkage cracking or fatigue cracking.

(2) *Appearance in Track.* No outward sign is visible until the separation reaches the rail surface. A defective weld may then be recognized by a vertical bleeding crack at the welded portion of the rail joint where the separation has reached the surface.

i. ***Detail Fracture*****.** See "Transverse Defects," paragraph C-3.z.

j. ***End Batter*****.**

(1) *Description.* Damage caused by wheels striking the rail ends.

(2) *Appearance in Track.* Appears as damage to or a depression in the top surface of the rail head at the ends of the rail (Figure C-8).

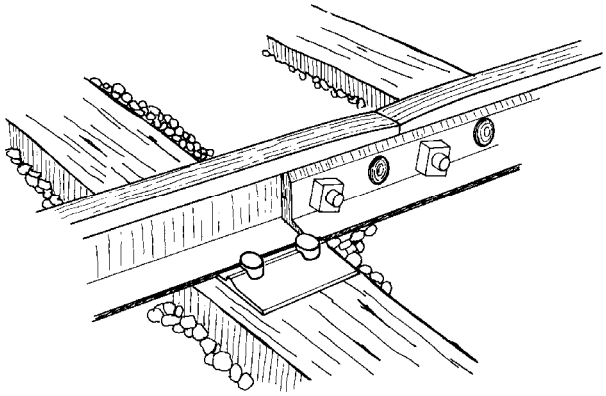


Figure C-8. Rail End Batter

k. ***Engine Burns (Burned Rail)*****.**

(1) *Description.* Rail that has been scarred on the running surface by the friction of a slipping locomotive.

(2) *Appearance in Track.* Round or oval rough spots or holes on the tread of the running surface. Engine burns may be deep (Figure C-9).

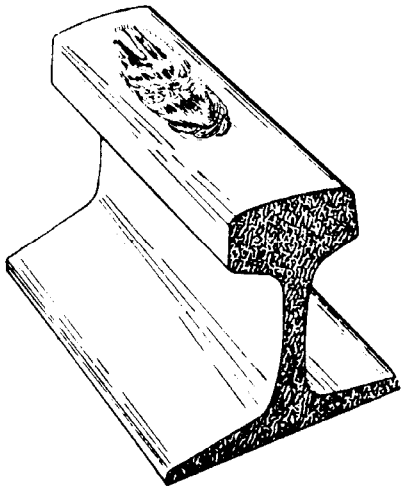


Figure C-9. Typical Appearance of Engine Burn

l. ***Engine Burn Fracture*****.**

(1) *Description.* A progressive fracture in the rail head starting from a point where engine wheels have slipped and burned the rail.

(2) *Appearance in Track.* No sign of transverse separation is visible until the defect reaches the rail surface (cracks out.) An engine burn fracture may then be recognized by one or more of the following characteristics:

(a) A hairline crack on the side of the head in the immediate vicinity of an engine burn and at right angles to the running surface. The crack may be visible on either the field or gage side of the head. An engine burn may lead to an engine burn fracture.

(b) Transverse thermal cracks extending from the burn to the gage corner and down the side of the head for at least 0.125 inch.

(c) A cracked-out horizontal separation on the field side of the rail head under the burned area often accompanied by one or more thermal cracks extending transversely to the gage corner (Figure C-10.)

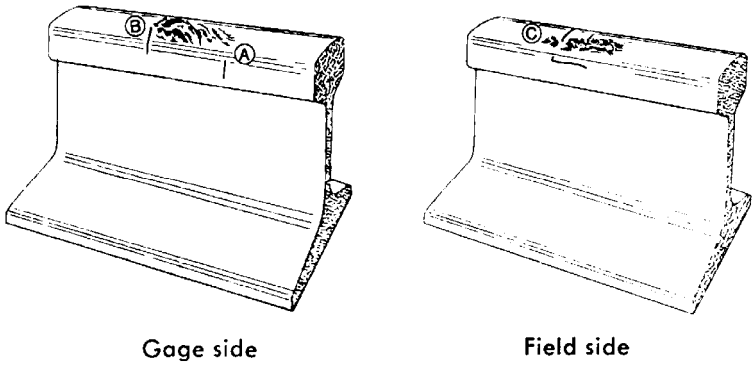


Figure C-10. General Appearance of Engine Burn Fracture

m. *Flaking*.

(1) *Description.* A progressive horizontal separation on the running surface near the gage corner, often accompanied by scaling or chipping. Flaking should not be confused with shelling as flaking occurs only on the running surface near the gage corner and is not as deep as shelling.

(2) *Appearance in Track.* Can be recognized by one or more of the following characteristics:

(a) Shallow depressions with irregular edges occurring on the running surface near the gage corner. Generally, flaking will occur within 0.25 inch of the corner of the rail.

(b) Horizontal hairline cracks along the running surface near the gage corner of the rail head, resembling small slivers (Figure C-11.)

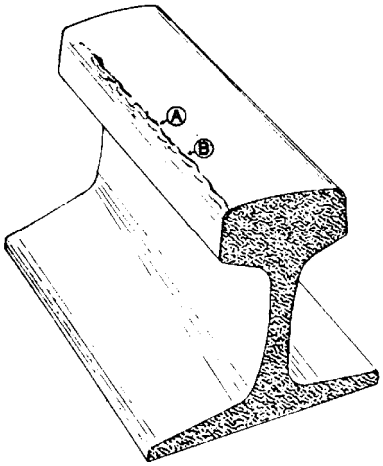


Figure C-11. General Appearance of Flaking

n. *Flowed Rail*.

(1) *Description.* A rolling out of the tread metal beyond the field or gage corner with no breaking down of the underside of the head.

(2) *Appearance in Track.*

(a) Surface metal on the head flowed toward the field side giving a creased appearance on the running surface near the field corner.

(b) A protruding lip extending along the length of the rail.

(c) In the advanced stage, flow becomes blade-like, jagged, or nonuniform and may hang down or separate from the rail head (Figure C-12.)

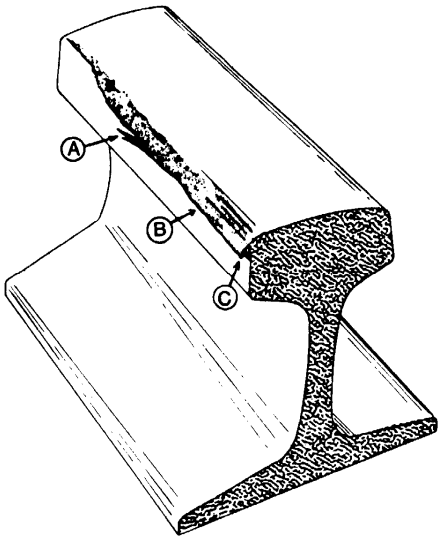


Figure C-12. General Appearance of Flow

o. *Head/Web Separation*.

(1) *Description.* A progressive fracture separating the head and web of the rail at the head fillet area.

(2) *Appearance in Track.* Can be recognized by one or more of the following characteristics:

(a) In earlier stages, wavy lines appearing along the fillet under the head.

(b) As the condition develops, a small crack will appear along the fillet on either side, progressing longitudinally with slight irregular turns upward and downward.

(c) In advanced stages, bleeding cracks will extend downward from the longitudinal separation through the web and may extend through the base (Figure C-13).

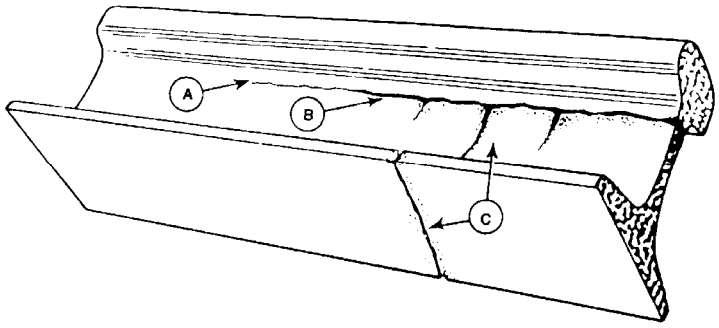


Figure C-13. General Appearance of Head/Web Separation

p. ***Horizontal Split Head*.**

(1) *Description.* A progressive longitudinal fracture in the rail head parallel to the running surface, usually 0.25 inch or more below the running surface.

(2) *Appearance in Track.*

(a) Before cracking out, a moderate size horizontal split head will appear as a flat spot on the running surface, often accompanied by a slight widening or dropping of the rail head. The flat spot will be visible as a dark spot on the bright running surface.

(b) After cracking out, the horizontal split head will appear as a hairline crack in either side or both sides of the rail head, usually 0.25 inch or more below the top of the rail head (Figure C-14).

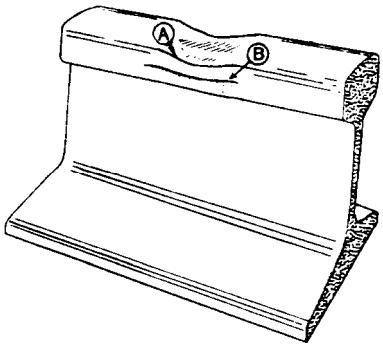


Figure C-14. General Appearance of Horizontal Split Head

q. ***Mill Defects*.**

(1) *Description.* Deformations, cavities, seams, or foreign material found in the head, web, or base of the rail.

(2) *Appearance in Track.* Any deformation in the rail, broken-out area, or inclusion (Figure C-15).

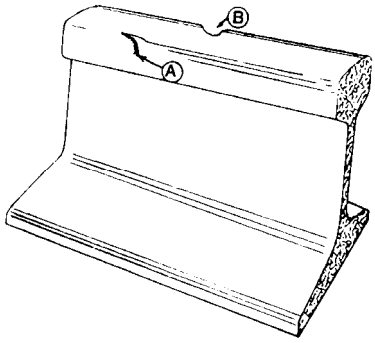


Figure C-15. General Appearance of Mill Defects

r. ***Piped Rail*.**

(1) *Description.* A progressive longitudinal fracture in the web of the rail with a vertical separation or seam, forming a cavity in the advanced stages of development.

(2) *Appearance in Track.*

(a) A bulging of the web on either or both sides. Shallow cracks due to distortion may be found in the bulging surface.

(b) A slight sinking of the rail head may exist above the pipe (Figures C-16 and C-17).

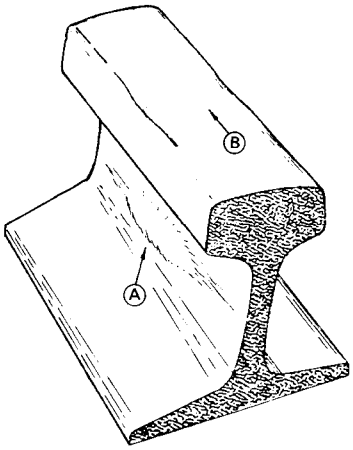


Figure C-16. General Appearance of Piped Rail

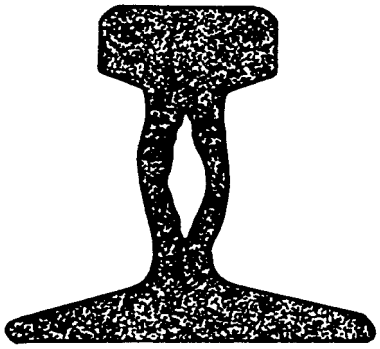


Figure C-17. Cross-sectional View of Piped Rail

s. ***Rail Wear.***

(1) *Description.* The loss of material from the running surface and side of the rail head due to the passage of wheels over the rail.

(2) *Appearance in Track.* Rail wear appears as a rounding of the running surface of the rail head, particularly on the gage side (Figure C-18).

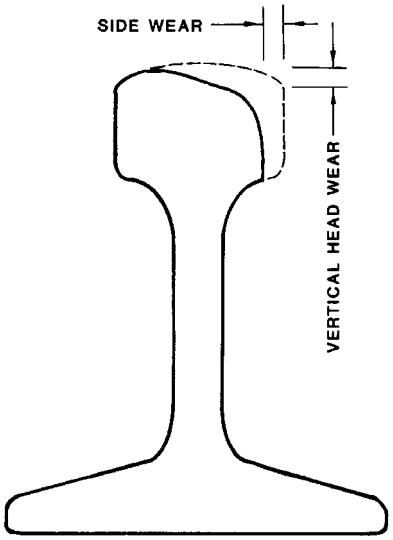


Figure C-18. General Appearance of Vertical Head and Side Wear

t. *Shelling*.

(1) *Description.* A progressive horizontal separation, which may crack out at any level on the gage side but generally at the gage corner. It extends longitudinally not as a true horizontal or vertical crack, but at an angle related to the amount of rail wear.

(2) *Appearance in Track.* Appears as one or more of the following:

(a) Dark spots irregularly spaced on the gage side of the running surface.

(b) Longitudinal separation at one or several levels in the upper gage corner with discoloration from bleeding.

(c) If the rail has been turned, the shelly spots will appear on the field side with an irregular overhanging lip of metal similar to flowed rail (Figure C-19).

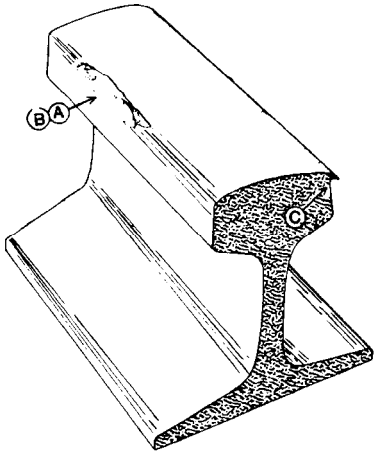


Figure C-19. General Appearance of Shelling

u. *Slivers*.

(1) *Description.* A sliver is the separation of a thin, tapered mass of metal from the surface of the head, web, or base of a rail.

(2) *Appearance in Track.* Thin slivers on the surface of the rail head and parallel to the rail length similar to wood slivers (Figure C-20).

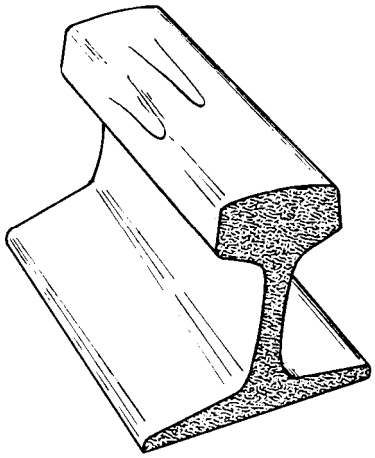


Figure C-20. General Appearance of Slivers

v. *Split Web*.

(1) *Description.* A progressive fracture through the web in a longitudinal and/or transverse direction.

(2) *Appearance in Track.* Horizontal and/or vertical bleeding cracks in the web (Figure C-21).

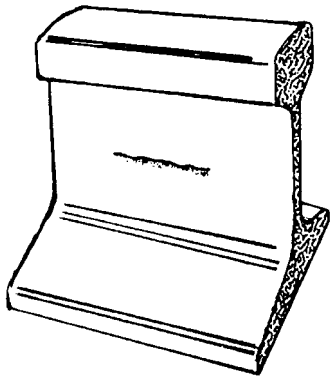


Figure C-21. General Appearance of Split Web

w. *Surface Bent Rail*.

(1) *Description.* The permanent downward bending of the rail ends due to long-term passage of traffic over track with loose or poorly supported joints. Surface bent rail cannot be corrected without replacing the rail.

(2) *Appearance in Track.* A downward bending of the rail head near the rail ends giving the appearance of low joints. When track with surface bent rail is surfaced

(raised and tamped), the rail ends soon return to a lower elevation. In the more serious cases the vertical curve in the rail head is still visible after surfacing.

x. *Surface Damage*.

(1) *Description.* Any damage to the surfaces of the rail, both the running surface and the external surfaces, caused by deep engine burns (running surface) or by striking the rail. Surface damage may lead to detail fractures or engine burn fractures.

(2) *Appearance in Track.* Deep engine burns, dents, nicks, cuts, or other abnormalities on the surface of the rail.

y. *Torch Cut Rail.*

(1) *Description.* Any rail that is cut or otherwise modified (including bolt holes) using an acetylene torch or other open flame.

(2) *Appearance in Track.* Irregular or rough rail ends and/or bolt holes (Figure C-22).

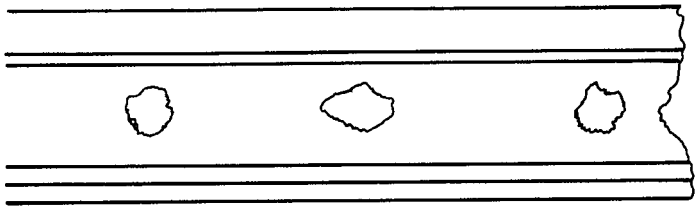


Figure C-22. General Appearance of Torch-Cut Rail

z. *Transverse Defects*. Compound fissure, transverse fissure, and detail fracture.

(1) *Description.* Any progressive fracture occurring in the rail head having a transverse separation, however slight. The exact type of transverse defect cannot be determined until after the rail is broken for examination.

(2) *Appearance in Track.* Not visible until the defect reaches an outer surface. A transverse defect may be recognized by one or more of the following characteristics:

(a) A hairline crack on the side of the head at right angles to the running surface, at the fillet under the head, and occasionally on the running surface.

(b) Bleeding (rust streaking) at the crack.

(c) A hairline crack at the gage corner of the rail head. On turned rail, this condition may occur at the field corner. Numerous small gage cracks or head checks are often present but should not cause suspicion unless a single crack extends much farther down the side and/or across the running surface.

(d) A horizontal hairline crack in the side of the rail head turning upward or downward at one or both ends, usually accompanied by bleeding. Under such conditions a flat spot will generally be present on the running surface.

(e) A hairline crack extending downward at right angles from a horizontal crack caused by shelling of the upper gage corner of the rail head (Figure C-23).

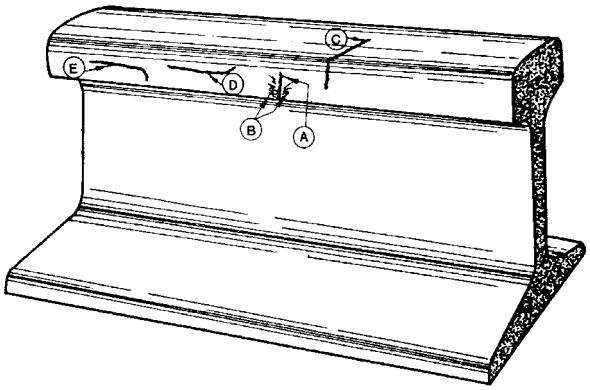


Figure C-23. General Appearance of Transverse Defects

aa. ***Vertical Split Head*****.**

(1) *Description.* A progressive longitudinal fracture in the head of the rail perpendicular to the running surface and is visible to a track inspector.

(2) *Appearance in Track.* Can be recognized by one or more of the following:

(a) A dark streak on the running surface.

(b) Widening of the head for the length of the split. The cracked side of the head may show signs of sagging.

(c) Sagging of the head causing a rust streak to appear on the fillet under the head.

(d) A hairline crack near the middle of the rail head.

(e) In advanced stages, a bleeding crack is apparent on the rail surface and in the fillet under the head (Figure C-24).

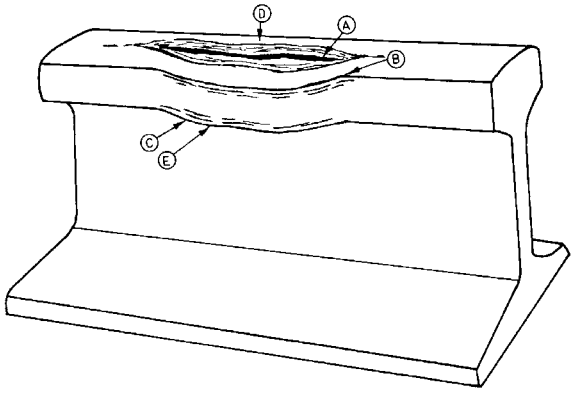
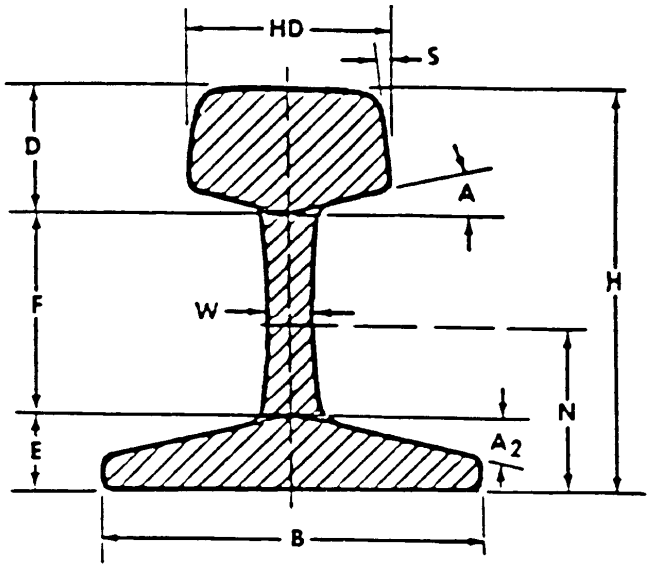


Figure C-24. General Appearance of Vertical Split Head

APPENDIX D

DETAILS OF RAIL SECTIONS

D-1. Table D-1 of this appendix presents a listing of dimensions and properties for various rail sections. This table can be used with Figure D-1 to assist in identifying rail sections and estimating amounts of rail wear.



(See Table D-1 for key)

Figure D-1. Details of T-Rail Section

Table D-1. Details of Rail Sections

		Manufacturer's Brand							Rail Dimensions (Inches)									
Section	Weight Per yard	Ill. Steel Co. Old No.	Ill. Steel Co. Carnegie Steel Co. T C & I Co. Inland steel Co. U. S. Steel Corp.	Midvale Steel Co.	Bethlehem Steel Co. Old No.	Bethlehem Steel Co. New No.	Lackawana Steel Co.	Colorado F & I Co.	Height (H)	Base (B)	Head (HD)	Web (W)	Depth of Head (D)	Fishing Height (F)	Depth Of Base (E)	Head angle (A)	Base angle (A_2)	CL of bolts (N)
AREA	140	--	--	--	--	140RE	--	--	7-5/16	6	3	3/4	2-1/16	4-1/16	1-3/16	3 to 1	4 to 1	4
AREA	136	--	--	--	--	136RE	--	1360	7-5/16	6	2-15/16	11/16	1-15/16	4-3/16	1-3/16	4 to 1	4 to 1	3-3/4
AREA	133	--	13331	--	--	133RE	--	1330	7-1/16	6	3	11/16	1-15/16	3-15/16	1-3/16	3 to 1	4 to 1	3-3/4
AREA	132	--	13225	--	--	132RE	--	1321	7-1/8	6	3	21/32	1-3/4	4-3/16	1-3/16	4 to 1	4 to 1	3-7/8
AREA	131	--	13128	--	--	131RE	--	1311	7-1/8	6	3	21/32	1-3/4	4-3/16	1-3/16	4 to 1	4 to 1	4-1/4
AREA	130	--	13025	--	--	130RE	--	1300	6-3/4	6	2-15/16	21/32	1-27/32	3-11/16	1-7/32	4 to 1	4 to 1	3-3/8
AREA	119	--	--	--	--	119RE	--	1190	6-13/16	5-1/2	2-21/32	5/8	1-7/8	3-13/16	1-1/8	4 to 1	4 to 1	3-1/4
AREA	115	--	11525	--	--	115RE	--	1150	6-5/8	5-1/2	2-23/32	5/8	1-11/16	3-13/16	1-1/8	4 to 1	4 to 1	3-1/4
AREA	112	--	11228	--	--	112RE	--	1121	6-5/8	5-1/2	2-23/32	19/32	1-11/16	3-13/16	1-1/8	4 to 1	4 to 1	3-3/4
AREA	110	--	11025	--	--	110RE	--	1100	6-1/4	5-1/2	2-25/32	19/32	1-23/32	3-13/16	1-1/8	4 to 1	4 to 1	3-1/8
AREA	100	--	10025	--	--	100RE	--	10025	6	5-3/8	2-11/16	9/16	1-21/32	3-9/32	1-1/16	4 to 1	4 to 1	2-31/32
ARA-A	100	10020	10020	565	163	100RA	10031	--	6	5-1/2	2-3/4	9/16	1-9/16	3-3/8	1-1/16	4 to 1	4 to 1	2-3/4
ARA-A	90	9020	9020	563	170	90RA	9031	902	5-5/8	5-1/8	2-9/16	9/16	1-15/32	3-5/32	1	4 to 1	4 to 1	2-37/64
ARA-A	80	8020	8020	--	169	--	8031	801	5-1/8	4-5/8	2-1/2	33/64	1-7/16	2-23/32	31/32	4 to 1	4 to 1	2-21/64
ARA-A	70	7020	7020	--	--	--	--	--	4-3/4	4-1/4	2-3/8	1 / 2	1-11/32	2-1/2	29/32	4 to 1	4 to 1	2-5/32
ARA-A	60	6020	6020	--	--	--	--	--	4-1/2	4	2-1/4	15/32	1-15/64	2-29/64	13/16	4 to 1	4 to 1	2-5/128
ARA-B	100	10030	10030	564	161	100RB	10032	1002	5-41/64	5-9/64	2-31/32	9/16	1-45/64	2-55/64	1-5/64	13°	13°	2-65/128
ARA-B	90	9030	9030	561	162	90RB	9032	905	5-17/64	4-49/64	2-9/16	9/16	1-39/64	2-5/8	1-1/32	13°	13°	2-11/32
ARA-B	80	8030	8030	569	171	--	8032	--	4-15/64	4-7/16	2-7/16	35/64	1-15/32	2-15/32	1	13°	13°	2-15/64
ARA-B	70	7030	7030	--	174	--	--	--	4-35/64	4-3/64	2-3/8	33/64	1-23/64	2-17/64	59/64	13°	13°	2-7/128
ARA-B	60	6030	6030	--	--	--	--	--	4-3/16	3-11/64	2-1/8	31/64	1-1/4	2-1/16	7/8	13°	13°	1-29/32
ASCE	100	10001	10040	536	247	100AS	1000	--	5-3/4	5-3/4	2-3/4	9/16	1-45/64	3-5/64	31/32	13°	13°	2-65/128
ASCE	90	9002	9040	535	245	90AS	900	--	5-3/8	5-3/8	2-5/8	9/16	1-19/32	2-55/64	59/64	13°	13°	2-45/128
ASCE	85	8504	8540	531	235	85AS	850	851	5-3/16	5-3/16	2-9/16	9/16	1-35/64	2-3/4	57/64	13°	13°	2-17/64
ASCE	80	8004	8040	530	251	80AS	800	800	5	5	2-1/2	35/64	1-1/2	2-5/8	7/8	13°	13°	2-3/16
ASCE	75	7506	7540	529	214	75AS	750	753	4-13/16	4-13/16	2-15/32	17/32	1-27/64	2-35/64	27/32	13°	13°	2-15/128
ASCE	70	7010	7040	532	237	70AS	700	701	4-5/8	4-5/8	2-7/16	33/64	1-11/32	2-15/32	13/16	13°	13°	2-3/64
ASCE	65	6507	6540	534	236	65AS	650	653	4-7/16	4-7/16	2-13/32	1 / 2	1-9/32	2-3/8	25/32	13°	13°	1-31/32
ASCE	60	6015	6040	533	244	60AS	600	603	4-1/4	4-1/4	2-3/8	31/64	1-7/32	2-17/64	49/64	13°	13°	1-115/128
ASCE	55	5501	5540	537	130	55AS	550	--	4-1/16	4-1/16	2-1/4	15/32	1-11/64	2-11/64	23/32	13°	13°	1-103/128
ASCE	50	5005	5040	542	129	50AS	500	--	3-7/8	3-7/8	2-1/8	7/16	1-1/8	2-1/16	11/16	13°	13°	1-23/32

Notes: See Figure D-1 for key All dimensions in inches **(Sheet 1 of 3)**

Table D-1 - Details of Rail Sections (Cont'd)

		Manufacturer's Brand							Rail Dimensions (Inches)									
Section	Weight Per yard	Ill. Steel Co. Old No.	Ill. Steel Co. Carnegie Steel Co. T C & I Co. Inland steel Co. U. S. Steel Corp.	Midvale Steel Co.	Bethlehem Steel Co. Old No.	Bethlehem Steel Co. New No.	Lackawana Steel Co.	Colorado F & I Co.	Height (H)	Base (B)	Head (HD)	Web (W)	Depth of Head (D)	Fishing Height (F)	Depth Of Base (E)	Head angle (A)	Base angle (A_2)	CL of bolts (N)
AT&SF	90	9021	9021	--	173	90SF	9033	903	5-5/8	5-3/16	2-9/16	9/16	1-15/32	3-5/32	1	4 to 1	4 to 1	2-37/64
Bang & Aroost.	70	--	--	--	--	--	703	--	4-3/4	4-3/4	2-7/16	1 / 2	1-13/32	2-19/32	3 / 4	12º	12º	2-3/64
Can Nor	80	8010	8010	--	--	--	804	--	5	5	2-9/16	35/64	1-13/32	2-11/16	29/32	13º	13º	2-1/4
Can Pac	85	--	8524	--	176	85CP	856	--	5-1/8	5	2-1/2	9/16	1-7/16	2-11/16	1	4 to 1	4 to 1	2-11/32
Can Pac	65	6508	6508	--	--	--	654	--	4-31/64	4-3/8	2-1/4	15/32	1-9/32	2-11/32	35/64	4 to 1	4 to 1	2-1/32
C of NJ	135	--	--	--	290	--	--	--	6-1/2	6	3-5/32	3 / 4	2	3-9/32	1-7/32	14º	14º	2-55/64
C & A	70	7002	--	--	--	--	--	--	4-3/8	4	2-35/96	35/64	1-17/24	1-11/12	3 / 4	12º	12º	1-17/24
DL & W	105	--	--	--	105-C	105DL	1052	--	6	5-3/8	2-3/4	5/8	1-23/32	3-1/4	1-1/32	13º	13º	2-21/32
DL & W	101	--	10133	--	299	101DL	10130	--	5-7/16	5-3/8	2-3/4	5/8	1-23/32	2-11/16	1-1/32	13º	13º	2-3/8
DL & W	91	--	9133	--	91-B	--	911	--	5-1/4	5-3/8	2-5/8	5/8	1-41/64	2-11/16	59/64	13º	13º	2-17/64
DL & W	75	--	--	--	75-C	--	753	--	4-11/16	5	2-1/2	1 / 2	1-43/64	2-13/64	13/16	18º	12º45'	1-117/128
Dudley	90	--	--	--	--	--	901	--	5-1/2	5	2-21/32	9/16	1-1/2	3-1/32	31/32	4 to 1	4 to 1	2-31/64
EJ & E	100	--	10050	--	--	--	--	--	5-9/16	5	2-21/32	9/16	1-37/64	2-51/64	1-3/16	4 to 1	4 to 1	2-75/128
Frictionless	125-1/2	--	--	--	125.5-F	--	--	--	7	5-1/2	1-13/16	11/16	2-3/8	3-13/32	1-7/32	18º	14º	2-3/4
Frictionless	98	--	--	--	305	--	--	--	5-27/32	5	2-1/2	9/16	1-31/32	2-25/32	1-3/32	15º	13º	2-31/64
Frictionless	97	--	--	--	97-B	--	--	--	5-7/8	5-9/64	2-1/4	9/16	1-15/16	2-55/64	1-5/64	13º	13º	2-65/128
Frictionless	93	--	--	--	--	--	932	--	6-1/8	5-1/2	2-1/8	19/32	1-13/16	3-3/8	15/16	13º	13º	2-5/8
Frictionless	92	--	--	--	304	---	--	--	5-7/16	5-3/8	1-15/16	5/8	2-3/32	2-5/16	1-1/32	13º	13º	2-3/16
Frictionless	90	--	9039	--	--	--	--	--	5-5/8	5-1/8	2-1/4	9/16	2	2-5/8	1	13º	13º	2-5/16
Frictionless	90	--	9029	--	--	--	--	--	6-3/32	5-1/8	1-59/64	9/16	1-15/16	3-5/32	1	4 to 1	4 to 1	2-37/64
Frictionless	79-1/2	--	--	--	79.5-C	--	--	--	5-3/16	5-3/16	1-15/16	9/16	2-1/32	2-9/32	7/8	13º	13º	2-1/64
Grt Nor	110	--	11036	--	--	110GN	--	--	6-1/2	5-1/2	2-3/4	19/32	1-5/8	3-3/4	1-1/8	1 to 4	1 to 4	3-1/4
Grt Nor	100	--	10036	--	--	100GN	1008	--	5-3/4	5	2-3/4	9/16	1-5/8	3	1-1/8	1 to 4	1 to 4	2-5/8
Grt Nor	90	9010	9024	560	160	90GN	9030	904	5-3/8	5	2-5/8	5/8	1-1/2	2-7/8	1	13º	13º	2-7/16
Grt Nor	90	--	9036	--	--	--	--	--	5-3/8	5	2-5/8	19/32	1-15/32	2-7/8	1-1/32	13º	13º	2-13/16
Grt Nor	85	8509	8553	--	--	--	854	--	5	5	2-21/32	21/32	1-19/32	2-1/2	29/32	14º	14º	2-5/32
Grt Nor	80	8009	--	--	--	--	802	--	5	5	2-13/32	5/8	1-5/8	2-1/2	7/8	14º	14º	2-1/8
Grt Nor	77-1/2	77501	--	--	--	--	775	--	5	5	2-3/8	5/8	1-11/16	2-1/2	13/16	14º	14º	2-1/16
Hock Val	80	--	--	540	--	--	--	--	5	4-59/64	2-31/64	29/64	1-95/128	2-25/64	111/128	13º	13º	2-1/16
Interb'g'h	100	10005	10005	--	100-E	100RT	1005	--	5-3/4	5-3/4	2-7/8	9/16	1-45/64	3-5/64	31/32	13º	13º	2-65/128
Interb'g'h	90	--	9050	--	90-E	90RT	902	--	5	5	2-7/8	11/16	1-25/32	2-11/32	7/8	13º	13º	2-3/64
Lehigh Val	136	--	--	--	136-C	136LV	--	--	7	6-1/2	2-15/16	21/32	1-7/8	3-7/8	1-1/4	4 to 1	4 to 1	3-1/16
Lehigh Val	110	--	11033	--	110-B	110LV	--	--	6	5-1/2	2-7/8	19/32	1-7/8	3-1/16	1-1/16	4 to 1	4 to 1	2-3/4
Mo Pac	85	8507	8550	--	--	--	853	--	5-7/32	5-1/4	2-15/32	75/128	1-3/4	2-39/64	55/64	13º	13º	2-21/128
Mo Pac	75	7512	7550	528	289	75MP	754	--	4-3/4	4-3/4	2-9/16	9/16	1-7/16	2-15/32	27/32	13º	13º	2-5/64
Nat Ry Mex	75	--	--	--	128	--	--	--	5	5	2-3/4	1 / 2	1-3/8	2-7/8	3/4	12º	12º	2-3/16

Notes: See Figure D-1 for key All dimensions in inches **(Sheet 2 of 3)**

Table D-1 - Details of Rail Sections (Concluded)

		Manufacturer's Brand							Rail Dimensions (Inches)									
Section	Weight Per yard	Ill. Steel Co. Old No..	Ill. Steel Co. Carnegie Steel Co. T C & I Co. Inland steel Co	Midvale Steel Co.	Bethlehem Steel Co. Old No.	Bethlehem Steel Co. New No.	Lackawana Steel Co.	Colorado F & I Co.	Height (H)	Base (B)	Head (HD)	Web (W)	Depth of Head (D)	Fishing Height (F)	Depth Of Base (E)	Head angle (A)	Base angle (A_2)	CL of bolts (N)
NYC	120	--	--	--	--	--	1201	--	7	6	3	21/32	1-5/8	4-5/16	1-1/16	4 to 1	4 to 1	3-7/32
NYC	105	--	10522	--	105-B	105DY	1051		6	5-1/2	3	5/8	1-5/8	3-13/32	31/32	4 to 1	4 to 1	3-1/8
NYC	100	10003	10022	--	175	--	1001		6	5-1/2	3	19/32	1-5/8	3-13/32	31/32	4 to 1	4 to 1	2-5/8
NYC	95	--	--	--	--	--	951	--	5-1/32	5-1/2	3	5/8	1-9/16	2-15/32	1	4 to 1	4 to 1	2-15/64
NYC	80	8008	8022	543	220	80DY	801	--	5-1/8	5	2-21/32	17/32	1-1/2	2-5/8	1	4 to 1	4 to 1	2-5/8
NYC & St L	85	8521	8521	--	172	--	8531	--	5-3/8	4-7/8	2-17/32	17/32	1-29/64	2-15/16	63/64	4 to 1	4 to 1	2-29/64
NYNH & H	107	--	--	--	172-D	107NH	1072	--	6-1/8	5-1/2	2-3/4	19/32	1-23/32	3-11/32	1-1/16	13°	13°	2-47/64
NYNH & H	100	10004	10034	--	100	100NH	1002	--	6	5-1/2	2-3/4	19/32	1-23/32	3-11/32	1-1/16	13°	13°	2-39/64
Nor Pac	66	6602	6602	547	--	--	--	--	4-17/32	4-1/2	2-5/16	17/32	1-27/64	2-11/32	49/64	13°	13°	1-15/16
PS-Penn	130	--	13031	589	130-B	130PS	13030	--	6-5/8	5-1/2	3	11/16	2	3-13/32	1-7/32	18°	14°	2-3/4
PS-Penn	125	--	12531	584	308	125PS	12530	--	6-1/2	5-1/2	3	21/32	1-7/8	3-13/32	1-7/32	18°	14°	2-59/64
PS-Penn	100	10031	10031	558	96-A	100PS	10030	--	5-11/16	5	2-43/64	9/16	1-13/16	2-25/32	1-3/32	15°	13°	2-31/64
PS-Penn	85	8530	8531	559	67-A	85PS	8530	--	5-1/8	4-5/8	2-1/2	17/32	1-21/32	2-15/32	1	15°	13°	2-15/64
PRR	85	8503	8533	500	67	85PG	852	--	5	5	2-9/16	17/32	1-3/4	2-3/8	7/8	13°	13°	2-1/16
PRR	70	7005	7033	504	--	70PR	--	--	4-1/2	4-1/2	2-7/16	1 / 2	1-19/32	2-1/8	25/32	13°	13°	1-27/32
P & R	100	--	10032	--	165	100RG	1007	--	5-5/8	5-3/8	2-21/32	9/16	1-45/64	2-55/64	1-1/16	13°	13°	2-63/128
RG So	52	--	--	--	--	--	--	521	4	4	2-1/8	25/64	1-23/64	2	41/64	13°	13°	1-41/64
Russian	67-1/2	--	--	587	--	--	--	--	5-3/64	4-21/64	2-23/64	15/32	1-29/64	2-11/16	29/32	1 to 3	1 to 3	2-1/4
Sea A Ln	85	--	8522	--	261	--	851	--	5-1/4	5	2-11/16	17/32	1-5/8	2-3/4	7/8	14°	14°	2-1/4
Sea A Ln	75	--	7522	--	221	--	--	--	5	5	2-9/16	1 / 2	1-3/8	2-3/4	7/8	14°	14°	2-1/4
Soo Ln	85	8520	8520	--	--	--	--	--	5-3/8	4-7/8	2-1/2	9/16	1-15/32	2-29/32	1	14°02'11"	14°02'11"	2-29/64
UP	90	9003	9023	--	--	---	--	901	5-3/4	5-3/8	2-3/4	17/32	1-1/2	3-3/8	7/8	13°	13°	2-9/16
UP	75	7513	7523	--	75-B	--	--	754	5	5	2-9/16	33/64	1-3/8	2-13/16	13/16	13°	13°	2-1/4
UP	75	7524	7524	--	--	75SP	--	757	4-15/16	4-7/16	2-7/16	33/64	1-3/8	2-5/8	15/16	4 to 1	4 to 1	2-1/4
Miscell	75	--	--	--	92	--	--	--	5	5	2-1/2	9/16	1-7/16	2-47/64	53/64	13°	13°	2-1/8
Miscell	70	--	--	--	97	--	703	--	4-3/4	4-3/4	2-7/16	1 / 2	1-13/32	2-19/32	3 / 4	12°	12°	2-3/64
Miscell	67	6704	6704	515	--	--	--	--	4-1/2	4-1/2	2-13/32	1 / 2	1-5/8	2-1/8	3 / 4	13°	13°	1-13/16
Miscell	67	--	6733	--	--	--	--	--	4-1/2	4-1/2	2-13/32	1 / 2	1-5/8	2-1/8	3 / 4	13°	13°	1-13/16
Miscell	65	6501	--	--	--	--	--	--	4-3/8	4-7/16	2-3/8	29/64	1-1/2	2-5/32	23/32	14°30'	12°30'	1-51/64
Miscell	65	6504	--	--	--	--	--	--	4-1/2	4-1/2	2-7/16	1 / 2	1-31/64	2-19/64	23/32	13°	13°	1-7/8
Miscell	60	6001	6051	--	--	--	--	--	4-1/4	4-1/16	2-5/16	1 / 2	1-7/16	2-1/8	11/16	14°	12°50'	1-3/4
Miscell	60	6017	6033	503	--	--	--	--	4-1/4	4-13/64	2-21/64	29/64	1-55/128	2-7/64	91/128	13°	13°	1-49/64
Miscell	56	5610	5610	--	--	--	--	--	4-1/4	3-31/32	2-7/32	13/32	1-7/16	2-1/8	11/16	14°	12°50'	1-13/16
Miscell	56	--	--	511	--	--	--	--	4	3-53/64	2-19/64	29/64	1-51/128	2-59/64	87/128	12°	12°	1-41/64
Miscell	56	5616	5633	--	--	--	--	--	4-1/4	4-1/8	2-1/4	3/8	1-27/64	2-1/8	45/64	13°	13°	1-49/64
Miscell	56	--	--	--	--	--	--	562	4-1/4	4-1/8	2-1/4	58/128	1-7/32	2-17/64	49/64	13°	13°	1-115/128

Notes: See Figure D-1 for key All dimensions in inches **(Sheet 3 of 3)**

APPENDIX E

FAR PART 213

[Code of Federal Regulations]
[Title 49, Volume 4]
[Revised as of October 1, 2003]
From the U.S. Government Printing Office via GPO Access
[CITE: 49CFR213.233]

TITLE 49--TRANSPORTATION

CHAPTER II--FEDERAL RAILROAD ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

PART 213--TRACK SAFETY STANDARDS--Table of Contents

Subpart F--Inspection

Sec. 213.233 Track inspections.

(a) All track shall be inspected in accordance with the schedule prescribed in paragraph (c) of this section by a person designated under Sec. 213.7.
(b) Each inspection shall be made on foot or by riding over the track in a vehicle at a speed that allows the person making the
inspection to visually inspect the track structure for compliance with this part. However, mechanical, electrical, and other track inspection devices may be used to supplement visual inspection. If a vehicle is used for visual inspection, the speed of the vehicle may not be more than 5 miles per hour when passing over track crossings and turnouts, otherwise, the inspection vehicle speed shall be at the sole discretion of the inspector, based on track conditions and inspection requirements. When riding over the track in a vehicle, the inspection will be subject to the following conditions—
(1) One inspector in a vehicle may inspect up to two tracks at one time provided that the inspector's visibility remains unobstructed by any cause and that the second track is not centered more than 30 feet from the track upon which the inspector is riding;
(2) Two inspectors in one vehicle may inspect up to four tracks at a time provided that the inspectors' visibility remains unobstructed by any cause and that each track being inspected is centered within 39 feet from the track upon which the inspectors are riding;
(3) Each main track is actually traversed by the vehicle or inspected on foot at least once every two weeks, and each siding is actually traversed by the vehicle or inspected on foot at least once every month. On high density commuter railroad lines where track time does not permit an on track vehicle inspection, and where track centers are 15 foot or less, the requirements of this paragraph (b)(3) will not apply; and
(4) Track inspection records shall indicate which track(s) are traversed by the vehicle or inspected on foot as outlined in paragraph (b)(3) of this section.
(c) Each track inspection shall be made in accordance with the following schedule--

Class of track	Type of track	Required frequency
Excepted track and Class 1,2,and 3 track	Main track and sidings	Weekly with at least 3 calendar days, interval between inspections, or before use, if the track is used less than once a week, or twice weekly with at least 1 calendar day interval between inspections, if the track carries passenger trains or more than 10 million gross tons of traffic during the preceding calendar year.
Excepted track and Class 1, 2, and 3 track	Other than main track and sidings	Monthly with at least 20 calendar days interval between inspections.
Class 4 and 5 track		Twice weekly with at least 1 calendar day interval between inspections.

(d) If the person making the inspection finds a deviation from the requirements of this part, the inspector shall immediately initiate remedial action.

Note to Sec. 213.233: Except as provided in paragraph (b) of this section, no part of this section will in any way be construed to limit the inspector's discretion as it involves inspection speed and sight distance.

[Code of Federal Regulations]
[Title 49, Volume 4]
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TITLE 49--TRANSPORTATION

CHAPTER II--FEDERAL RAILROAD ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

PART 213--TRACK SAFETY STANDARDS--Table of Contents

Subpart F--Inspection

Sec. 213.235 Inspection of switches, track crossings, and lift rail assemblies or other transition devices on moveable bridges.

(a) Except as provided in paragraph (c) of this section, each switch, turnout, track crossing, and moveable bridge lift rail assembly or other transition device shall be inspected on foot at least monthly.

(b) Each switch in Classes 3 through 5 track that is held in position only by the operating mechanism and one connecting rod shall be operated to all of its positions during one inspection in every 3 month
period.

(c) In the case of track that is used less than once a month, each switch, turnout, track crossing, and moveable bridge lift rail assembly or other transition device shall be inspected on foot before it is used.

Sec. 213.239 Special inspections.

In the event of fire, flood, severe storm, or other occurrence which might have damaged track structure, a special inspection shall be made of the track involved as soon as possible after the occurrence and, if possible, before the operation of any train over that track.

APPENDIX F

SUMMARY OF STANDARDS

Summary of Standards**							
	Maintenance Standards			Safety Standards			
	Deviation for Track Category		Paragraph Reference in UFC 4-860-03	Restricted Operation 10 mph	Close to Traffic	Paragraph Reference in FRA TSS	Construction/ Repair Tolerances
Item	A	B					
Roadway	Pumping Track*		3-1	*		None	Not Present
	Erosion or Washouts*			*			
	Slides, Slippage or Slope Instability *			*			
	Settlement*			*			
	Washouts*			*			
Drainage	Water Diverted onto track*		3-2	*		213.33	
	Hazardous Drainage Structures*			*			
	Inadequate Drainage Structures*			*			
	Obstruction of flow*			*			
Vegetation	Interferes with visibility along Right-of-Way*		3-3	*		213.37	
	And at Highway Crossings						
	Obstructs drainage*			*			
	Interferes with Train Operations and/or Track Inspection*			*			
	Presents Fire Hazard*			*			
	Interferes with Personnel Walking within 8 ft of Track Centerline*			*			
	Brushes Side of Rolling Stock*			*			
Ballast	Fouled Ballast*		4-1	*		213.103	
	Covers Top of Ties*			*			
	Insufficient Ballast*			*			
Ties:						213.109	See 5-4.d.
Min. Nondefective Tie per 39 ft			5-6.c.(1)			213.109 (c) and (d)	
Tangent and LT 2 °	Less than 12	10		Less than 8	Less than 7		
Curves 2 ° or GT	Less than 13	11		Less than 10	Less than 9		

* Operating restrictions may be needed depending on seriousness of the condition.

** Further information regarding classification of defects and operating restrictions is provided in NAVFACINST 11230.1.

Summary of Standards**							
	Maintenance Standards			Safety Standards			
	Deviation for Track Category		Paragraph Reference in UFC 4-860-03	Restricted Operation	Close to Traffic	Paragraph Reference	Construction/ Repair
Item	A	B		10 mph		in FRA TSS	Tolerances
Ties – Cont'd							
Consecutive Defective Tangent and LT 2 ° Curves 2 ° or GT	 3 2	 3 2	5-5.c.(1)	 4 3	 5 or more 4 or more		0
Joint Ties:							213.109(f)
No. of Nondefective Required – 24" C/L	2	1	5-5.c.(2)	1	0		2
Missing/Skewed	Tie missing or skew greater than 8 in. in 3 or more consecutive ties		5-5.d., 5-5.e., 5-5.f.		---	---	See 5-4.d.
Tie Plates	Improper type broken flame cut or defective*		6-1 and 6-2	---	---	213.123	See 6-2.
Spikes	Improper type, broken, flame cut, or defective.		6-1 and 6-3	---	---	213.127	See 6-3
	Insufficient Number*						
	Improper Installation						
	Improper Spiking Pattern through slots in angle bar						
	Loose or missing spikes*						
	Spike beneath rail base						
Joint Bars	Improper type, flame cut or defective*		6-4.a.	---	---	213.121	See 6-4.a.
Compromise Joints	Improper type, design, dimension, home-made, flame cut, or defective*		6-4.b.	---	---	213.121	See 6-4.b.
Joint Bars	Cracked or broken*		6-4.c.	---	Cracked between center bolt holes	213.121	---
Track Bolts	None loose or missing		6-4.e.	LT 2 per rail or All bolts loose	LT1 per rail	213.121	None loose or missing

* Operating restrictions may be needed depending on seriousness of the condition.
** Further information regarding classification of defects and operating restrictions is provided in NAVFACINST 11230.1.

Summary of Standards**								
	Maintenance Standards			Safety Standards				
	Deviation for Track Category		Paragraph Reference in UFC 4-860-03	Restricted Operation	Close to Traffic	Paragraph Reference	Construction/ Repair	
Item	A	B		10 mph		in FRA TSS	Tolerances	
Rail End Mismatch			6-4.f.			213.115		0"
Tread	GT 1/8"	GT 1/8"		---	GT 1/4"			
Gage Side	GT 1/8"	GT 1/8"		GT 3/16"	GT 1/4"			
Rail Joint Gap	GT 3/4"	GT 3/4	6-4.g.	GT 1-1/4"	GT 2"	---	---	---
Rail - Defective	See Table 7-1		7-1	---	---	213.113	---	
Turnouts - General	Improper materials, rail not same weight/ section compromise joint in turnout*		8-1 through 8-2	---	---	213.133	---	
- Switch Point Gap	1/8"	1/8"	8-3.b.	GT 1/4"	GT 3/8"	---	213.135	0"
- Broken/Worn Points	Broken/worn GT 1/2" down & 6 in back from point		8-3.c.	---	---	213.135	---	
- Point Rail Elevation			8-3.c.	Switch point higher than stock rail	Point rail lower than stock rail beyond taper	213.135	---	
- Lever Latches & Point Locks	Missing damaged insecure otherwise inoperative*		8-3.d.	---	---	213.135	---	
- Switch Stand	Not secure*		8-3.e.	---	---	213.135	---	
- Connecting Rod Switch Rod & Clip	Insecure damaged or shimmed		8-3.f. & 8-3.g.	---	---	213.135	---	
- Switch Heel	Heel not fully secure, heel bolts missing		8-3.i.	Bolts loose or missing---	---	213.135	---	
- Rail Braces	Improper materials or installation		8-3.j.	LT 4 per stock rail	---	213.135	---	
- Frog Point Wear/Damage	GT 1/2" down and 6" back all categories		8-4.a	GT 5/8" down and 6" back	---	213.137	1/8" of original contour	
- Frog Surface Wear	GT 5/16"	GT 5/16"	8-4.b.	GT 3/8"	---	213.137	1/8" of original contour	

* Operating restrictions may be needed depending on seriousness of the condition.
** Further information regarding classification of defects and operating restrictions for Navy Installation is provided in NAVFACINST 11230.1

Summary of Standards**

Item	Maintenance Standards			Safety Standards			Construction/ Repair Tolerances
	Deviation for Track Category		Paragraph Reference in UFC 4-860-03	Restricted Operation	Close to Traffic	Paragraph Reference	
	A	B		10 mph		in FRA TSS	
Turnouts - Frog Guarding Face wear	GT 5/16"	GT 5/16"	8-4.c	GT 3/8		213.141	1/8" of original contour
- Frog Flangeway Width	1-5/8"	1-5/8"	8-4.f.	LT 1-5/8"	LT 1-1/2"	213.143	1-7/8"
- Frog Flangeway Depth	LT 1-5/8"	LT 1-5/8"	8-4.g.	LT 1-1/2"	LT 1-3/8"	213.137	1-7/8"
- Guard Check gage	LT 54-3/8"	LT 54-3/8"	8-5.c.	LT 54-1/4"	LT 54-1/8"	213.143	54-5/8"
- Guard Face Gage	GT 53.0"	GT 53.0"	8-5.d.	GT 53-1/8"	GT 53-1/4"	213.143	52-3/4"
- Guard Rail Flangeway Width	1-5/8"	1-5/8"	8-5.e.	LT 1-5/8"	LT 1-1/2"	213.143	1-7/8"
Rail Crossing Flangeway Width	1-5/8"	1-5/8"	9-2.b.	LT 1-5/8"	LT 1-1/2"	213.133	1-7/8"
Rail Crossing Flangeway Depth	1-1/2"	1-1/2"	9-2.b.	LT 1-1/2"	LT 1-3/8"	213.133	1-7/8"
Road Crossing - Formed Flangeway Width	LT 2-1/2"	LT 2-1/2"	10-2.a.	LT 1-3/4”	---	---	21/2 to 3"
Road Crossing Flangeway Depth	LT 2.0"	LT 2.0"	10-2.b.	LT 1-1/2”	---	---	GE 2.0"
Gage - Minimum	LT 56-1/8"	LT 56-1/8"	12-2.d.	---	LT 56.0"	213.53	See 12-2.c.
-Maximum	57-1/2"	57-1/2"		GT 57-1/2	GT 57-3/4		
Cross level - Tangent	GT 1-1/4"	GT 1-1/2"	12-3.	GT 2.0"	GT 3.0"	213.63	0
- Curves	GT 1-1/4"	GT 1-1/2"	12-3.	GT 2.0"	GT 3.0"		Designated Superelevation
Warp	GT 1-3/4"	GT 1-3/4"	12-4.	GT 2.25"	GT 3.0"	213.63	0
Alignment- Tangent	GT 2"	GT 2"	12-6.	GT 3.0"	GT 5.0"	213.55	0
- Curves	GT 2"	GT 2"	12-6.	GT 3.0"	GT 5.0"		Degree of curve
Profile/Surface	GT 2-1/4"	GT 2-1/4"	12-7.	GT 2-3/4"	GT 3.0"	213.63	0

- Operating restrictions may be needed depending on seriousness of the condition.
- ** Further information regarding classification of defects and operating restrictions for Navy Installation is provided in NAVFACINST 11230.1